Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
P.O. Lonere, Dist. Raigad, Pin 402 103, Maharashtra
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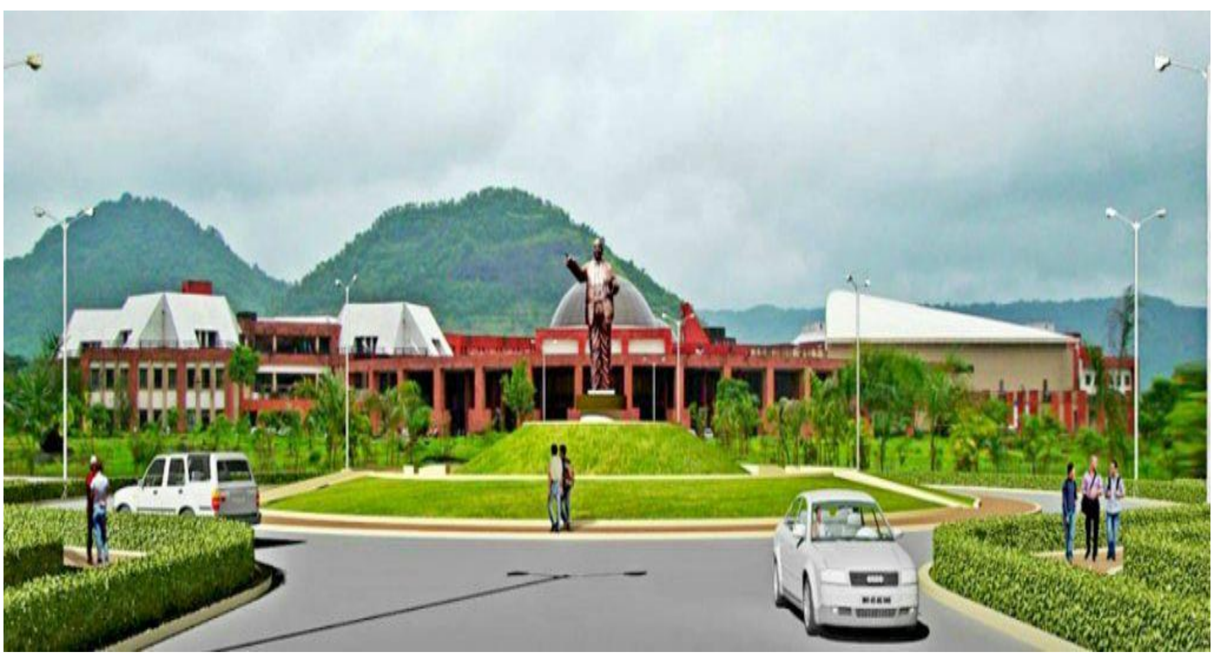
Curriculum for Undergraduate Degree Programme
S.Y. B. Tech. in Civil Engineering

With effect from AY 2021-22



Dr. Babasaheb Ambedkar Technological University
Lonere 402 103, Dist- Raigad, Maharashtra, INDIA

Teaching & Evaluation Scheme for Second Year B. Tech. Civil Engg.

Semester- III

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC 5	BTBS301	Mathematics – III	3	1	-	20	20	60	100	4
ESC 8	BTCVES302	Mechanics of Solids	3	1	-	20	20	60	100	4
PCC 1	BTCVC303	Building Construction & Drawing	2	1	-	20	20	60	100	3
PCC 2	BTCVC304	Hydraulics -I	3	1	-	20	20	60	100	4
PCC 3	BTCVC305	Surveying	2	1	-	20	20	60	100	3
HSSMC2	BTHM306	Soft Skill Development	2	-	-	50	-	-	50	Audit
LC 1	BTCVL 307	Solid Mechanics Laboratory	-	-	2	20	-	30	50	1
LC 2	BTCVL 308	Hydraulics-I Laboratory	-	-	2	20	-	30	50	1
LC 3	BTCVL 309	Surveying Laboratory	-	-	2	20	-	30	50	1
Internship	BTES210P	Internship –I Evaluation (From Sem II)	-	-	-	-	-	50	50	Audit
		Total	**15**	**05**	**06**	**210**	**100**	**440**	**750**	**21**

Semester- IV

Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 4	BTCVC401	Building Planning and Drawing	2	-	-	20	20	60	100	2
PCC 5	BTCVC402	Environmental Engineering	2	-	-	20	20	60	100	2
PCC 6	BTCVC403	Structural Mechanics - I	2	1	-	20	20	60	100	3
PCC 7	BTCVC404	Water Resources Engineering	3	-	-	20	20	60	100	3
PCC 8	BTCVC405	Hydraulics - II	2	1	-	20	20	60	100	3
PCC 9	BTCVC406	Engineering Geology	2	1	-	20	20	60	100	3
LC 4	BTCVL407	Building Planning and CAD Lab.	-	-	2	20	-	30	50	1
LC 5	BTCVL408	Environmental Engg. Lab.	-	-	2	20	-	30	50	1
LC 6	BTCVL409	HE-II Lab.	-	-	2	20	-	30	50	1
Internship	BTCVP410	Field Training / Internship/Industrial Training (minimum of 4 weeks training in Summer Vacation after Semester IV and appear at examination in Semester V)	-	-	-	-	-	-	-	To be evaluated in V Sem.
		Total	**13**	**03**	**06**	**180**	**120**	**450**	**750**	**19**

Detailed Syllabus

BTBS301Mathematics – III

Teaching Scheme: (3 Lectures +1 Tutorial) hours/week

Course Contents

Module 1: Laplace Transform **(Lectures 09)**

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by tn, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Module 2: Inverse Laplace Transform **(Lectures 09)**

Introductory remarks; Inverse transforms of some elementary functions; General methods of finding inverse transforms; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms; Applications to find solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Module 3: Fourier Transform **(Lectures 09)**

Definitions – integral transforms; Fourier integral theorem (without proof); Fourier sine and cosine integrals; Complex form of Fourier integrals; Fourier sine and cosine transforms; Properties of Fourier transforms; Parseval's identity for Fourier Transforms.

Module 4: Partial Differential Equations and Their Applications **(Lectures 09)**

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one-dimensional heat flow equation $\frac{\partial u}{\partial t} = c^2\frac{\partial^2 u}{\partial x^2}$, and two-dimensional heat flow equation

Module5: Functions of Complex Variables **(Lectures 09)**

Limit and continuity of f(z); Derivative of f(z) ; Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Mapping: Translation, magnification and rotation, inversion and reflection , bilinear transformation; Conformal mapping. Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books

1) Grewal B. S., "Higher Engineering Mathematics" Khanna Publishers, New Delhi.

2) Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, New York.

3) Das H. K. and Er. Verma Rajnish, "Higher Engineering Mathematics", S. Chand & Co. Pvt. Ltd., New Delhi.

4) Dr. Singh B. B., "A course in Engineering Mathematics (Vol III)", Synergy Knowledgeware, Mumbai.

5) Wartikar J.N. and Wartikar P.N., "Engineering Mathematics Vol. I & II", PVG Prakashan, Pune, 1992

6) Ramana B. V., "Higher Engineering Mathematics", Tata McGraw-Hill Publications, New Delhi.

Reference Books

1) Peter O' Neil, "A Text Book of Engineering Mathematics" Thomson Asia Pte Ltd., Singapore.

2) Wylie C. R. & Barrett L. C., "Advanced Engineering Mathematics", TMH Publishing Co. Ltd., N. Delhi.

3) Dr. Singh B. B., "Integral Transforms and their Engineering Applications", Synergy Knowledgeware, Mumbai.

4) Sneddon I. N., "Integral Transforms", Tata McGraw-Hill , New York.

Course Outcomes: On completion of the course, student will be able to formulate and solve mathematical model of civilengineering phenomena in field of structures, survey, fluid mechanics and soil mechanics.

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BTCVES302 Mechanics of Solids

Teaching Scheme:(3 Lectures +1 Tutorial) hours/week

Course Contents

Module 1: Stress and Strain (Lectures 10)

Simple stress -Analysis of internal forces, simple stress, shearing stress, bearing stress, diaphragm or skin stresses in thin walled vessels, statically indeterminate members and thermal stresses

Simple strains -Stress strain diagram for different engineering materials and its importance for elastic and plastic analysis, Hooke's law: axial and shearing deformations, Poisson's ratio: biaxial and tri-axial deformations, variation of stress with inclination of element, relationship between modulus of rigidity and modulus of elasticity, variation of stress at a point: analytical derivation, introduction to strain measurement devices, Sensors: working principle

Module 2: Axial Force, Shear Force and Moment in Beam (Lectures 10)

Axial force, shear force and moment in beams – concept of unbalanced forces at a transverse section, axial forces, shear forces and moment – interaction of these, relations among load shear and moment, introduction to moving loads

Module 3: Stresses in beams (Lectures 10)

Theory of cylindrical bending, Relationship between intensity of loading, shear force and bending moment over elemental length, Derivation of flexural formula, economic sections, analysis of flexural action, derivation of formula for shearing stress, concept of shear flow, shear lag and shear center

Torsion -Assumptions, derivation of torsion formulae, torsion of circular shafts, power transmission, stresses and deformation in determinate solid/hollow homogeneous shafts

Module 4: Columns and Struts (Lectures 10)

Concept of short and long columns, formulae by Euler and Rankin, Euler's Crippling load for different end conditions, limitation of Euler's formula, equivalent length, eccentrically loaded short compression members, Kern of a section; load applied off the axes of symmetry, introduction to combined axial and flexural loads,

Module 5: Combined Stresses (Lectures 8)

State of simple shear, Analytical and graphical representation of state of combined stress at a point, absolute maximum shearing stress, application of Mohr's circle to combined loading, principal stresses and strains

Theories of Failure- maximum principal stress theory, maximum principal strain theory, maximum strain energy theory, maximum shear stress theory, maximum shear strain theory.

Text Books:

- Singer F.L. and Pytle, 2011, "Strength of Materials", Harper Collins Publishers, Fourth Edition
- Junnarkar S.B. (2014), "Mechanics of Structures", Charotor Publishers, Anand, 31st edition,
- Khurmi R.S., 2018, "Strength of Material", S. Chand and Co., Edition revised 1968, New Delhi
- Sadhu Singh, 1978, "Strength of Materials", Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-048-7
- Prasad I.B, 1988, "A text book of Strength of Materials", Khanna Publishers, N. Dehli, ISBN NO:978-81-7409-069-X
- Timoshenko S.P. and Young D.H., 2002, "Elements of Strength of Materials", East West Press, 4th edition 1962, New Delhi
- Prasad I.B, 1988, "A text book of Strength of Materials", ISBN: 978-81-7409-069-X
- Dr. Sadhu Singh, 1978, "Strength of Materials", ISBN: 978-81-7409-048-7
- Ramamrutham S., 2011, "Strength of Materials", Dhanpat rai and Sons, Delhi

Reference Books:

- Beer F P., Jhonston E. R., John. T. D E wolf, 2017, "Mechanics of Materials" TMH, 7th edition
- Popov E.P.,2015, "Introduction to Mechanics of Solids", Prentice-Hall, Second Edition 2005
- Crandall S.H., Dahl N.C., & Lardner T.J., 1955, "An Introduction to Mechanics of Solids", Tata McGraw Hill, 2nd Edi, 1978
- Nash W., 2005, "Strength of Materials Schaum's outline series", McGraw Hill, fourth edition
- Punmia B. C., 2018, "Mechanics of Materials" Laxmi Publications, revised edition, 2016
- Subramanian R., 2016, "Strength of Materials" Oxford University Press, 2nd edition, New Delhi
- Dr. Sadhu Singh, 1978, "Theory and Solved Problems in Adv. Strength of Materials", ISBN: 978-81-7409-212-7

Course Outcomes: On completion of the course, the students will be able to:

CO1: Perform the stress-strain analysis.
CO2: Draw force distribution diagrams for members and determinate beams.
CO3: Visualize force deformation behavior of bodies.
CO4: Perform failure analysis

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BTCVC 303 Building Construction & Drawing

Teaching Scheme: (2 Lectures + 1 Tutorials) hours/week

Course Contents

Module 1: Masonry Construction **(Lectures06)**

Stone masonry: Random rubble, un-coursed rubble, coursed rubble & ashlar brickwork & brick bonds - english, flemish, principles to be observed during construction composite masonry, various partition walls, brick, aluminum & timber, solid concrete blocks, hollow concrete blocks and light weight blocks (aerated autoclaved), soil stabilized blocks, fly ash blocks, cement concrete walls

Module 2: Concrete for Construction **(Lectures 06)**

Introduction and properties of ingredients, importance of admixture materials such as pozzolona, fly ash, specific purpose chemical admixtures, Properties of fresh and hardened concrete

Module 3: Arches and Lintels **(Lectures 06)**

Arches and their stability, technical terms in arches, types of arches, methods of construction; Lintel: Necessity, materials: wood, stone, brick, steel, R.C.C. and reinforced brick lintels, beams: types according to material, layout such as primary and secondary, continuous beams, formwork for RCC elements: function, requirements

Module 4: Means of Lateral Communication **(Lectures 10)**

Doors and windows-Doors - classification based on parameters such as material, geometry, fixtures and fastening
Windows - classification based on parameters such as material, geometry, fixtures and fastening
Use of composite materials for doors and window frames and shutters, laying out of passages
Stairs: Terminology, requirements of a good stair, functional aspects, various types, uses and limitations
Ramps: Requirements and types, planning aspects for physically handicapped person
Elevators: Types and their Use

Module 5: Flooring Roofs and Types **(Lectures 08)**

Flooring: Types, factors for selections of floorings, flooring in ground and upper floors, various types of tiled flooring: natural, composite, synthetic, and special purpose flooring, concrete flooring for industrial purpose: tremix flooring
Roof coverings: Terms used, roof and their selection, pitched roofs and their types, roof coverings and their selection. Natural, composite, synthetic, and special purpose roof coverings, timber trusses (King Post and Queen Post), steel trusses types and their suitability

Precast and Pre-engineered Building Advantages and disadvantages.

List of Drawing Assignments

1) Sketch Book consisting of free hand proportional scale sketches for items to be drawn on drawing sheets as mentioned below under (2)
2) Drawing to scale on a half imperial drawing sheet covering following aspects.
   a) Lettering, Symbols, Types of lines and dimensioning as per IS 962.
   b) Foundations: - Isolated, Combined Footings, Under Reamed Piles, Rafts.
   c) Types of Stone Masonry: Elevation and Sectional Drawings.
   d) Types of Brick masonry: Elevation and Sectional Drawings.
   e) Types of Doors: Elevation and Sectional Drawings.
   f) Types of Windows: Elevation and Sectional Drawings, Standard Aluminum Sections.
   g) Types of Stairs: Plan and Sectional Drawings.
   h) Trusses: Various types, various roof covering materials, sketches for sectional profiles
   i) Typical plan for a single room and sectional views.
3) Site visit: To understand various building materials and their use.

Text Books

- Punmia B.C., Jain A. K., 2008, “Building Construction", Laxmi Pub. Pvt. Ltd., 10th Edi, N. Delhi
- Arora S. P. and Bindra S. P., 2010, “Text Book of Building Construction”, Dhanpat Rai Publications
- Kumar Sushil, 2010, “Building Construction” Standard Publishers, 20th Edition,.
- P. Purushothama Raj, 2016, “Building Construction Materials and Techniques”, Pearson Education
- Jain V.K., 2015, “Automation Systems in Smart and Green Buildings” ISBN NO: 978-81-7409-237-3

Reference Books

- NBC 2005, National Building Code of India, Parts III, IV, VII and IX, B.I.S. New Delhi
- Chudley R., 1973, "Construction Technology", Vol.1, 2, 3 and 4 ELBS Publisher
- SP 7- National Building Code Group 1 to 5, B.I.S. New Delhi
- I.S. 962 - 1989 Code for Practice for Architectural and Building Drawings, B.I.S. New Delhi
- Sikka V. B., 2015, “A Course in Civil Engineering Drawing”, S. K. Kataria and Sons

- Catalogues. Information Brochures, Trade Literature by material or product manufacturers
- Mehta, Scarborough, Armpriest, 2007, "Building Construction", Pearson Education
- Macay W.B, 2004, "Building Construction", Vol. I, II, III, IV, Pearson Education
- Jain V.K., 2015, "Handbook of Designing and Installation of Services in High Rise Building Complexes" ISBN : 978-81-7409-245-8

Course Outcomes: On completion of the course, students will be able to:

CO1: Understand types of masonry structures.
CO2: Comprehend components of building and there purposes.
CO3: Draw plan, elevation and section of various structures.
CO4: Apply the principles of planning and by laws used for building planning.
CO5: Prepare detailed working drawing for doors and windows.

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BTCVC 304 Hydraulics - I

Teaching Scheme: (3 Lectures +1 Tutorial) hours/week

Course Contents

Module 1: Fluid Statics **(Lectures 10)**

Definition of fluids, fluid properties-density, specific weight, specific volume, specific gravity, viscosity, compressibility, surface tension, capillarity, vapor pressure, types of fluids - Newtonian and non-Newtonian fluid, continuum, fluid pressure

Forces on fluid elements, fundamental equation, manometers, hydrostatic thrust on submerged surfaces, buoyancy, stability of unconstrained bodies, fluids in rigid body motion

Module 2: Fluid Dynamics **(Lectures 10)**

Types of flow, continuity equation, derivation and applications of momentum equation, flow measuring devices, Euler's equation, Bernoulli's equation, velocity potential and stream function, concept of flow net

Module 3: Laminar & Turbulent Flow **(Lectures 10)**

Fully developed laminar flow between infinite parallel plates, both plates stationary, upper plate moving with constant speed, fully developed laminar flow in pipe.

Turbulent flow: Shear stress distribution and turbulent velocity profiles in fully developed pipe flow, velocity distribution and shear stresses in turbulent flow, Prandtl mixing length theory, Nikuradse's experiment, Introduction to Boundary Layer Theory

Module4: Dimensional Analysis and Similitude **(Lectures 10)**

Nature of dimensional analysis, Rayleigh's Method, Buckingham pi theorem, dimensionless groups and their physical significance, flow similarity and model studies, Scale Effects, Distorted and Undistorted Models

Module5: Flow through Pipes **(Lectures 08)**

Loss of energy in pipes, pipe discharging from a reservoir, pipe connecting two reservoirs in series and parallel, siphon, transmission of power through nozzle, water hammer in pipes- rigid and elastic water column theory, surge tanks - function, calculation of head loss, introduction to Moody's chart, nomograms and other pipe diagrams

Text Books

- Fox. R. W. And Mc-Donald. A. T., 2011, "Introduction to Fluid Mechanics", John Wiley and Sons, Fifth Edition
- Modi and Seth, 2017, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, Tenth Edition , 1991
- Kumar K. L., 2010, "Fluid Mechanics", S. Chand publication
- Bansal R. K., 1989, "Fluid Mechanics", Laxmi publication Delhi
- Jain A.K, 1998, "Fluid Mechanics including Hydraulic Machines" ISBN: 978-81-7409-194-7

Reference Books

- Streeter V. L., Bedford K. W. and Wylie E. B., 1998, "Fluid Dynamics", New York, McGraw-Hill, Ninth Edition.
- Som S. K. & Biswas G., 2017, "Introduction to Fluid Mechanics & Fluid Machines", Tata McGraw-Hill.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Calibrate the various flow measuring devices.
CO2: Determine the properties of fluid and pressure and their measurement.
CO3: Understand fundamentals of pipe flow, losses in pipe and analysis of pipe network.
CO4: Visualize fluid flow phenomena observed in Civil Engineering systems.

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BTCVC305 Surveying

Teaching Scheme : (2 Lectures +1 Tutorial) hours/week

Course objectives:

1) To determine the relative position of any objects or points of the earth.
2) To determine the distance and angle between different objects.
3) To prepare a map or plan to represent an area on a horizontal plan.

Course Contents

Module 1: Chain Surveying **(Lectures 08)**

Definition, principles, classification, fields and office work, scales, conventional signs, survey instruments, their care and adjustment, ranging and chaining, reciprocal ranging, setting perpendiculars, well-conditioned triangles, traversing, plotting , enlarging and reducing figures

Module 2: Compass & Plane Table Surveying **(Lectures06)**

Prismatic compass, surveyor's compass, bearing systems and conversions, local attraction, magnetic declination, dip traversing, adjustment of errors.

Plane table instruments and accessories, merits and demerits, methods: radiation, intersection, resection, traversing

Module 3: Leveling and Applications **(Lectures08)**

Level line - Horizontal line - Levels and Staves, Sprit level – Sensitiveness, Bench marks - Temporary and permanent adjustments, Fly and Check leveling, Booking, reduction, Curvature and Refraction – reciprocal leveling - Longitudinal and cross sections - Plotting - Contouring - Methods - Characteristics and uses of contours - Plotting - Earth work volume - Capacity of reservoirs. Planimeter-Types, Theory, concept of zero circle, Study of Digital Planimeter, Computation of Areas and Volumes

Module 4: Theodolite Surveying **(Lectures 08)**

Theodolite - Vernier and micro-optic - Description and uses - temporary and permanent adjustments of vernier transit –Angles: Horizontal - Vertical - Heights and Distances - Traversing - Closing error and distribution - Gales's table - Omitted measurements

Module 5: Engineering Surveys **(Lectures 08)**

Reconnaissance, Preliminary and location surveys for engineering projects, Layout, Setting out works, Route Surveys for highways, railways and waterways, introduction to curve ranging, Mine Surveying - Instruments – Tunnels: correlation of underground and surface surveys, shafts

Text Books

- Kanetkar T.P. and Kulkarni S. V., 2014, "Surveying and Leveling", Vols. I, II and III, Vidyarthi Gruh Prakashan, Pune
- Punmia B.C., 1967, "Surveying", Vols. I, II and III, Laxmi Publications, 16th edition, 2016

Reference Books

- Clark D., 1944, "Plane and Geodetic Surveying", Vol. I & II, C.B.S. Pub. & Distri., N. Delhi, 6th edi.
- Anderson J. M. and Mikhail E. M., 1986, "Introduction to Surveying", McGraw Hill Book Company
- Bannister A. and Raymond S., 1959, "Surveying", ELBS, Sixth Edition, 1992
- Kahmen Heribert and Faig Wolfgang, 2017, "Surveying", Walter de Gruyter, 1995

Course Outcomes: On completion of the course, the students will be able to:

CO1: Perform measurements in linear/angular methods.
CO2: Perform plane table surveying in general terrain.
CO3: Know the basics of leveling and Theodolite survey in elevation and angular measurements.

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BTHM306 Soft Skill Development

Teaching Scheme: (2 Lectures) hours/week

Program Educational Objectives:

1) To build the skills like team building so that they can work efficiently in groups.

2) To provide knowledge of conflict management while working in large organizations.

3) To develop management skills required in routine work environment.

4) To polish the personality of the learners in order to make them good leaders and employees.

5) To imbibe qualities like manners & etiquettes co-ordination, mutual understanding while working in a group.

Module 1: Development of Proficiency in English **(Lectures 05)**

Speaking skills, Feedback & questioning technique, Objectivity in argument (Both one on one and in groups), 5 Ws& 1 H & 7 Cs for effective Communication, Imbibing Etiquettes and manners, Study of different pictorial expressions of non-verbal communication and their analysis

Module 2:Self-Management **(Lectures 05)**

Self-Evaluation, Self-discipline, Self-criticism, Recognition of one's own limits and deficiencies, dependency, etc., Self-Awareness, Self-Management, Identifying one's strengths and weaknesses, Planning & Goal setting, Managing self-emotions, ego, pride, Leadership & Team Dynamics

Module 3: Time Management Techniques **(Lectures 04)**

Practice by game playing and other learning strategies to achieve the set targets Time Management Concept, Attendance, Discipline & Punctuality, Acting in time, Quality /Productive time

Module 4: Motivation/ Inspiration **(Lectures 04)**

Ability to shape and direct working methods according to self-defined criteria, Ability to think for oneself, Apply oneself to a task independently with self-motivation

Motivation techniques: Motivation techniques based on needs and field situations

Module 5: Interpersonal & Computing Skills **(Lectures 06)**

Positive Relationship, Positive Attitudesand Empathies: comprehending others' opinions, points of views, and face them with understanding Mutuality, Trust, Emotional Bonding, Handling Situations (Interview), Importance of interpersonal skills

Designing an effective Presentation, Contents, appearance, themes in a presentation, -Tone and Language in a presentation, Role and Importance of different tools for effective presentation

Reference Books

1) Mitra, Barun, "Personality Development and Soft Skills", Oxford University Press, 2016
2) Ramesh, Gopalswamy, "The Ace of Soft Skills: Attitude, Communication & Etiquette for Success", Pearson Education, 2013
3) Covey, Stephen R., "Seven Habits of Highly Effective People: Powerful Lessons in Personal Change"
4) Rosenberg Marshall B., "Nonviolent Communication: A Language of Life"

Program **Educational Outcomes**

1) Learners will acquire interpersonal communication skills.
2) Learners will develop the ability to work independently.
3) Learners will develop the qualities like self-discipline, self-criticism and self-management.
4) Learners will have the qualities of time management and discipline.
5) Learners would be able to present themselves as an inspiration for others.

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BTCVL307 Solid Mechanics Laboratory

Practical: 2 hours / week

Practical Work consists of performance of at least seven experiments from the list below (excluding the eleventh study)experiment: Detailed report is expected.

List of Experiments

1. Tension test on ferrous and non-ferrous alloys (mild steel / cast iron /aluminum etc.)
2. Compression test on mild steel, aluminum, concrete, and wood.
3. Shear test on mild steel and aluminum (single and double shear tests).
4. Torsion test on mild steel and cast iron solid bars and pipes.
5. Flexure test on timber and cast iron beams.
6. Deflection test on mild steel and wooden beam specimens.
7. Graphical solution method for principal stress problems.
8. Impact test on mild steel, brass, Aluminum, and cast iron specimens.
9. Experimental on thermal stresses.
10. Strain measurement involving strain gauges / rosettes.

Assignment involving computer programming for simple problems of stress, strain computations.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Evaluate Young Modulus, torsional strength, hardness and tensile strength of given specimens.

CO2: Determine the strength of coarse aggregates.
CO3: Find the compressive strength of concrete cubes and bricks.

CO4: Determine physical properties of given coarse aggregates, fine aggregates and cement samples.

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BTCVL 308 Hydraulics- I Laboratory

Practical: 2 hours / week

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal. Practical examination shall be based on above.

1) Measurement of Viscosity of various fluids
2) Demonstration of working of different types of valves and pipe fittings
3) Measurement of pressure Piezometer, manometers, Pressure gauges
4) Measurement of discharge - Calibration of measuring tank, Use of hook or point gauge.
5) Verification of Bernoulli's Theorem
6) Determination of metacentric height.
7) Calibration of an orifice / mouthpiece / venturimeter / orifice meter
8) Study of factors affecting coefficient of friction for pipe flow (for two different materials and two differentdiameters)
9) Determination of loss of head due to Pipe Fittings

Use of computer programs such as MS Excel is desirable for post-processing of results.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Analyze the properties of fluids and their verification.
CO2: Predict empirical behavior of fluids.
CO3: Apply principles of hydraulics while working in field.

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BTCVL309 Surveying Laboratory

Practical: 2 hours / week

Practical Work consists of performances among the list below and detailed reporting in form of field book, journal and drawing sheets.

Perform each of the following practical work

1) Use of Dumpy Level, Auto Level and Tilting Level.
2) Sensitivity of Bubble Tube using Dumpy Level.
3) Evaluation of constant of Planimeter, and use of Digital Planimeter for measurement of areas.
4) Study of Theodolite.
5) Methods of Plane Table Survey
6) Study and use of Total Station

Among following any two shall be performed

1) Reciprocal Levelling.
2) Illustration of Permanent adjustment of Dumpy Level
3) Measurement of Horizontal Angle by Various Methods
4) Measurement of Magnetic Bearing and Vertical Angle by Theodolite
5) Two Point and Three Point Problems

Among following two shall be performed

1) Road survey, 2) Radial Contouring, 3) Block Contouring, 4) Theodolite Traversing

Course Outcomes: On completion of the course, the students will be able to:

CO1: Use the theodolite along with chain/tape, compass on the field.
CO2: Apply geometric and trigonometric principles of basic surveying calculations.
CO3: Plan a survey, taking accurate measurements, field booking, and adjustment of errors.
CO4: Apply field procedures in basic types of surveys, as part of a surveying team.
CO5: Employ drawing techniques in the development of a topographic map.

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BTES210P Internship Evaluation I (from semester II)

Student shall undergo field training / industrial training / internship during summer vacation after Semester II. This training is at elementary level expecting exposure to field practices. A brief report shall be submitted. Evaluation shall be based on reportand power point presentation.

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Semester- IV											
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 4	BTCVC401	Building Planning and Drawing	2	-	-	20	20	60	100	2
PCC 5	BTCVC402	Environmental Engineering	2	-	-	20	20	60	100	2
PCC 6	BTCVC403	Structural Mechanics - I	2	1	-	20	20	60	100	3
PCC 7	BTCVC404	Water Resources Engineering	3	-	-	20	20	60	100	3
PCC 8	BTCVC405	Hydraulics - II	2	1	-	20	20	60	100	3
PCC 9	BTCVC406	Engineering Geology	2	1	-	20	20	60	100	3
LC 4	BTCVL407	Building Planning and CAD Lab.	-	-	2	20	-	30	50	1
LC 5	BTCVL408	Environmental Engg. Lab.	-	-	2	20	-	30	50	1
LC 6	BTCVL409	HE-II Lab.	-	-	2	20	-	30	50	1
Internship	BTCVP410	Field Training / Internship/Industrial Training (minimum of 4 weeks training in Summer Vacation after Semester IV and appear at examination in Semester V)	-	-	-	-	-	-	-	To be evaluated in V Sem.
		Total	**13**	**03**	**06**	**180**	**120**	**450**	**750**	**19**

BTCVC 401 Building Planning and Drawing

Teaching Scheme: (2 Lectures) hours/week

Course Contents

Module 1: Principles of building planning **(6 Lectures)**

Principles of building planning, significance sun diagram, wind diagram, orientation, factors affecting, and criteria under Indian condition, concept of green building: aspect at planning level, construction stage and operational level.

Module 2: Building Services **(8 Lectures)**

Building planning byelaws & regulations as per SP-7, National Building Code of India group 1 to 5, planning of residential building: bungalows, row bungalows, apartments and twin bungalows, procedure of building permission, significance of commencement, plinth completion or occupancy certificate

Anthropometry: Study of Human dimensions, Concept of percentile in Indian standards, space required for various simple activities, Circulation spaces.

Module 3: Plumbing Systems **(8 Lectures)**

Various materials for system like stoneware, GI, AC, CI, PVC, HDPE and various types of traps, fittings, chambers, need of septic tank, concept of plumbing & drainage plan, introduction to rainwater harvesting, concept of rainwater gutters, rainwater outlet & down tank systems
Electrification: wiring types, requirements & location of various points, and concept of earthing

Fire resistance in building: Fire protection precautions, confining of fire, fire hazards, characteristics of fire resisting materials, building materials and their resistance to fire

Module4: Ventilation **(8 Lectures)**

Definition, necessity of ventilation, functional requirements, various system & selection criteria.

Air conditioning: Purpose, classification, principles, various systems

Thermal Insulation: General concept, Principles, Materials, Methods, Computation of Heat loss & heat gain in Buildings

Module 5: Introduction to Acoustics & Green Building **(6 Lectures)**

Absorption of sound, various materials, Sabine's formula, optimum reverberation time, conditions for good acoustics Sound insulation: Acceptable noise levels, noise prevention at its source, transmission of noise, Noise control-general considerations

Green Building: Concept, Principles, Materials, Characteristics, Applications

Reference Books

- Shah, Kale, Pataki, "Building Drawing", Tata McGraw- Hill
- Sane Y. S.,"Building Design and Drawing", Allied Book Stall, Pune
- Jain V.K., "Automation Systems in Smart and Green Buildings", Khanna Publishers, N. Dehli ISBN No 978-81-7409-237-3
- Jain V.K., "Handbook of Designing and Installation of Services in High Rise Building Complexes", Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-245-8
- Deodhar S.V., "Building Science and Planning", Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-199-8
- Jain A.K., "The Idea of Green Building"Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-256-4
- SP 7- National Building Code Group 1 to 5- B.I.S. New Delhi
- I.S. 962 – 1989 Code for Practice for Architectural and Building Drawings

Course Outcomes: On completion of the course, the students will be;

CO1: To plan buildings considering various principles of planning and byelaw of governing body.
CO2: Comprehend various utility requirements in buildings
CO3 : Understand various techniques for good acoustics.

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BTCVC402 Environmental Engineering

Teaching Scheme: (2 Lectures+1 Tutorial) hours/week

Course Contents

Module 1: Introduction **(6 Lectures)**

Environment and its components, importance of water, role of environmental engineer, sources of water, water demand: Design flow, design period, design population, factors affecting water consumption, variation in demand, and design capacity for water supply components, quality of water: Physical, chemical, biological characteristics, Indian standard for quality of potable water

Module 2: Treatment of Water **(10 Lectures)**

Conveyance of raw water: Canals and pipelines, hydraulics of conduits, laying and jointing of pipelines, testing of pipe lines, designing of rising main, type of valves, types of pumps, intake structure, types of intake structures, necessity of water treatment processes

Types of Treatments:

Aeration: Necessity, methods, removal of taste and odour, design of aeration fountain

Sedimentation: Suspended Solids, settling velocity, types of sedimentation tanks, surface loading, detention time, inlet and outlet arrangements

Coagulation: Necessity, coagulant dosage, choice of coagulants, optimum pH

Rapid Mixing: Necessity, gravitational, mechanical, pneumatic devices

Slow Mixing and Flocculation: Design of flocculation chamber, mean velocity gradient, design of clari-flocculator, plate settler and tube settler

Filtration: Theory of filtration, filter materials, types of filters, components, working and cleaning of filters

Disinfection: Theory of disinfection, factors affecting, efficiency of disinfection, types of disinfectants, break point chlorination, bleaching powder estimation

Water softening methods: Lime-soda, ion exchange method, demineralization

Module 3: System of Water Supply **(6 Lectures)**

Continuous and intermittent system, type of distribution systems, layouts, methods of supply: gravity, pumping and combination, hydraulic analysis of distribution system

Module 4: Treatment **(10 Lectures)**

Treatment of Waste Water

Sources of wastewater flows, components of wastewater flows, wastewater constituents, characteristic of municipal waste water, necessity of treatment of waste water, sewerage systems, concept of sewage, sullage, storm water, introduction of preliminary treatment, primary treatment, secondary treatment, introduction to tertiary or advanced treatment fundamentals of anaerobic treatment, sewage and industrial waste of common origin, types

Treatment of Solid Waste

Types, sources, characteristics, ill-effects of improper solid waste management, collection, processing techniques, methods of treatment of solid waste-composting, incineration, pyrolysis and sanitary land filling. biodegradable, non-degradable segregation of solid waste, concept of hazardous waste management, e-waste disposal

Module 5: Air Pollution **(4 Lectures)**
Definition, sources of air pollution, types air pollutants, atmospheric stability, mixing heights, plume types and meteorological parameters, effects of air pollution, control measures of air pollution

Text Books

- Rao and Rao,"Air Pollution ", Tata McGraw Hill Publications, New Delhi, 1990
- Garg S. K., "Water Supply Engineering", Khanna Publishers, New Delhi
- Birdi J. S. and Birdi G. S., "Water Supply & Sanitary Engineering", DhanpatRai Pub. Company, 8th edition, New Delhi

Reference Books

- Peavy and Rowe, "Environmental Engineering", McGraw Hill Publications
- Stern, "Environmental Engineering", Vol. I to IV, McGraw Hill Publications
- Sharma and Kaur, "Environmental Chemistry", Goyal Publisher
- Government Of India Publication, "Water Supply and Treatment Manual"
- Fair and Geyr, "Environmental Engineering", McGraw Hill Publications
- Steel and McGhee, "Environmental Engineering", McGraw Hill Publications
- Viessman& Hammer, "Water Supply & Pollution Control", Harper Collins Collage Publishers
- Publications by reouted organizations such as WHO, NEERI, MERI, MPCB, CWPRS, etc.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Apply the water treatment concept and methods.
CO2: Prepare basic process designs of water and wastewater treatment plants.
CO3: Apply the wastewater treatment concept and methods.
CO4: Apply the solid waste management concepts.

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BTCVC 403 Structural Mechanics– I

Teaching Scheme: (2 Lectures +1 Tutorial) hours/week

Course Contents

Module 1: Beam Deflections **(Lectures 06)**

Calculations of deflection for determinate beams by double integration, Macaulay's method, moment area method, conjugate beam method, deflection by method of superposition

Module 2: Energy Principles **(Lectures 06)**

Strain energy and strain energy density, strain energy in traction, shear, flexure and torsion - Castiglano's and Engessor's energy theorems, principle of virtual work, application of energy theorems for computing deflections in beams, Maxwell's reciprocal theorem, Williot Mohr diagrams

Module 3: Method of Consistent Deformation **(Lectures 08)**

Different structural systems, concept of analysis, basic assumptions, indeterminacy, choice of unknowns, Castiglano's theorem **Indeterminate Beams:** Analysis of indeterminate beams: Propped cantilever and fixed beams - fixed end moments and reactions for standard cases of loading – slopes and deflections in fixed beams

Module 4: Moment Distribution Method **(Lectures 08)**
Analysis of continuous beams propped cantilevers, continuous beams - theorem of three moments - analysis of continuous beams settlement effects, thermal effect, Shear Force and Bending Moment diagrams for continuous beams, portal frames with and without sway

Module 5: Slope Deflection Method **(Lectures 08)**
Analysis of continuous beams, analysis of rigid frames, frames without sway and with sway, settlement effects, introduction to difficulties in frames with sloping legs and gabled frames

Text Books

- Reddy C. S., "Basic Structural Analysis", Tata McGraw Hill,3rd edition 2010
- Wang C.K., "Statically Indeterminate Structures", McGraw Hill
- Vazirani V.N., Ratwani M.M and Duggal S.K., "Analysis of Structures - Vol. I", ISBN NO:978-81-7409-140-8
- Khurmi R.S., "Theory of Structures", S Chand, Delhi
- Punmia B.C., "Structural Analysis", Laxmi Publications

Reference Books

- Timoshenko and Young, "Theory of structures", McGraw Hill
- Norris C. H. and Wilbur J. B., "Elementary Structural Analysis", McGraw Hill
- Kinney J. S., "Indeterminate Structural Analysis", Oxford and IBH
- Hibbler R. C., "Structural Analysis", Pearson Publications, 9th Edition
- Schodek, "Structures", Pearson Education, 7th edition
- Ramamrutham S. and Narayanan R., "Theory of Structures" Dhanpat Rai Publishers, Delhi

Course Outcomes: On completion of the course, the students will be able to:

CO1: Describe the concept of structural analysis, degree of indeterminacy.
CO2: Calculate slopes and deflection at various locations for different types of beams.
CO3: Identify determinate and indeterminate trusses and calculate forces in the members of trusses
Perform the distribution of the moments the in continuous beam and frame

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BTCVC404 Water Resources Engineering

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction **(6 Lectures)**
Introduction, definition, scope, necessity, ill-effects of irrigation, advantages, types of irrigation systems, methods of distribution of water, development of irrigation in India
Water Requirement of Crops
Water requirement of crops, base, delta and duty, methods of improving duty, types of soil, types of soil water, soil moisture, consumptive use, irrigation frequency, irrigation methods, crops season, crop pattern

Module 2: Reservoirs **(6 Lecturers)**
Planning of Reservoirs: Classification of Reservoir, Selection of site for Reservoir, Investigation works for Reservoir, Yield and Capacity of Reservoir, Mass Curve and Demand Curve, Storage Calculations, Control Levels, Useful Life of Reservoir, Silting of Reservoirs, Losses in Reservoirs

Module 3 Dams and Hydraulic structures **(8 Lectures)**
Difference between weir, barrage and dam, Gravity Dams – Estimation of Loading, Design Criteria, Causes of Failure of Gravity Dam, Precaution against Failure, Theoretical and Practical Profile, Stability Calculations, Galleries, Joints, and Earth Dams: Components and their Functions, Design Criterion, Inverted Filters, Downstream Drainage, Causes of Failure of Earthen Dam. Arch Dams – Types, Forces on Arch Dam, Introduction and types of Spillway.

Module 3: Weirs and Canals **(8 Lectures)**
Weirs on Permeable Foundations: Theories of Seepage, Bligh's Creep Theory, Limitations of Bligh's Creep Theory, Khosla's Theory, Piping and Undercutting Canals: Types, Alignment, Kennedy's and Lacey's Silt Theories, Canal Losses, Typical Canal Sections, Canal Lining: Necessity and Types, Canal Structures: Cross Drainage Works and Canal Regulatory Works

Module 4: Hydrology **(6 Lectures)**
Introduction to hydrology: hydrologic cycle, rain, surface and ground water
measurement of rainfall, peak flow, base flow, precipitation and its measurement, average depth of precipitation, water losses, flood frequency, catchment area formulae, flood hydrograph, rainfall analysis, infiltration, run off, estimation of runoff, unit hydrograph and its determination, s- hydrograph

Module 5:

Lift Irrigation **(8 Lectures)**
Lift irrigation, wells and tube wells, introduction, classification of well, specific yield, deep and shallow wells, comparative advantage of well and canal irrigation, duty of well water, types of tube wells, types of strainers, boring methods. Darcy's law, permeability, safe yield of basin. Lift irrigation schemes: Various components and their design principles (Only concepts).
Water logging and drainage
Causes of water logging, preventive and curative measures, drainage of irrigation of lands, reclamation of water logged, alkaline and saline lands, Preventive and Curative Measures Water Conservation: Rain water Harvesting, Ground Water Recharge, small scale techniques of surface water detention such as: Soil embankments, field ponds, concrete bandhara.

Text Books

1. Varshney R. S., Gupta & Gupta, 1987, “Theory and Design of Irrigation Structures”, Vol. I & II
2. Punamia B. C. Pandey B. B. and Lal, 1992, “Irrigation and Water Power Engineering”, Standard Publishers, New Delhi
3. Garg S. K., 1976, “Irrigation Engineering & Hydraulic Structures”,Khanna Publishers, N. Delhi,
4. Priyani, 1982, “Irrigation and Water Power”, Charotar Publishing House, Anand
5. Bharat Singh,1979, “Irrigation”, Nemchand Brothers, Roorkee
6. Subramanya K., 1984, “Engineering Hydrology”, Tata Mc-Graw Hill Company Limited, N. Delhi

References Books

1. USBR, “Design of Small Dam", OXFORD & IBH, Publishing Company
2. Justinn, 1961, “Engineering for Dam” Vol. I, II, III, Creager and Hinds
3. Leliavsky, “Design of Hydraulic Structures” Vol. I & II,
4. C B I & P “River Behaviour, Management and Training”
5. Circular of Government of Maharashtra, 18 February 1995, “Design of Canals”

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand need of Irrigation in India and water requirement as per farming practice in India.
CO2: Understand various irrigation structures and schemes. CO3: Develop basis for design of irrigation schemes.

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BTCVC405 Hydraulics-II

Teaching Scheme: (2 Lectures +1 Tutorial) hours/week

Course Contents

Module 1: Uniform Flow in Open Channel **(Lectures 06)**
Introduction, difference between pipe flow and open channel flow, types of open channels, types of flows in open channel, geometric elements, velocity distribution, measurement of velocity-(pitot lube, current meter) weir & spillway: sharp, broad & round crested weirs, calibration of weir, time of emptying tank with weir, profile of ogee spillway, flow below gates

Module 2: Steady & Uniform Flow **(Lecture 06)**
Chezy's& Manning's formula, Roughosity coefficient, uniform flow computations, hydraulically efficient section- considerations for rectangular, triangular, trapezoidal, circular sections
Specific energy: definition & diagram, concept of critical, sub-critical, super-critical flow, specific force, specific discharge derivation of relationships and numerical computations

Module 3: Varied Flow & Impact of Jet **(Lectures 10)**
Gradually (G.V.F.): Definition, classification of channel Slopes, dynamic equation of G.V.F. (Assumption and derivation), classification of G.V.F. profiles-examples, direct step method of computation of G.V.F. profiles
Rapidly varied flow (R.V.F.): Definition, examples, hydraulic jump- phenomenon, relation of conjugate depths, parameters, uses, types of hydraulic jump
Impact of Jet: Impulse momentum principle, impact of jet on Vanes-flat, curved (stationary and moving), inlet & outlet velocity triangles under various conditions, Series of flat, curved vanes mounted on wheel

Module 4: Turbines **(Lectures 08)**
Turbines: Importance of hydro-power, classification of turbines, description, typical dimensions and working principle of Pelton, Francis & Kaplan turbine (detailed design need not to be dealt with), Module quantities, specific speed, performance characteristics, selection of type of turbine, description & function of draft tube, Thomas's cavitation number

Module 5: Pumps **(Lectures 06)**
Pumps: Classification, component parts, working of centrifugal pump, performance characteristics, pump selection, common troubles & remedies, introduction to different types of pumps: reciprocating, multi-stage, jet, air lift, submersible pump

Text Books

- Modi, Seth, “Fluid Mechanics – Hydraulic & Hydraulic Mechanics” Standard Book House
- Bansal R.K., “Fluid Mechanics”, Laxmi Publications, 9th edition 2017
- Garde R. J., “Fluid Mechanics through Problems”, New Age Publications, 3rd edition 2011
- Jain A. K., “Fluid Mechanics”, Khanna Publications, 8th edition, 2003, Delhi
- Kumar K. L., “Fluid Mechanics”, Eurasia Publication House, 11th edition, Delhi
- Rangaraju, “Open Channel flow”, Tata McGraw-Hill Pub. Co., Delhi
- Subramanian K., “Fluid Mechanics through Problems” Tata McGraw-Hill Pub. Co., Delhi
- Subramanian K., “Flow in Open Channel”, Edition V, Tata McGraw-Hill Pub. Co., Delhi

Reference Books

- Streeter, "Fluid Mechanics" McGraw-Hill International Book Co., 3rd edition, Auckland
- Shames, "Mechanics of Fluids", McGraw Hill, 4th edition
- Chaw V. T., "Flow in Open Channel", McGraw-Hill International Book Co., Auckland
- Hughes & Brighton, "Fluid Mechanics", Tata McGraw Hill

Course Outcomes: On completion of the course, the students will

CO1: Design open channel sections in a most economical way.
CO2: Know about the non-uniform flows in open channel and the characteristics of hydraulic jump.
CO3: Understand application of momentum principle of impact of jets on plane

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BTCVC406 Engineering Geology

Teaching Scheme: 3 hours/week

Course Contents

Module 1: Introduction and Physical Geology **(Lectures 06)**

Definition, Scope and subdivisions, applications of Geology in Civil Engineering, Major features of the Earth's structure, internal structure of earth, and Geological work of river: features of erosion, deposition and transportation, Civil Engineering Significance, Geological work of wind: Processes and features of erosion, deposition and transportation, Civil Engineering Significance. Volcano: Central and Fissure types, Products of volcano, Mountain: Origin and formation, types, examples.

Module 2: Mineralogy and Petrology **(Lectures 06)**

Mineralogy: Physical properties of mineral, Classification of minerals, Petrology: Definition, rock cycle, Igneous rocks: origin, textures and structures, classification, concordant and dis-concordant intrusions, civil engineering significance, Secondary rocks: formation, classification, residual deposits: soil, laterite and bauxite and their importance, Sedimentary deposits: formation, textures, classification and structures, civil engineering significance, chemical and organic deposits, Metamorphic rocks: agents and types of metamorphism, stress and anti-stress minerals, structures, products of metamorphism.

Module 3: Structural Geology, Building Stones and Ground Water **(Lectures 08)**

Outcrop, Strike and Dip, Unconformity-Types, Outliers and Inliers, Overlap Fold and Fault: Parameters, Classification, Causes, Civil Engineering significance Joint: Types, Civil engineering considerations.
Building Stones - Properties of rocks, Requirement of good building stone, various building stones in India.
Groundwater: Sources of groundwater, water table, zones of groundwater, porosity and permeability.

Module 4: Preliminary Geological Investigations **(Lectures 08)**

Preliminary geological survey, steps in geological investigations, consideration of structural features. Exploratory drilling: observations, preservation of cores, core logging, core recovery, graphical representation of core log, limitation of exploratory drilling method.

Module 5: Geology of Dams, Reservoirs, Tunnels and Bridges **(Lectures 08)**

Dam, types of dams, Influence of geological conditions on location, alignment, design and types of a dam, geological considerations in site selection for dams, Site improvement techniques, dams on carbonate rocks, sedimentary rocks, folded strata and Deccan traps, favorable and unfavorable geological conditions for a reservoir site**.** Tunneling:- Types of tunnels, influence of geological conditions on tunneling, difficulties during tunneling, tunnel lining, tunneling in folded strata, sedimentary rocks and Deccan traps. Bridges:- Types of bridges, dependence of types of bridges on geological conditions.

Text Books

- Singh Prabin, 2009, "Engineering and General Geology", S. K. Katariya and sons, Delhi
- Mukerjee P. K., 2013, "A Text Book of Geology", World Press Pvt. Ltd., Calcutta
- Gokhale K.V.G.K. and Rao D. M., 1982, "Experiments in Engineering Geology", TMN, New-Delhi
- Gupte R. B., "A Text Book of Engineering Geology", Pune Vidyarthi Griha Prakashan, Pune
- Subinoy Gangopadhyay, 2013, "Engineering Geology ",oxford university

Reference Books

- G. W. Tyrrell, 1926, "Principles of Petrology", B. I. Publication Pvt. Ltd., New Delhi
- A. Holmes, 1944, "Principles of Physical Geology", ELBS Chapman & Hall, London
- Billings M. P., 1942, "Structural Geology", Prentice Hall of India Private Ltd., New Delhi
- Legget R. F., 1983"Geology Hand book in Civil Engineering", McGraw-Hill, New York
- Krynine D. P. & Judd W. R., 2005, "Principles of Engineering Geology & Geo-technics", CBS Publishers &Distri., New Delhi
- Reddy Dr. D. V., 2017, "Engineering Geology for Civil Engineering", Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
- Read H. H., 1962, "Rultey's Elements of Mineralogy", CBS Publishers & Distributors, Delhi

List of Assignments

It consists of study of relevant rock and mineral samples. Detailed report is expected.

- Megascopic study of Rock forming minerals
- Megascopic study of Ore forming minerals
- Megascopic study of Igneous rocks
- Megascopic study of Secondary rocks

- Megascopic study of Metamorphic rocks
- Cross-section Preparation and interpretation of geological maps
- Study of Structural Geological models
- Preparation of bore log /lithologs
- Interpretation of bore- hole data

Study Visit to the places of Engineering Geological importance.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Recognize the different land forms which are formed by various geological agents.
CO2: Identify the origin, texture and structure of various rocks and physical properties of mineral.
CO3: Emphasize distinct geological structures which have influence on the civil engineering structure.
CO4: Understand how the various geological conditions affect the design parameters of structures.

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BTCVL407 Building Planning and CAD Lab

Practical: 2 hours / week

Term work shall consist of detailed report of in form of set of drawings mentioned below. In practice sessions, free-hand sketching in drawing book shall be insisted.

1) Imperial size sheets based on actual measurement of existing residential building consisting of plan, elevation, section passing through staircase, Site plan. Area statement & brief specifications.
2) Planning & design of a building (Minimum G+1): Full set of drawings for:
    1) Municipal Submission drawing as per local statutory body bye-laws such as Town Planning, Municipal Council or Corporation Authorities.
    2) Foundation / Center Line Drawing.
    3) Furniture layout plan.
    4) Electrification plan.
    5) Water supply & drainage plan.
    6) Project report giving details of Drainage System, Water Supply System, Water Tank, Septic Tank Design of terrace Drainage System.
    7) Rain water harvesting systems
3) Setting out of planned building actually on ground using conventional or modern surveying instruments

It is desirable to use drawings produced in this submission for carrying out structural design under BTCVL708 and / orBTCVL806 in next semesters. If this is implemented, student shall get extra 10% weightage limited to maximum limit.

Course Outcomes: On completion of the course, the students will be able to:

Draw plan, elevation and section of load bearing and framed structures.

Draw plan, elevation and section of public structures.

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BTCVL 408 Environmental Engineering Laboratory

Practical: 2 hours / Week

Practical Work consists of performance of at least six experiments from the List (A) below:

(A) Determination of:

1) pH and Alkalinity
2) Hardness
3) Chlorides
4) Chlorine demand and residual chlorine
5) Turbidity and optimum dose of alum
6) MPN
7) Sulphates
8) Fluorides and Iron
9) Total Solids, Dissolved Solids & Suspended Solids
10) Sludge Volume Index (SVI)
11) Dissolved Oxygen
12) BOD and COD

B) Site Visit to Water Treatment Plant:

A report based on the visit to water treatment plant shall be submitted.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Quantify the pollutant concentration in water, wastewater and ambient air.
CO2: Recommend the degree of treatment required for the water and wastewater.
CO3: Analyze the survival conditions for the microorganism and its growth rate.

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BTCVL 409 Hydraulic Engineering Laboratory - II

Practical: 2 hours / week

Practical Work consists of at least three performances from groups listed below and detailed reporting in form of journal. Practical examination shall be based on above.

Group (A)

1) Calibration of V notch / Rectangular notch.
2) Calibration of Ogee Weir.
3) Study of hydraulic jump
    a) Verification of sequent depths,
    b) Determination of loss in jump.
    c) Study of parameters with respect to Fraud Number: i) Y2/Y1; ii) Length; iii) Energy loss
4) Study of flow below gates – Discharge v/s head relation, Equation of flow, Determination of contraction in fluid in downstream of gate.
5) Velocity distribution in open channel in transverse direction of flow.

Group (B)

1) Impact of jet.
2) Study of Turbines (Demonstration).
3) Tests on Centrifugal Pump.
4) Study of Charts for Selection of Pumps

Use of computer programs such as MS Excel is desirable for post-processing of results.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand various properties of fluids and measurement techniques.
CO2: Carry out calibrations of various flow measuring devices.
CO3: Understand mechanism of hydraulic jump, various jets and pumps.

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BTCVP410 Field Training/Internship/Industrial Training

Students are expected to undergo industrial training for at least four weeks at factory / construction site / design offices or in combination of these. Training session shall be guided and certified by qualified engineer / architect / contractor in civil engineering. A neat detailed report on activities carried out during training is expected. Students should undergo training in Summer Vacation after Semester IV and appear at examination in Semester V.

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Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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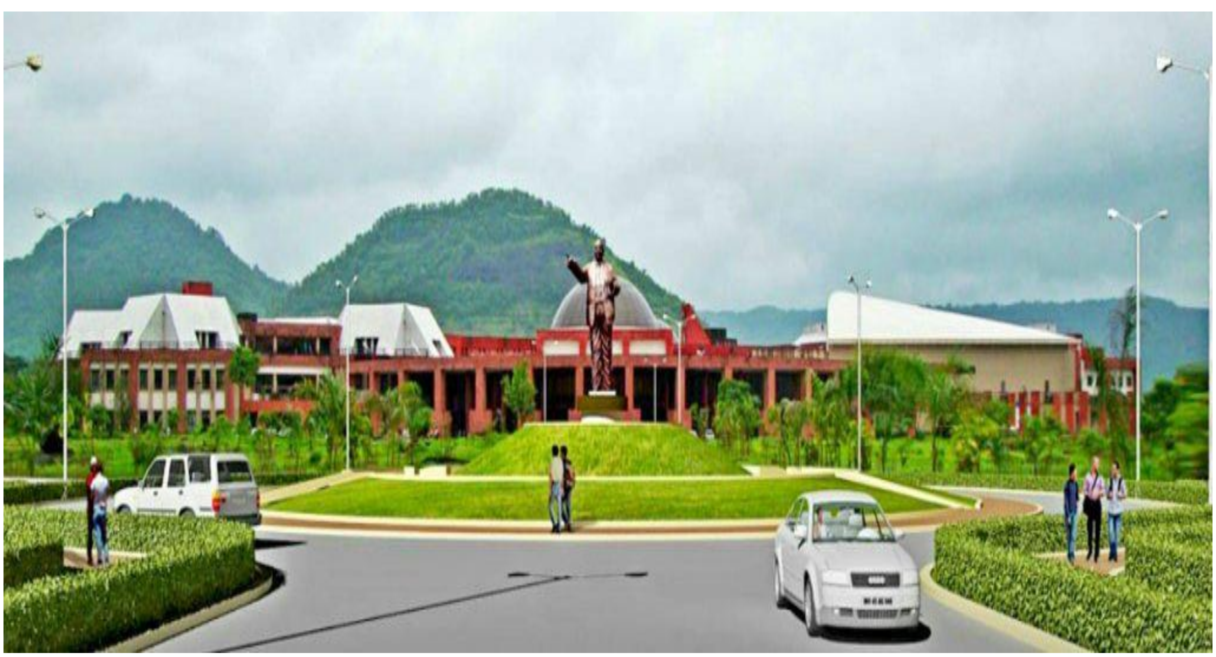
Draft Copy of Curriculum for Undergraduate Degree Programme

B. Tech. in Civil Engineering

Third Year

With effect from AY 2022-2023



Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for Third Year B Tech Civil Engg.

Semester- V										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 10	BTCVC 501	Design of Steel Structures	2	1	-	20	20	60	100	3
PCC 11	BTCVC 502	Geotechnical Engineering	3	1	-	20	20	60	100	4
PCC 12	BTCVC 503	Structural Mechanics –II	2	1	-	20	20	60	100	3
PCC 13	BTCVC 504	Concrete Technology	2	-	-	20	20	60	100	2
HSSMC3	BTHM505	Project Management	3	-	-	20	20	60	100	3
PEC 1	BTCVPE506	A. Advanced Environmental Engg. B. Applied Geology C. Hydraulic Engineering Design D. Advanced Water Resources E. Geomatics F. Town and Urban Planning G. Material, Testing and Evaluation H. Construction Economics & Finance	3	-	-	20	20	60	100	3
ESC10	BTCVES507	Software applications in Civil Engineering	2	-	-	50	-	-	50	Audit
LC 7	BTCVL508	SDD of Steel Structures Lab.	-	-	2	20	-	30	50	1
LC 8	BTCVL509	Geotechnical Engineering Lab.	-	-	2	20	-	30	50	1
LC 9	BTCVL510	Concrete Technology Lab.	-	-	2	20	-	30	50	1
Internship	BTCVP410	Internship – 2 Evaluation	-	-	-	-	-	-	-	Audit
		Total	**17**	**3**	**6**	**230**	**120**	**450**	**800**	**21**

Semester- VI											
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 14	BTCVC601	Design of RC Structures	3	1	-	20	20	60	100	4
PCC 15	BTCVC602	Foundation Engineering	3	1	-	20	20	60	100	4
ESC 9	BTCVES603	Artificial Intelligence (NPTEL/SWAYAM)	3	-	-	20	20	60	100	3
PCC 16	BTCVC604	Transportation Engineering	3	-	-	20	20	60	100	3
PEC 2	BTCVPE605	A. Industrial Waste Treatment B. Managerial Techniques C. Open Channel Flow D. Water Power Engineering E. Ground Improvement Techniques F. Structural Audit G. Intelligent Transportation Systems H. Plastic Analysis of Structures I. Numerical Methods in Civil Engg. J. Engineering Management	3	-	-	20	20	60	100	3
OEC 1	BTCVOE606	A. Environmental Impact Assessment B. Basic Human Rights C. Business Communication and Presentation Skills D. Composite Materials E. Experimental Stress Analysis F. Python Programming G. Operation Research H. Applications of Remote Sensing and Geographic Information Systems I. Civionics: Instrumentation & Sensor Technologies for Civil Engineering J. Planning for Sustainable Development K. Development Engineering	3	-	-	20	20	60	100	3
HSSMC4	BTHM607	Indian Constitution	2	-	-	50	-	-	50	Audit
LC 10	BTCVL608	SDD of RC Structures Lab.	-	-	2	20	-	30	50	1
LC 11	BTCVL609	Transportation Engineering Lab	-	-	2	20	-	30	50	1
Project	BTCVM610	Mini Project	-	-	2	20	-	30	50	1
Internship	BTCVP611	Field Training/ Internship/Industrial Training (minimum of 4 weeks training in Summer Vacation after Semester VI and appear at examination in Semester VII.)	-	-	-	-	-	-	-	Credits to be evaluated in VII Sem
Total			**20**	**2**	**6**	**230**	**120**	**450**	**800**	**23**

Detailed Syllabus

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for Third Year B Tech Civil Engg.

Semester- V										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 10	BTCVC 501	Design of Steel Structures	2	1	-	20	20	60	100	3
PCC 11	BTCVC 502	Geotechnical Engineering	3	1	-	20	20	60	100	4
PCC 12	BTCVC 503	Structural Mechanics –II	2	1	-	20	20	60	100	3
PCC 13	BTCVC 504	Concrete Technology	2	-	-	20	20	60	100	2
HSSMC3	BTHM505	Project Management	3	-	-	20	20	60	100	3
PEC 1	BTCVPE506	A. Advanced Environmental Engg. B. Applied Geology C. Hydraulic Engineering Design D. Advanced Water Resources E. Geomatics F. Town and Urban Planning G. Material, Testing and Evaluation H. Construction Economics & Finance	3	-	-	20	20	60	100	3
ESC10	BTCVES507	Software applications in Civil Engineering	2	-	-	50	-	-	50	Audit
LC 7	BTCVL508	SDD of Steel Structures Lab.	-	-	2	20	-	30	50	1
LC 8	BTCVL509	Geotechnical Engineering Lab.	-	-	2	20	-	30	50	1
LC 9	BTCVL510	Concrete Technology Lab.	-	-	2	20	-	30	50	1
Internship	BTCVP410	Internship – 2 Evaluation	-	-	-	-	-	-	-	Audit
		Total	**17**	**3**	**6**	**230**	**120**	**450**	**800**	**21**

BTCVC 501 Design of Steel Structures

Teaching Scheme: (2 Lectures + 1 Tutorial) hours/week

Course Contents

Module 1: Introduction and Connections **(6 Lectures)**

Introduction, advantages & disadvantages of steel structures, permissible stresses, factor of safety, methods of design, types of connections, various types of standard rolled sections, types of loads and load combinations

Types: Riveted, Bolted, Welded; Analysis of axially & eccentrically loaded connections (subjected to bending & torsion), Permissible Stresses, Design of connections, failure of joints

Module 2: Axially Loaded Members **(8 Lectures)**

Tension members: Common sections, net effective area, load capacity, connection using weld / bolts, design of tension splice Compression members: Common sections used, effective length and slenderness ratio, permissible stresses, load carrying capacity, connection using weld / bolt

Beams: Laterally supported & unsupported beams, design of simple beams, built up beams using flange plates, curtailment of flange plates, web buckling & web crippling, secondary and main beam arrangement, beam to beam connections.

Module 3: Industrial Roofing **(8 Lectures)**

Gantry girder: Forces acting on a gantry girder, commonly used sections, introduction to design of gantry girder as laterally unsupported beam, connection details
Roof trusses: Components of an industrial shed, types of trusses, load calculations and combinations, design of purlins, design of truss members, design of hinge & roller supports

Module 4: Columns and Column Bases **(6 Lectures)**

Simple and built up section, lacing, battening, column subjected to axial force and bending moment, column splices.

Column bases: Analysis and design of: Slab base, gusseted base and moment resisting bases, grillage foundation, design of anchor bolt

Module 5: Introduction to Plastic Analysis and Limit State method **(8 Lectures)**

Introduction to: Plastic Analysis, Hinge Formation, Collapse Mechanism, Recent approaches in Steel Structure design based on Plastic Analysis Method and Limit State Approach, Introduction to Provisions in IS 800-2007

Note: Contents in Module 1 to part of 5 shall be taught with help of relevant text or reference books based on elastic design concept and IS 800: 1984. Unit 6 shall be taught with reference to IS 800 2007
Use of IS 800: 1984 and 2007, IS 875 (All Parts), IS: Handbook No.1 for Steel Section and Steel Table is permitted for theory examination.

Text Books

- Duggal S. K., “Design of Steel Structures”, Tata McGraw Hill Pub. Co. Ltd., New Delhi
- Gambhir, “Fundamentals of Structural Steel Design”, Tata McGraw Hill Pub. Co. Ltd., New Delhi
- Negi L. S., “Design of Steel Structures”, Tata McGraw Hill Pub. Co. Ltd., New Delhi
- Chandra Ram, “Design of Steel Structures”, Vol. I & Vol. II, Standard Book House, New Delhi
- Dayaratnam P., “Design of Steel Structures”, Wheeler Publishing, New Delhi
- Subramanian N., “Steel Structures: Design and Practice” Oxford Univ. Press, Delhi
- Vazirani V.N. and Ratwani M.M., “Design and Analysis of Steel Structures”, ISBN NO: 978-81-7409-295-3
- Sai Ram K. S., “Design of Steel Structures”, Pearson Education, 2nd Edition

Reference Books

- Arya A. S. and Ajamani J.L., “Design of Steel Structures”, Nemchand and Brothers, Roorkee
- Vazirani&Ratwani, “Design of Steel Structures”, Standard Book House, New Delhi
- Duggal S. K., “Limit State Design of Steel Structures”, Tata McGraw Hill Pub. Co. Ltd., New Delhi
- Publications of Bureau of Indian Standards, New Delhi, IS 800:1984, 2007, IS 875 (Part I to V)
- Gaylord E.H. and Gaylord C.N., “Design of Steel Structures” McGraw Hill, New York
- Lothers J.E., “Design in Structural Steel” Vol.-I, Prentice Hall New Jersy
- Salmon and Johnson, “Steel Structures: Design and Behaviour”, Harper and Row, New York
- Steel Designers Manual.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify and compute the design loads and the stresses developed in the steel member.

CO2: Analyze and design the various connections and identify the potential failure modes.

CO3: Analyze and design various tension, compression and flexural members.
CO4: Understand provisions in relevant BIS Codes.

BTCVC502 Geotechnical Engineering

Teaching Scheme: (3 Lectures + 1 Tutorial) hours/week

Course Contents

Module 1: Introduction **(8 Lectures)**

Definition of soil and soil engineering, Application areas of soil mechanics, Three Phase system, Soil moisture, Soil minerals Soil structure, Terzaghi's effective stress concept, Effective and neutral pressure

Module 2: Soil Consistency **(10 Lectures)**

Index properties of soil: Different unit weights of soil, and their determination, unit weight of solids, unit weights of soil mass, method for determination of field density viz. sand replacement and core cutter, Specific Gravity determination methods void ratio and porosity, degree of saturation, Inter relation between weight volume state, density indexes, Atterberg's limits and their significance,Soil Classification: Soil classification based on particle size and consistency, I.S. classification system

Module 3: Flow of Water Through Soil: Permeability **(10 Lectures)**

Head, gradient and potential, Darcy's law, Factors affecting permeability, Field and Laboratory methods of determining permeability, Seepage pressure, quick sand condition, Derivation of Laplace equation, Flow net: characteristics& application, construction of flow net, piping phenomenon, Permeability through stratified soil, Discharge and seepage velocity.

Module 4: Shear Strength **(10 Lectures)**

Concept of shear, Coulomb's theory and failure envelope, Principle stress, stress analysis (Total stress approach and effective stress approach), representation of stresses on Mohr's circle for different types of soil such as cohesive and cohesionless, saturated and partly saturated soil etc, Application of shear stress parameters in the field, Different types of shear tests: Unconsolidated undrained, Consolidated undrained and consolidated drained choice of the type of test, box shear test, triaxial compression test with pore pressure and volume change measurement, Unconfined compression test, vane shear test

Module 5: Compressibility of Soils **(10 Lectures)**

CompactionTheory of compaction, factors influencing compaction, compacted density, Laboratory Standard and modified compaction test, Method and measurement of field compaction, Field compaction control Consolidation Compressibility: Definition, compressibility of laterally confined soil, compression of sand and clay, e-p and e-log p curve, compression index. Consolidation: Terzaghi's theory of one dimensional consolidation, consolidation test, determination of coefficient of consolidation, degree of consolidation, relevance of one dimensional consolidation to field condition, time factor

Earth Pressure Theories: Earth pressure at rest, active and passive conditions, Elementary idea about Rankin's and Coulomb's earth pressure. Graphical methods for active earth pressure.

Text Books:

- Kasamalkar B. J., "Geotechnical Engineering", Pune Vidyarthi Griha Prakashan Pune
- Murthy V.N.S., "Soil Mechanics & Foundation Engineering", U.B.S. Publishers and Distributors N. Delhi
- Punmia B.S., "Soil Mechanics & Foundation Engineering", Laxmi Publications
- Arora K. R., "Soil Mechanics" Standard Publishers, N. Delhi
- Gopal R Rao "Basic Soil Mechanics "

Reference Books:

- Alam Singh, "Text book of soil mechanics in theory and practice", Asian Pub. House, Mumbai
- Taylor D.W., "Fundamentals of Soil mechanics"
- Terzaghi and Peak "Soil mechanics" John Willey and Sons, New-York
- Scott R. F., "Principal of soil mechanics"
- Lambe T.W, "Soil Testing" by Willey Eastern Ltd., New Delhi

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand different soil properties and behavior

CO2: Understand stresses in soil and permeability and seepage aspects.

CO3: Develop ability to take up soil design of various foundations

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BTCVC503 Structural Mechanics -II

Teaching Scheme: (2 Lectures + 1 Tutorial) hours/week

Course Contents

Application of all methods shall be restricted to beams, Frames and /or pin jointed frames or trusses of Degree of Indeterminacy up to three.

Module 1: Analysis of trusses **(6 Lectures)**

Analysis of determinate and indeterminate pin jointed trusses by energy method, effects of settlement and pre-strains
.

Moving Loads and Influence Lines

Introduction to moving loads, concept of equivalent UDL, absolute maximum bending moment and shear force, concept of influence lines, influence lines for reaction, shear force, bending and deflection of determinate beams, influence line diagram (ILD) for forces in determinate frames and trusses, analysis for different types of moving loads, single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than span, application of Muller Breslau principle for determinate structures to construct ILD.

Module 2: Cables, Suspension Bridges and Arches **(8 Lectures)**

Analysis of forces in cables, suspension bridges with three hinged and two hinged stiffening girders, theory of arches, Eddy's theorem, circular , parabolic and geometric arches, concept of radial shear force and axial thrust, analysis of three hinged and two hinged arches, effect of yielding of supports, rib shortening and temperature changes. ILD for 3 hinged arches and suspension bridges

Module 3: Analysis of Indeterminate Structures by direct Flexibility Method **(8 Lectures)**

Fundamental concepts of flexibility method of analysis, flexibility coefficients and their use in formulation of compatibility equations, application of above methods to propped cantilevers, fixed beams, continuous beams,simple pin jointed frames including effect of lack of members, rigid jointed frames.

Module 4: Analysis of Indeterminate Structures by direct Stiffness Method **(8 Lectures)**

Fundamental concepts of stiffness method of analysis, stiffness coefficients for prismatic members and their use for formulation of equilibrium equation, applications of the above methods to indeterminate beams and simple rigid jointed frames, rigid jointed frames with inclined member but having only one translational DoF in addition to rotational DoF's, including the effect of settlement of supports, pin jointed frames.

Module 5: Finite Element Method (Contents to conceptual level) **(6 Lectures)**
Introduction to analysis by discretization such as finite difference method, Finite element method: types of elements-1D, 2D, 3D, Plane Strain and Plane Stress Problem, isoperimetric and axisymmetric, convergence criteria, Pascal's triangle, direct stiffness method, principle of minimum potential energy. Shape functions, concept of local and global stiffness matrix

Text Books

- Reddy C. S., "Basic Structural Analysis", Tata McGraw Hill
- Pandit G. S. and Gupta S. P., "Structural Analysis - a Matrix Approach", Tata McGraw Hill, N.Delhi, 1986
- Chandrupatla T. R., Belegundu A. D., "Introduction to Finite Elements in Engineering, Prentice Hall, N. Delhi, 1996
- Thadani B. N. and Desai J. P., "Structural Analysis"
- Punmia B.C., "Structural Analysis", Laxmi Publications
- Vazirani V.N., Ratwani M.M and Duggal S.K., "Analysis of Structures - Vol. II" Khanna Publishers, N. Dehli, Sadhu Singh, "Theory and Solved Problems in Adv. Strength of Materials", Khanna Publishers, N. Dehli,
- Ramamrutham S. and Narayanan R., "Theory of Structures" DhanpatRai Publishers, Delhi

Reference Books

- Norris C. H. and Wilbur J. B., "Elementary Structural Analysis", McGraw Hill
- Beaufait, F. W., "Basic Concepts of Structural Analysis", Prentice Hall, N.J. Kinney J. S., "Indeterminate Structural Analysis", Oxford and IBH
- Krishnamurthy, C.S., "Finite Element Analysis – Theory and Programing", Tata McGraw Hill, N. Delhi 1994
- Hibbler R. C., "Structural Analysis", Pearson Publications
- Kanchi M. B., "Matrix Methods of Structural Analysis", Wiley Eastern Ltd., N. Delhi
- Wang C. K., "Matrix Methods of Structural Analysis", International Text-book, Scranton, Pennsylvania, 1970
- Gere J.M., Weaver W., "Analysis of Framed Structures", D. Van Nostrand Company, Inc., Princeton, N. Jersey

Course Outcomes: On completion of the course, the students will be able to:

CO1: Have a basic understanding of matrix method of analysis and will be able to analyze the determinant structure.

CO2: Have a basic understanding of the principles and concepts related to finite difference and finite element methods

CO3: Have a basic understanding of concept of influence line

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BTCVC504 Concrete Technology

Teaching Scheme: (2 Lectures) hours/week

Course Contents

Module 1 **(4 Lectures)**

Materials for Concrete: Cement, Manufacturing Process, Physical Properties, Hydration of Cement, hydration products, Chemical Compounds in Cement, Types of Cement, Aggregates: Classification of aggregates, Physical Properties, Bulking of Sand, Mechanical Properties, Water: Specifications of Water to be used For Concrete

Module 2 **(4 Lectures)**

Properties of Fresh Concrete -Types of Batching, Mixing, Transportation, Placing Including Pumping and Compaction Techniques for Good Quality Concrete, Workability, Factors affecting workability, Methods of Measuring Workability, Segregation and Bleeding, setting time, Curing of Concrete, Types of curing, Temperature Effects on Fresh Concrete

Module 3 **(4 Lectures)**

Admixtures In Concrete: Types, Plasticizers and Super-plasticizers and their Effects On Workability, Air Entraining Agents, Accelerators, Retarders, Pozzolanic Admixtures, Green concrete, Bonding Admixtures, Damp-Proofing Admixtures, Construction Chemicals

Module 4 **(8 Lectures)**

Desired Properties of Concrete, Strength, Durability &Im-permeability, Characteristic Strength, Compressive, Tensile and Flexure of Concrete, Bond Strength, Tests on Concrete, Modulus of Elasticity, Effect of W/C Ratio and admixtures on Strength, Types of concrete, High Strength and High Performance Concrete Creep and Shrinkage of Concrete, Significance, Types of Shrinkage and Their Control,

Factors Affecting Creep. Durability of Concrete: Minimum & Maximum Cement Content, Strength & Durability Relationship, Exposure to Different Conditions, Factors Contributing to Cracks in Concrete, Sulphate Attack, Alkali Aggregate Reaction (AAR), factors affecting on AAR, Deteriorating effects of AAR, Chloride Attack, Corrosion of Steel (Chloride Induced)

Module 5 **(4 Lectures)**

Concrete Mix Design, Nominal Mix Concrete, Factors Governing Mix Design, Methods of Expressing Proportions, Trial Mixes, Acceptance Criteria, Factors Causing Variations, Field Control, Statistical Quality Control, Quality Measurement in
Concrete Construction, Non-destructive Testing of Concrete

Text Books

- Gambhir M. L. "Concrete Technology", Tata Mc-Graw Hill 2015 15th edition
- Shetty M. S. "Concrete Technology", S. Chand 2005.
- Krishnaswamy, "Concrete Technology", DhanapatRai and Sons

Reference Books

- Orchard, "Concrete Technology", Applied Science Publishers
- Neville A. M., "Concrete Technology", Pearson Education
- Neville A. M., "Properties of Concrete", Pearson Education
- Relevant Publications by Bureau of Indian Standards, New Delhi
- IS:10262(2009), IS:456 (2009), IS 4926 (2003)

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand the various types and properties of ingredients of concrete.
CO2: Understand effect of admixtures on the behavior of the fresh and hardened concrete.
CO3: Formulate concrete design mix for various grades of concrete.

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BTHM505 Project Management

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(8 Lectures)**

Introduction, Steps in Project Management, fundamentals of material, machinery and manpower management in Project, Bar Chart, Mile stone chart, Development of network, Fulkerson's Rule, Introduction to CPM, Time estimates, floats, critical path

Module 2: **(6 Lectures)**

Network Compression, Least Cost and Optimum Duration, Resource Allocation, Updating Calculations for Updated Network

Module 3: **(8 Lectures)**

Introduction to PERT, concept of probability, normal and beta distribution, central limit theorem, time estimates, critical path, slack, probability of project completion

Module 4: **(8 Lectures)**

Introduction to engineering economics, importance, demand and supply, types of costs, types of interests, value of money – time and equivalence, tangible and intangible factors, introduction to inflation, cash – flow diagram, economic comparisons – discontinuing methods, non-discontinuing criteria

Module 5: **(6 Lectures)**

Linear break even analysis – problems, quality control – concept, statistical methods – control charts
Total quality management– philosophy of Juran, Deming, importance, Quality Circle implementation, introduction to ISO 9000 series and 14000 series, Introduction to Computer Aided Project Management

Text Books

- Roy Pilcher, "Project Cost Control in Construction",Sheridon House Inc.(Feb1988)
- Gupta R.C. "Statistical Quality Control", khanna publishers 9th edition
- Layland Blank and Torquin, "Engineering Economics",Mc-Graw-Hill Edition
- Naik B. M. "Project Management",Stosius Inc./Advent Book division
- Khanna O.P., "Work Study",Dhanpatrai publication
- Srinath L. S. "CPM PERT", Affiliated East-West Press (Pvt) ltd

Reference Books

- Antill and Woodhead, "C.P.M. in Construction Practice", Wiley-Interscience 4th edition 1990
- Taylor. G.A., "Management and Engineering Economics", Mc-Graw Hill 4th edition
- Roy Pilcher, "Principles of Construction Management" Mc-Graw Hill Higher Education 2rd revision

Course Outcomes: On completion of the course, the students will be able to: Understand various steps in project Management, different types of charts.Construct network by using CPM and PERT method.
Determine the optimum duration of project with the help of various time estimates.
Know the concept of engineering economics, economic comparisons, and linear break even analysis problems.
Understand the concept of total quality Management including Juran and Deming's philosophy.

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BTCVPE506 A. Advanced Environmental Engineering

Teaching Scheme :(3 Lectures) hours/week

Course Contents

Module 1: Low cost wastewater treatment methods **(8 Lectures)**
Principles of waste stabilization pond, Design and operation of oxidation pond, aerobic & anaerobic Lagoons, Aerated Lagoon, Oxidation ditch, Septic tank. Concept of recycling of sewage Disposal of waste water-stream pollution, Self Purification, DO sag curve, Streeter Phelp's Equation, Stream classification, disposal on land, effluents standards for stream and land disposals

Module 2: Industrial Waste Water Treatment Management **(8 Lectures)**

Sources of Pollution: Physical, Chemical, Organic and Biological properties of Industrial Wastes – Differences between industrial and municipal waste waters –Effects of industrial effluents on sewers and treatment plants, Prevention vs Control of Industrial Pollution
Pre and Primary Treatment: Equalization, Proportioning, Neutralization, Oil Separation by Floatation, Prevention v/s Control of Industrial Pollution

Module 3: Waste Water Treatment Methods **(8 Lectures)**
Nitrification and De-nitrification – Phosphorous removal – Heavy metal removal – Membrane Separation Process–Reverse osmosis– Chemical Oxidation–Ion Exchange – Air Stripping and Absorption Processes – Special Treatment Methods – Disposal of Treated Waste
Common Effluent Treatment Plants (CETPs): Need, Planning, Design, Operation & Maintenance Problems

Module 4: Environmental Sanitation **(6 Lectures)**
Communicable diseases, Methods of communication, Diseases communicated by discharges of intestines, nose and throat, other communicable diseases and their control
Module 4: Insects and Rodent Control **(6 Lectures)**
Mosquitoes, life cycles, factors of diseases control methods - natural &chemical, Fly control methods and fly breeding prevention, Rodents and public health, plague control methods, engineering and bio-control methods in Rural areas, Population habits and environmental conditions, problems of water supply and sanitation aspects, low cost excreta disposal systems, Rural sanitation improvement schemes.

Text Books

- Masters G.M. (2008) "Introduction to Environmental Engineering and Science"Prentice-Hall of India Pvt. Ltd., N. Delhi
- Metcalf & Eddy (1982) "Waste Water Engineering Treatment & Disposal", Tata McGraw Hill, New Delhi
- Garg S. K. (1979) "Sewage Disposal and Air Pollution Engineering", Khanna Publishers,New Delhi
- Rao M.N.& Datta A. K. (2018)"Waste water treatment", Oxford & Ibh Publishing Co Pvt Ltd, New Delhi

Reference Books

- Peavey H. S., Rowe D.R. (2017) "Environmental Engineering", McGraw-Hill Book Co., New Delhi
- Viessman W. and Hammer M. J. (2008) "Water Supply and Pollution Control",Pearson Publications, N. Delhi
- Hammer M. J. (2012) "Water and Waste water Technology", Prentice-Hall of India Private Limited,New Delhi
- Canter L. W. (1995) "Environmental Impact Assessment", Tata McGraw Hill Publication,New Delhi

Course Outcomes: On completion of the course, the students will be able to:

1. Determine the sewage characteristics and design various sewage treatment plants.
2. Understand municipal water and wastewater treatment system design and operation.
3. Apply environmental treatment technologies and design processes for treatment of industrial waste water.
4. Understand the rural sanitation schemes.

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BTCVPE 506B Applied Geology

Teaching Scheme: (3Lectures) hours/week

Course Contents

Module 1: Stratigraphy and Indian geology **(6 Lectures)**

geological time scale, physiographic divisions of India and their geological, geomorphologic and tectonic characteristics, study of important geological formations of India namely: Vindhyan, Gondwana, and Deccan traps with respect to: distribution, lithology, tectonics, economic importance etc. significance of these studies in civil engineering

Module 2: Sub-surface exploration **(8 Lectures)**

Steps in geological studies of project site, engineering consideration of structural features, exploratory drilling, preservation of cores, core logging, graphical representation of core log, limitations of exploratory drilling method, numerical problems on core drilling, introduction to geological map

Sub-surface water: Runoff, fly off and percolation of surface water, juvenile, connate and meteoric water, water table, zones of subsurface water, perched water table, aquifer theory

Module 3: Engineering geology of Deccan traps **(8 Lectures)**

Types of basalts and associated volcanic rocks, engineering characteristics, infillings of gas cavities, compact and amygdaloidal basalt as construction material, effect of jointing, hydrothermal alteration and weathering on engineering behaviour, tail channel erosion problem in Deccan trap region, suitability for tunnelling, problems due to columnar basalt, dykes, red bole, tachylitic basalt, volcanic breccias and fractures, laterites: origin, occurrence and engineering aspects, ground water bearing capacity of rocks of Deccan trap region, percolation tanks

Module 4: Geology of soil formations **(6 Lectures)**

Soil genesis, geological classification of soils, residual and transported soils, soil components, characteristics of soils derived from different types of rocks, nature of alluvium and sand from rivers of Deccan trap region, scarcity of sand

Geophysics:

Various methods: magnetic, gravitational and electrical resistivity methods, applications of electrical resistivity method using Wenner configuration in civil engineering problems such as: finding thickness of over burden and depth of hard rock, locating the spot for ground water well, seepage of water finding,

Module 5: Rock mechanics: **(8 Lectures)**

General principles, engineering properties of rocks and their dependence upon geological characters, in- built stresses in rocks, measurements of these stresses

Plate tectonics, seismic zones of world, seismic activity of Deccan trap region, various theories on the origin of the seismic activity of Deccan trap region, prediction of earthquake, earthquake resistant constructions, numerical problems based on seismic data, cause and prediction and preventive measurement of landslide in Deccan trap region.

Text Books

- Gupte R. B., “A Text Book of Engineering Geology”, Pune Vidyarthi Griha Prakashan, Pune.
- Gokhale K.V.G.K. and Rao D. M., “Experiments in Engineering Geology”, TMN, New-Delhi.
- Mukerjee P. K., “A Text Book of Geology”, The World Press Pvt. Ltd., Calcutta.
- Prabin Singh, “Engineering and General Geology”, S. K. Katariya and sons, Delhi.

Reference Books

- Tyrrell G. W., “Principles of Petrology”, B. I. Publication Pvt. Ltd., New Delhi.
- Holmes A., “Principles of Physical Geology”, ELBS Chapman &Hall,London.
- Billings M. P., “Structural Geology”, Prentice Hall of India Private Ltd., New Delhi.
- Farmer L. W., “Engineering Properties of Rocks”, Champman& Hall, London.
- SathyaNarayanSwamiB. S., “Engineering Geology”, DhanpatRai& Co.(P) Ltd, Delhi

Course Outcomes: On completion of the course, the students will be able to:

CO1 :Understand geological time scale and physiographic division of India and their geological and characteristics different geological formation in India.

CO2: Perform sub surface exploration and interpret core log.

CO3:Solve numerical problem based on core drilling and seismic data.
CO4 :Familiar with origin of earthquake, seismic wave and landslide in Deccan trap.

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BTCVPE 506C Hydraulic Engineering Design

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(6 Lectures)**

Design of Spillways and Energy Dissipation for Flood Control Storage and Conveyance Systems, major features of dams (e.g., type, design basis, spillway type), Analysis of Spillway flow, Design of stilling basis

Module 2: Hydraulic Processes: Pressurized Pipe Flow **(8 Lectures)**

Continuity and energy equations to pipe network, problems, Calculation of friction losses, DarcyWeisbach, Colebrook-White, Jain, Hazen-Williams, Manning's, loss coefficient tables to estimate local energy losses, analysis of pipe networks by interpreting energy and hydraulic grade lines

Module 3: Boundary Layer Theory **(8 Lectures)**

Concept, Boundary layer along thin plate- Characteristics, Laminar, Turbulent Boundary Layer, laminar sub layer, Various Thicknesses-Nominal, displacement, Momentum, Energy. Hydraulically smooth and Rough boundaries, Separation of Boundary layer, control of Separation, Introduction to Drag and Lift on submerged bodies (Flat plates, Sphere, Cylinder, aerofoil), Stokes law, Concept of Drag and Lift coefficients.

Module 4: **(8 Lectures)**

Impulse momentum principle, impact of jet on Vanes-flat, curved (stationary and moving), inlet & outlet velocity triangles under various conditions, Series of flat, curved vanes mounted on wheel.

Module 5: **(6 Lectures)**

Pump Performance, Analysis of pump performance with regards to pump location, multi-pump system performance in a specified hydraulic system

Text Books:

- Rajnikant M. Khatsuria "Hydraulics of Spillways and Energy Dissipators by"
- R.S.Varshney, S.C. Gupta, R.L. Gupta Theory and Design of Hydraulic Structures Vol. 1 and 2
- Bansal R.K., "Fluid Mechanics", Laxmi Publications, 9th edition 2017
- Garde R. J., "Fluid Mechanics through Problems", New Age Publications, 3rd edition 2011
- Jain A. K., "Fluid Mechanics", Khanna Publications, 8th edition, 2003, Delhi
- Subramanian K., "Fluid Mechanics through Problems" Tata McGraw-Hill Pub. Co., Delhi

Reference Books

- Streeter, "Fluid Mechanics" McGraw-Hill International Book Co., 3rd edition, Auckland
- Hughes & Brighton, "Fluid Mechanics", Tata McGraw Hill
-

Course Outcomes:On completion of the course, the students will be able to:

CO1: Analyse spillway flow

CO2: Compute drag and lift coefficients using the theory of boundary layer flows.

CO3: Analyse Pump performance

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BTCVPE 506D Advanced Water Resources

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Hydrogeology **(8 Lectures)**

Porosity and Permeability of Rocks, Groundwater in Igneous, Metamorphic, Sedimentary Rocks and Non Industrated Sediments, Hydro-geological Regions of India, Surface and Subsurface Geophysical methods for Groundwater Explorations..

Module 2: Well Hydraulics **(8 Lectures)**

Aquifers and Aquifer Parameters, Darcy's law, Hydraulic Conductivity and its Characteristics, Dupuit Equation, Groundwater Flow Direction Steady Groundwater Flow, Groundwater Flow Equation, Estimation of Aquifer Parameters from Pumping Test Data, Graphical Techniques and their Limitations, Groundwater Well Losses, Interference among Wells, Potential Flow, Image well theory and its Application in Groundwater Flow.

Module 3: Water Well Design and Well Drilling **(8 Lectures)**

Water Well Design and Well Drilling: Well Screen, Development and Completion of Well, Rotary Drilling and Rotary Percussion Drilling, maintenance of Wells.

Module 4: Groundwater Management **(6 Lectures)**

Groundwater Management: Conjunctive Use, Alternative Basin Yields, Artificial Recharge of Groundwater, Groundwater Quality.
Groundwater Modelling: Groundwater Flow, mathematical, Analog and Digital modeling, Regional Groundwater Modelling.

Module 5: Ground Water Development **(6 Lectures)**

Introduction, Development of artificial recharging, Methods of artificial recharging, Suitability of artificial recharging methods.

Text Books:

- Walton, W.C.(1970) "Groundwater Resources Evaluation", McGraw Hill Inc, n York .
- Todd, D.K. (1995), "Groundwater Hydrology", John Wiley & Sons, Singapore
- Johnson, E.E. (1966),"Groundwater", E. Johnson Inc. Washington.
- Raghunath, H.M. (1992) "Groundwater", Wiley Eastern Ltd, N Delhi
- Sharma, H.D. and Chawla, A.S. (1977), "Manual on Groundwater and Tube Wells", Technical Report No. 18, CBIP, New Delhi,
- Davis, S.N. and De Weist, R.J.M. (1966), "Hydrogeology", John Wiley & Sons, N York.
- Garg, S.P. (1993) "Groundwater and Tube Wells", Oxford and IBH Publishing C. N Delhi.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Apply methods to recharge ground water

CO2: Ability to know about various surface and subsurface geophysical methods for groundwater explorations.

CO3: Ability to know about well hydraulics

CO4: Ability to know about design principles of well

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BTCVPE 506E Geomatics

Teaching Scheme: (3 Lectures) hours/week

Contents

Module 1: Tachometry **(8 Lectures)**

Significance and systems, principle, constants, basic formulae and field work stadia method, auto reduction tachometer, tangential system

Electronic Distance Measurement: Importance, principles of electronic distance measuring (EDM) instruments, classification of EDM's based on carrier waves used, study and use of total station

Module 2: Triangulation **(8 Lectures)**

Principle & classification, system, selection of station, base line measurement, correction and use of subtense bar, signals, satellite station, reduction to center, spherical excess, angular observations, tri-iteration

Triangulation Adjustments: Theory of errors, laws of weights, concept of most probable value

Module 3: Field Astronomy **(8 Lectures)**

Terms, co-ordinate systems, determination of latitude and true bearing by observation on the sun and pole star

Curves: Horizontal and vertical curves, simple curves, setting with chain and tapes, tangential angles by theodolite, double theodolite, compound and reverse curves, transition curves, functions and requirements, setting out by offsets and angles, vertical curves, sight distance requirements

Module 4: Photogrammetry **(6 Lectures)**

Terms, types, vertical photographs, scale, ground coordinates, relief displacement, flight planning photomaps and mosaics, stereoscopy and photo interpretation

Module 5: Introduction to Remote Sensing **(6 Lectures)**

Introduction, classification and principles, electromagnetic energy and its interaction with matter, idealized systems, sensors, platforms, and application in civil engineering, G.P.S & G.I.S. as surveying techniques – Overview, uses and applications

Text Books

- Bannister A., Raymond S., Wartikar J.N., Wartikar P.N.,1992 "Surveying", ELBS, 6th Editon,
- Heribert Kahmen and Wolfgang Faig,1995 "Surveying ", Walter de Gruyter,
- Kanetkar T.P., "Surveying and Leveling", Vols. I, II and III, Vidyarthi Gruh Prakashan, Pune
- Punmia B.C., "Surveying", Vols. I , II and III, Laxmi Publications

Reference Books

- James M. Anderson and Edward M. Mikhail, "Introduction to Surveying", McGraw Hill Book Company
- Clark D., "Plane and Geodetic Surveying", Vol. I and II, C.B.S. Publishers and Distributors, New Delhi, Sixth Edition
- Agor, "Advanced Surveying", Khanna Publications, Delhi
- Arora K. L., "Surveying", Vol.1 & 2
- Basak, "Surveying and Levelling"
- Duggal S. K., "Surveying", Vol 1 & 2, Tata Mcgraw Hill Publications, New Delhi
- Gopi S., Satikumar R. and Madhu N., "Advanced Surveying", Pearson Education
- Chandra A. M., "Higher Surveying", New Age International Publication

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand basics different types of curves on roads and their preliminary survey.

CO2: Perform setting of curves, buildings, culverts and tunnels.

CO3: Comprehend different geodetic methods of survey such as triangulation, trigonometric leveling.

CO4: Comprehend modern advanced surveying techniques.

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BTCVPE 506 F Town and Urban Planning

Teaching Scheme: Lectures: 3 Hours / Week

Course Contents

Module 1: **(8 Lectures)**

Necessity and scope of Town Planning, Brief history, Greek and Roman Towns, Planning in ancient India - Indus Valley Civilization, Vedic Period, Buddhist Period, Medieval Period, Mogul Period, British Period, Post-Independence Period, Theories in urban and regional planning

Module 2: **(8 Lectures)**

Town Planners in Modern Era such as Sir Patrick Geddes, Sir Ebenezer Howard, Clarence stein, Sir Patrick Abercrombie, Le Corbusier, Present Status of Town Planning in India, Efficiency Measures, Planners skills, Integrated Area Planning in India. Distribution and sizes of Settlements

Module 3: **(8 Lectures)**

Layout of Residential Units, Neighborhood Unit Planning, Radburn Plan, Grid Iron Pattern, Shoe String Development, Growth Pattern of Towns, Concentric Satellite, Ribbon Development, Scattered growth

Module 4: **(6 Lectures)**

Elements of Town, Various Zones, Development Control Rules and Building Bye Laws, Urban Roads: Objective, Classification, Road Networks, Data Collection Surveys, Analysis of data,

Town aesthetics, Landscape Architecture, Suitability of Trees, Treatment of Traffic Islands, Open Spaces Walkways Public Sit-outs, Continuous Park System, Green ways

Town Planning works with reference to M.R.T.P. Act, Land Acquisition Act, Necessity and procedure of acquisition

Module 5: **(6 Lectures)**

Village Planning, Multilevel Planning, Decentralization Concepts, Rural Developments, Planning Methodology, GrowthCentre Approach, Area Development Approach, Integrated Rural Development Approach

Text Books:

1. Hiraskar G.K. (2018) “Town and country Planning”DhanpatRai Publication, N. Delhi
2. Rangawala S.C. (2015) “Town Planning”, Charotar Publications, Anand
3. Sundaram K.V. (1978) “Urban and Regional Planning in India”, Vikash Publishing House P.L
4. MRTP Act 1966 & 2002
5. Land Acquisition Act - 1894
6. Misra S. N. (1984) “Rural Development Planning-Design and Method”, Satvahan Publications, N. Delhi

Reference Books

1. Eisner S. and Gallion A. (1993) “The Urban Pattern”, John Wiley & Sons, N. Delhi

Outcomes: Upon completion of the course the students will be able to:

1. Understand town and Urban planning and their essential attributes
2. Identify elements of planning and regulations of the same
3. Implement guidelines provided by standard authorities

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BTCVPE506 G. Materials, Testing &Evaluation

Teaching Scheme: (3 Lectures) hours / Week

Course Contents

Module1: **(8 Lectures)**
Basic Properties of Materials: importance of materials in civil engineering construction, types of materials such as ceramics, concrete, composites, optical /electronics materials, glass, metals, nano-materials ,polymers and plastics, wood and other materials. some basic properties of materials such as temperature, energy, specific heat, thermal conductivity, coefficient of thermal expansion ,mechanical properties of metals ,stress, strain modulus of elasticity, ,stress-strain behavior, elastic and plastic deformations, elastic properties of materials, tensile properties, ductility, resilience and toughness ,compressive, shear and torsional deformation, hardness. Variability of material properties.

Module2: **(8 Lectures)**
Civil Engineering Materials: introduction to cement and concrete, uses of cement, strength of cement and concrete ,sand, coarse aggregates, mortar and grouts, masonry mortars, rendering, cementitious grouts, RCC, clay bricks ,calcium silicate bricks, concrete blocks., rubbles, steel , steel grades, mechanical properties of steel, different applications, floor and roofing tiles, slates, timber, strength of timber ,Engineered wood products, metals, glass for glazing, glass fibres, glass wool, bituminous materials, binder properties, binder mixtures, asphalt mixture.

Module3: **(6 Lectures)**
Composite Materials: RCC, FRC, steel/concrete composite bridge decks, fibre reinforced plastics structural insulated panels.
Comparison of Different Materials, Introduction, comparison of strengths of various materials, comparison for environmental impact, health and safety.

Module 4: **(6 Lectures)**
New Techniques in Constructions—Introduction,3D printing, photo catalytic admixture, self-healing concrete, zero cement concrete ,hemp lime, wood-glass epoxy composites, bamboo.

Module 5: **(8 Lectures)**
Material Testing ,Machines And Equipment Requirements---Necessity of material testing, various testing methods, destructive tests, classification of destructive tests---static, impact and cyclic testing,
non-destructive testing—its classification ,visual inspection, penetration test, magnetic detection, ultrasonic test, radiography test and spark test. Types of testing machines, UTM and CTM, force and displacement controlled machines, loading frames. Hardness testing machines, fracture tests.

Recommended Books:

- Deodhar S.V. (1990) Civil Engineering Materials’ Allied Publishers, N. Delhi.
- RangwalaS.C. (1983)Civil Engineering Materials', DhanpatRai and Sons, N. Delhi.

References:

- B.I.S., 1980, ''National Building Code of India', ISI, New Delhi.

Course Outcomes: The required course for emphasis in development engineering will help students

CO1: To develop skill to construct strong and durable structures by applying knowledge of material science.
CO2: To make the students aware of quality assurance and control in their real life as a professional.
CO3: To propose suitable material in adverse conditions

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BTCVPE506 H. Construction Economics & Finance

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1 **(8 Lectures)**

Engineering Economics, Time Value of Money, Cash Flow diagram, Nominal and effective interest – continuous interest, Single Payment Compound Amount Factor, Uniform series of Payments, comparing alternatives, Present worth Analysis, Annual worth Analysis, Future worth Analysis, Rate of Return Analysis, Break Even Analysis, Benefit/Cost Analysis

Module 2 **(8 Lectures)**

Economics of Project Parameters, Equipment Economics, Operating Costs, Buy, Rent and Lease Options, |Replacement Analysis, Cost Estimates, Type of Estimates, Parametric Estimate, Management Accounting, Financial accounting principles, basic concepts, Financial statements, accounting ratios

Module 3 **(6 Lectures)**

Investment Evaluation and Financing Projects, Taxation, Depreciation, switching between different depreciation methods, Inflation, Sources of finance, equity, debit, securities, borrowings, debentures, Working capital requirement, financial institutes

Module 4 **(8 Lectures)**

Financial Management, Introduction, Charts of Accounts, Balance Sheet, Financial Ratios, Working Capital Management, Budgeting and budgetary control, Performance budgeting. Profit & Loss, statement, Ratio analysis, Appraisal through financial statements, International finance forward

Module 5 **(6 Lectures)**

PPP in Projects Public Private Participation in Projects- PPP Models, BOOT, BOT, Joint Ventures, BOOT, BOT, Annuity, DBFO, External Commercial Borrowings, International Finance, FIDIC.

Text Books

- Blank, L.T., and Tarquin, A. J., (1988). *Engineering Economy*, Mc-Graw Hill Book Co.
- Collier C. and Gla Gola C. (1998). *Engineering Economics & Cost Analysis*, Addison Wesley Education Publishers,
- Patel, B. M., (2000). *Project management- strategic Financial Planning, Evaluation and Control,* Vikas Publishing House Pvt. Ltd. New Delhi,
- Shrivastava, U. K., (2000). *Construction Planning and Management*, Galgotia Publications Pvt. Ltd. New Delhi.

References

- Van Horne, J.C. (1990). Financial Management and Policy, Prentice-Hall of India Ltd.
- Taylor, G.A. (1968). Managerial and Engineering Economy. East-West Edition.
- Thuesen, H.G. (1959). Engineering Economy, Prentice-Hall, Inc.
- Brigham, E.F. (1978). Fundamentals of Financial Management, the Dryden Press, Hinsdale, Illinios,
- Kolb, R.W. and Rodriguez, R.J. (1992). Financial Management, D.C. Heath & Co.
- Walker, E.W. (1974). Essentials of Financial Management, Prentice Hall of India Private Limited, New Delhi.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Adopt as per principles of economics and financing
CO2: Analyze available alternatives and propose best suitable among them
CO3: Apply various models of financial management and accounting

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BTCVES507 Software Applications in Civil Engineering

Teaching Scheme: (2 Lectures) hours/week

Course Contents

Module 1: **(5 Lectures)**
Importance and need of software for modeling, analysis and design in Civil Engineering field, Advantages and limitations of software, causes for errors, validation of software results. Failures due to errors in modeling, data entry and interpretation of software results.

Module 2: **(5 Lectures)**
Determination of Bending Moment Diagram, Deflections for different loading conditions for a Simply Supported Beam and Cantilever Beam. Determination of fixed end moments for different loading conditions of a fixed beam. Calculation of Influence line diagrams at any section of a Simply Supported Beam.

Module 3: **(5 Lectures)**
Application of problems in Hydraulics such as Hardy cross method in the Analysis of pipe network, Computation of water surface profiles in open channel flows. Estimation of Settlement of foundations in Cohesive Soil, Stability Analysis of Slopes. Estimation Earth Pressures in Cohesive and Cohesionless soils.

Module 4: **(5 Lectures)**
Application of problems in Environmental engg., Transportation Engg. Design of Slabs using I.S. Code method. Analysis and Design of Beams by using Limit state method. Design of columns subjected to axial load and Uni-axial Moment. Design of Isolated Footing. Design of rolled steel columns, built up columns, Beams and built-up Beams.

Module 5: **(4 Lectures)**
Software application in various disciplines of Civil Engineering: Learning and practice of any one software: from at least any 4 domain from 14 domain

1. Drafting and drawing: AutoCAD,
2. building information modelling:
3. Numerical Analysis and Mathematical operations:
4. Structural Analysis and Design:
5. Finite Element Analysis:
6. Project Management: MS Project
7. Geotechnical Engineering:
8. Quantity Surveying:
9. Environmental Engineering:
10. Remote Sensing and Geographical Information System: QGIS,
11. Transportation Engineering:
12. Hydraulics and Water Resources Engineering:
13. Different Open-source software used for specific problems
14. MS Excel: Conduct concrete mix design for M40 grade concrete. or any exercise of Civil Engineering domain.

(Any open source softwares such as Auto CAD, MS Project, QGIS may be used for above purpose and along with that other appropriate softwares can be used for the same.)

Text Books

- Computer aided design, software and analytical tools by C.S. Krishnamoorthy & S. Rajesh.
- Computer applications in Civil Engineering by S.K. Parikh.
- Computer aided design in Reinforced concrete by V.L. Shah.

Reference Books

- http://www.stepinau.com/offline/Civil/4-1/COMPUTER%20APPLICATIONS%20IN%20CIVIL%20%20ENGINEERING/COMPUTER%20APPLICATIONS%20IN%20CIVIL%20%20ENGINEERING.html#.YrANZXZBxQI
- https://www.inspirenignite.com/mh/ce-c507-software-applications-in-civil-engineering-syllabus-for-ce-6th-sem-2018-pattern-mumbai-university/

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand & Analyse civil engineering softwares

CO2: Use applications of various softwares in specialized works of civil engineering

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BTCVL508 SDD of Steel Structures Lab

Practical: 2 Hours / Week

Term work shall consist of detailed analytical report for structural design and drawing of any one of the following steel structures from Group A and B. Student may use IS 800 1984 or 2007.

Group A

1) Industrial Shed: Roof Truss with Necessary Bracing System, Purlins, Column and Column Bases
2) Industrial Shed: With Portal or Gable Frames of Solid or Open Web Sections with Necessary Bracing System, Purlins, Column and Column Bases
3) Industrial Shed: Gantry Girder, Columns with Necessary Bracing System, Purlins, Column and Column Bases
4) G + 3 Building Structure

Group B

1) Foot Bridge: Analysis using Influence lines for Main Truss, Cross Beams, Raker, and Joint Details
2) Plate Girder: Analysis and Design of Rivetted or Welded Plate Girder.
3) Elevated Water Tank: Analysis and Design of Staging and Tank Body.
4) Steel Chimneys

Course Outcomes: on completion of the course, student will be able to

CO1: simulate a practical design requirement in to a theoretical statement to solve mathematically to arrive at a safe economical and realistic feasible solution that can be executed.

BTCVL509 Geotechnical Engineering Lab

Practical: 2 hours / week

Term work shall consist of performance of at least seven experiments from the following mentioned list of experiments.

1) Specific gravity determination of coarse and fine grained soil
2) Particle size distribution-Mechanical sieve analysis, wet sieve analysis
3) Determination of Atterberg's consistency limit
4) Permeability- Determination of coefficient of permeability
5) Field density determination
6) Direct shear box test
7) Procter compaction test
8) Tri-axial test
9) Unconfined compression test
10) One dimensional consolidation test

Course Outcomes: On completion of the course, the students will able to:

CO1: Determine different engineering properties of soil.

CO2: Identify and classify soils based on standard geotechnical engineering practices.

CO3: Perform Laboratory oratory compaction and in-place density tests.

CO4: Perform and interpret direct shear tests and estimate shear strength parameters.

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BTCVL 510 Concrete Technology Laboratory

Practical: 2 Hours / Week

Term work shall consist of performing minimum five experimental sets from the list below.

1) Testing of Cement: Consistency, Fineness, Setting Time, Specific Gravity,
2) Soundness and Strength Test for Cement
3) Testing of Aggregates: Specific Gravity, Sieve Analysis, Bulking of Fine Aggregate, Flakiness Index, Elongation Index and Percentage Elongation
4) Placement Tests on Concrete: Workability Tests: Slump, Compaction,
5) Strength Tests on Concrete: Compression, Flexure, Split & Tensile Test,
5) Effects of Admixture: Accelerator, Retarder, Super Plasticizer,
6) Exercise and verification of Concrete Mix Design,
7) Non-destructive Testing for Concrete.

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Evaluation of (BTCVP410) Field Training/Internship/Industrial Training

Evaluation of industrial training undergone by students in Summer Vacation after Semester IV. A neat detailed report on activities carried out during training has to be submitted, along with a presentation to evaluate the training work.

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Detailed Syllabus

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching & Evaluation Scheme for Third Year B Tech Civil Engg.

Semester- VI											
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 14	BTCVC601	Design of RC Structures	3	1	-	20	20	60	100	4
PCC 15	BTCVC602	Foundation Engineering	3	1	-	20	20	60	100	4
ESC 9	BTCVES603	Artificial Intelligence (NPTEL/SWAYAM)	3	-	-	20	20	60	100	3
PCC 16	BTCVC604	Transportation Engineering	3	-	-	20	20	60	100	3
PEC 2	BTCVPE605	A. Industrial Waste Treatment B. Managerial Techniques C. Open Channel Flow D. Water Power Engineering E. Ground Improvement Techniques F. Structural Audit G. Intelligent Transportation Systems H. Plastic Analysis of Structures I. Numerical Methods in Civil Engg. J. Engineering Management	3	-	-	20	20	60	100	3
OEC 1	BTCVOE606	A. Environmental Impact Assessment B. Basic Human Rights C. Business Communication and Presentation Skills D. Composite Materials E. Experimental Stress Analysis F. Python Programming G. Operation Research H. Applications of Remote Sensing and Geographic Information Systems I. Civionics: Instrumentation & Sensor Technologies for Civil Engineering J. Planning for Sustainable Development K. Development Engineering	3	-	-	20	20	60	100	3
HSSMC4	BTHM607	Indian Constitution	2	-	-	50	-	-	50	Audit
LC 10	BTCVL608	SDD of RC Structures Lab	-	-	2	20	-	30	50	1
LC 11	BTCVL609	Transportation Engineering Lab	-	-	2	20	-	30	50	1
Project	BTCVM610	Mini Project	-	-	2	20	-	30	50	1
Internship	BTCVP611	Field Training/ Internship/Industrial Training (minimum of 4 weeks training in Summer Vacation after Semester VI and appear at examination in Semester VII.)	-	-	-	-	-	-	-	Credits to be evaluated in VII Sem
Total			20	2	6	230	120	450	800	23

BTCVC 601 Design of RC Structures

Teaching Scheme: (3 Lectures + 1 Tutorial) hours/week

Course Contents

Module 1: Introduction **(4 Lectures)**

Basic Aspects of Structural Design, Introduction to Design Philosophies, Stress Strain behavior of Materials Working stress method, Ultimate load method and Limit state method, Comparison of Different Philosophies, Factor of Safety, Estimation of Loads.

Working Stress Method

Module 2: **(8 Lectures)**

Stress block parameters, permissible stresses, balanced, under reinforced and over reinforced section, analysis and design for flexure, shear, analysis and design of singly and doubly reinforced beams. Design of axial and uniaxial eccentric loaded columns, Isolated Column Footings, WSM design requirements as per Annexure B of IS 456:2000

Limit State Method

Module 3: Introduction to LSM **(10 Lectures)**

Introduction to limit state approach, types and classification of limit states, characteristics strength and characteristics load, load factor, partial safety factors, strain variation diagram, stress variation diagram, serviceability criteria

Limit State of Collapse in Shear and Bond

Design for shear: shear failure, types of shear reinforcement, minimum shear reinforcement, design of shear reinforcement

Design for bond: types, factors affecting, resistance, check for development length, detailing of reinforcement

Module 4: Limit State of Collapse in Flexure **(16 Lectures)**

Design of beams: Analysis and Design: Singly and Doubly Reinforced Beams, Flanged (L and T) sections.

Design of Slabs: One-Way and Two-Way Slab: Behavior of slabs, types, support conditions, analysis and design with various conditions Staircases, effective span and load distribution, design of dog- legged and open well stair case.

Module 5: Limit State of Collapse in Compression **(10 Lectures)**

Design of columns, and footings

Analysis and design of axially and eccentrically loaded short columns (Circular and Rectangular), construction of Interaction diagrams for uni-axial bending and its application in design, concept of design charts, concept of bi-axial bending, concept of interaction surface, Design of isolated column footing for axial load, and uni-axial bending.

Text Books

- IS: 456-2000, IS: 456-1978, Bureau of Indian Standards, New Delhi
- Karve and Shah, "Limit State Theory & Design", Structures Publications, Pune
- Jain A.K., "Reinforced Concrete Design (Limit State)", Nemchand Brothers, Roorkee
- Sinha and Roy, "Fundamentals of Reinforced Concrete"
- Sinha S.N., "Reinforced Concrete Design, Vol. I, II", Tata Mc-Graw Hill
- Varghese P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, New Delhi
- Mehra H. and V.N. Vazirani, "Limit State Design of Reinforced Concrete Structures", Khanna Publishers, N. Delhi, ISBN No: 978-81-7409-162-9
- Vazirani V.N. and Ratwani M.M., "Design of Reinforced Concrete Structures", Khanna Publishers, N. Delhi, ISBN No: 978-81-7409-232-8
- Pillai S Unnikrishna, and Menon Devdas., "Reinforced Concrete Design" Tata Mc-Graw Hill

Reference Books

- Punmia B.C., "Reinforced Concrete Design, Vol. I, II", Laxmi Publications
- Relevant Publications by Bureau of Indian Standards, New Delhi

Course Outcomes: On completion of the course, the students will be able to comprehend the various design philosophies used in design of reinforced concrete. Analyze and design the reinforced concrete sections using working stress and limit state method.

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BTCVC 602 Foundation Engineering

Teaching Scheme: (3 Lectures + 1 Tutorial) hours/week

Course Contents

Module 1: **(8 Lectures)**

Introduction, General requirements to be satisfied for satisfactory performance of foundations, Soil exploration: Necessity, Planning, Exploration Methods, Soil Sampling Disturbed and undisturbed, Rock Drilling and Sampling, Core Barrels, Core Boxes, Core Recovery, Field Tests for Bearing Capacity evaluation, Test Procedure & Limitations

Module 2: **(10 Lectures)**

Bearing Capacity Analysis - Failure Modes, Terzaghi's Analysis, Specialization of Terzaghi's Equations, Skempton Values for Nc, Meyerhof's Analysis, I.S. Code Method of Bearing Capacity Evaluation, Effect of Water Table, Eccentricity of load, Safe Bearing Capacity and Allowable Bearing Pressure, Settlement Analysis: Immediate Settlement - Consolidation Settlement, Differential Settlement, Tolerable Settlement, Angular distortion

Module 3: **(10 Lectures)**

Foundations for Difficult Soils - Guidelines for Weak and Compressible Soils, Expansive soil, Parameters of Expansive Soils, Collapsible Soils and Corrosive Soils, Causes of Moisture changes in Soils, Effects of Swelling on Buildings, Preventative measures for Expansive Soils, Design of Foundation on Swelling Soils, Ground Improvement Methods: for general considerations, for Cohesive Soils, for Cohesionless Soils,

Shallow Foundations: Assumptions & Limitations of Rigid Design Analysis, Safe Bearing Pressure, Settlement of Footings, Design of isolated, Combined, Strap Footing (Rigid analysis), Raft Foundation (Elastic Analysis), I. S. Code of Practice for Design of Raft Foundation

Module 4: **(10 Lectures)**

Deep foundations: Pile Foundation: Classification, Pile Driving, Load Carrying Capacity of Piles, Single Pile Capacity, Dynamic Formulae, Static Formulae, Pile Load Tests, Penetration Tests, Negative skin Friction, Under Reamed Piles, Group Action of Piles,
Caissons Foundations: Box, Pneumatic, Open Caissons, Forces, Grip Length, Well Sinking, Practical Difficulties And Remedial Measures
Sheet Piles: Classification, Design of Cantilever Sheet Pile in Cohesionless and Cohesive soils. Design of Anchored Sheet Pile by Free Earth Support Method, Cellular Cofferdams: Types, Cell Fill Stability Considerations

Module 5: **(10 Lectures)**

Slope Stability: Different Definitions of Factors of Safety, Types of Slope Failures, Stability of an Infinite Slope of Cohesionless Soils, Stability Analysis of an Infinite Slope of Cohesive Soils, Stability of Finite Slopes- Slip Circle Method, Semi Graphical and Graphical Methods, Friction Circle Method, Stability Number: Concept and its use

Text Books

- Kasamalkar, B.J., "Foundation Engineering", Pittsburgh vintage Grand Prix
- Murthy V.N.S., "Soil Mechanics and Foundation Engineering", CRC Press 2002
- Arora K.R., "Soil Mechanics and Foundation Engineering", Standard publication 2009
- Punmia B. C., "Soil Mechanics And Foundation Engineering", Laxmi publication 16th 2017
- Nayak N.V., "Foundation Design Manual", DhanpatRai And Sons
- Brahma S.P., "Foundation Engineering", Tata McGraw-Hill 5th Edition
- Braja Das, "Principles of Geotechnical Engineering", Engage Learning 9th edition
- Bowles J.E., "Foundation analysis & Design", McGraw-Hill Higher Education 5th edition

References Books

- Teng W.C., "Foundation Design", Prentice-Hall Inc
- Tomlinson M.J., "Foundation Design & Construction", Prentice-Hall; 7th edition
- Lee, "Sheet Piles" Concrete Publication,1961
- Relevant Publications by Bureau of Indian Standards, New Delhi
- IS 6403:1981, IS 1904:1986, IS 4091:1979

Course Outcomes: On completion of the course, the students will be able to:

To predict soil behavior under the application of loads and come up with appropriate solutions to foundation design queries. Analyze the stability of slope by theoretical and graphical methods.
Analyze the results of in-situ tests and transform measurements and associated uncertainties into relevant design parameters. Synthesize the concepts of allowable stress design, appropriate factors of safety, margin of safety, and reliability.

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BTCVES603 Artificial Intelligence

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction **(08 Lectures)**

What Is AI? Thinking humanly: The cognitive modeling approach. Thinking rationally: The “laws of thought” approach, acting rationally: The rational agent approach. The Foundations of Artificial Intelligence, Mathematics, Economics, Neuroscience, Computer engineering, The History of Artificial Intelligence. AI becomes an industry (1980-- present). Agents and Environments, Good Behavior: The Concept of Rationality.

Module 2: Search Techniques **(06 Lectures)**

Problem-Solving Agents, Well-defined problems and solutions, Formulating problems, Real-world problems. Uninformed Search Strategies, Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search, Informed (Heuristic) Search Strategies, Greedy best-first search, A* search: Minimizing the total estimated solution cost, Heuristic Functions. The effect of heuristic accuracy on performance. Beyond Classical Search, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.

Module 3: Game Playing **(06 Lectures)**

Games, Optimal Decisions in Games, The minimax algorithm, Optimal decisions in multiplayer games, Alpha Beta Pruning, Move ordering, Imperfect Real-Time Decisions, Cutting off search, Forward pruning, Stochastic Games, Evaluation functions for games of chance, Partially Observable Games, Krieg spiel: Partially observable chess, Card games, State-of-the-Art Game Programs, Alternative Approaches.

Module 4: Logic and inference **(08 Lectures)**

Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, the Structure of Problems, Knowledge-Based Agents, the Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic. Forward Chaining, Backward Chaining, Definition of Classical Planning. Algorithms for Planning as State-Space Search, Planning Graph

Module 5: Learning **(08 Lectures)**

Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Model selection: Complexity versus goodness of fit, From error rates to loss, Regularization, The Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Ensemble Learning, Online Learning, Practical Machine Learning, A Logical Formulation of Learning**.**

Text Books:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach. III Edition
2. E. Rich, K. Knight& S. B. Nair - Artificial Intelligence, 3/e, McGraw Hill.

References:

1. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hal of India
2. G. Luger, “Artificial Intelligence: Structures and Strategies for complex problem Solving”, Fourth Edition, Pearson Education, 2002.
3. N.P. Padhy “Artificial Intelligence and Intelligent Systems”, Oxford UniversityPress-2015.
4. T. L. Lee, H. M. Lin, and Y. P. Lu, “Assessment of highway slope failure using neural networks,” Journal of Zhejiang University.
5. B. K. R. Prasad, H. Eskandari, and B. V. V. Reddy, “Prediction of compressive strength of SCC and HPC with high volume fly ash using ANN,” Construction and Building Materials.
6. S. K. Das, P. Samui, and A. K. Sabat, “Application of artificial intelligence to maximum dry density and unconfined compressive strength of cement stabilized soil,” Geotechnical and Geological Engineering.
7. T. Dessalegne and J. W. Nicklow, “Artificial life algorithm for management of multi-reservoir river systems,” Water Resources Management.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify the AI based problems
CO2: Apply techniques to solve the AI problems.
CO3: Define learning and explain various logic inferences.
CO4: Discuss different learning techniques

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BTCVC604 Transportation Engineering

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction **(6 Lectures)**
Importance of various modes of transportation, Highway Engineering, Road Classification, Developments in RoadConstruction, Highway Planning, Alignment and Surveys

Module 2: **(6 Lectures)**
Geometric Design- Cross section elements, Sight distances, Horizontal alignment, Vertical alignment, Intersections, Construction of Pavements, Construction and Maintenance of Drainage, Road Arboriculture

Module 3: **(8 Lectures)**
Highway Materials: Soil – relevant properties, Various tests, Aggregates – strength, hardness, toughness, soundness, durability, shape, specific gravity, water absorption, Bituminous materials – Bitumen, Tar, and Asphalt – various properties, Design of Bituminous paving mixes-Marshall stability test

Module 4: Traffic Engineering **(8 Lectures)**
Traffic Characteristics, Speed, Journey Time and Delays, Vehicle Volume Counts, Origin and Destination Studies, Analysis and Interpretation of Survey Data, Traffic Operations, Design of Signals and Rotary intersections, Parking Space Design,Highway Lighting, Planning and Administration, Road Markings, Signs
Road Accidents and Safety: Classification, Causes, Mitigation and Control Measures, Aspects of Safety in Usage of Roads, Type and Design of anti-crash barriers, Introduction to Intelligent Transport Systems (ITS).

Module 5: Pavement Design **(8 Lectures)**
Basic Principles, Methods for different Types of Pavements, Design of flexible pavement using IRC: 37- 2012, Design of rigid pavement using IRC: 58-2011
Other modes of Transport
Introduction to Railways, Airways, Waterways, Pipeline Transportation, Classification, Requirements, Comparative Studies

Text Books

- Khanna and Justo, “Highway Engineering”, Nemchand& Bros., Roorkee
- Khanna S.K., “Highway Engineering”,
- Arora N. L., “Transportation Engineering”
- Bindra and Arora, “Highway Engineering”, Standard Publishers
- Vazirani V.N. and Chandola S.P., “Transportation Engineering”, VolIKhanna Publishers, N. Delhi
- Vazirani V.N. and Chandola S.P., “Transportation Engineering”, Vol II Khanna Publishers, N. Delhi ISBN NO: N/A
- Shahani P.B, “Road Techniques” Khanna Publishers, N. Delhi ISBN NO: 978-81-7409-197-1 PRICE 149/-
- Kadiyali L.R, “Traffic Engineering and Transport Planning”, Khanna Publishers, N. Delhi, ISBN NO:978-81-7409-220-X

Reference Books

- Garber, N.J. and Hoel, L.A., “Traffic and Highway Engineering”, West Publishing Company, New York
- Jones, J.H., “Geometric Design of Modern Highways’, E & FN SPON Ltd., London.
- Khistry, C.J., “Transportation Engineering – An Introduction’, Prentice Hall of India Ltd.
- Agor R., “Surface Transportation (Railways and Highways)”,Khanna Publishers, N. Delhi ISBN NO: 978-81-7409-273-1

CO: On completion of the course, the students will be able to:

Comprehend various types of transportation systems and their history of the development Comprehend to various types of pavements
Design the pavements by considering various aspects associated with traffic safety measures.

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BTCVPE 605A Industrial Waste Treatment

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction **(8 Lectures)**

Water use in industry, Industrial water quality requirements, Deterioration of water quality, Classification and characterization of Industrial wastewater, Standards of Disposal, Monitoring of wastewater flow, Quality and quantity variations in waste discharge. Liquid wastes from industries – their volumes and characteristics, Effect of disposal into natural water courses, Municipal sewers and on land, River standards and effluent standards. Designated Water Quality Standards, Type of samples-Grab and Composite.

Module 2: Treatment objectives and strategies **(6 Lectures)**

Waste Volume reduction, Strength reduction techniques, Segregation, proportioning, Waste Neutralization methods for acidic and alkaline waste, Equalization tank- online and offline, design problem. Recycle, reuse and byproduct recovery, Concept of Zero liquid Discharge (ZLD)

Treatment objectives and strategies, Treatment techniques for removal of specific pollutants in industrial wastewaters, e.g., oil and grease, cyanide, fluoride, calcium, magnesium, toxic organics, heavy metals, radioactivity.

Module 3: Manufacturing processes for industries **(6 Lectures)**

Manufacturing process flow sheets along with sources and characteristics of wastewater for various industries sugar, Distillery, Textile, Tannery, Paper and pulp mill, dairy, Fertilizer, steel mill, power plant etc.

Development of Treatment flowsheets based on characteristics of industrial wastewater. Industrial wastewater Treatment alternatives (Treatment Flowsheets) for above listed industries

Dewatering and disposal of sludge – floatation, vacuum filtration, centrifugation, filter press and membrane filters.

Module 4: Effluent Treatment Plants **(8 Lectures)**

Water pollution control act and Environmental Protection act - organizational set up of central and state boards for water pollution control, other important provisions. Classification of river on water use, minimal national standards, socio-economic aspects of water pollution control. Modern Trends in Environmental Engineering, Cleaner Production Technologies, Environmental Bio-Technology, Bioremediation.

Common Effluent Treatment Plants (CETPs): Concept, Need, Objectives, Methodology, grouping of industries, Location, Design, Operation and Maintenance Problems and Economical aspects.

Module 5: Treatability and environmental aspects **(8 Lectures)**

Treatability index, Population equivalent, Treatability aspects of raw industrial wastewater with domestic sewage, partially treated industrial wastewater with domestic sewage, Completely treated industrial wastewater with domestic sewage. Stream and effluent standards, Introduction to Water Quality Index (WQI) - simple problems.

Introduction to environmental impact assessment and environmental audit.

ISO 14000- introduction, how it is helpful to industries. Importance of Environmental management plan and environmental monitoring plan, Consent to operate and consent to establish

Text Books

- Metcalf and Eddy,1995,Wastewater Engineering - Collection, Treatment, Disposal and Reuse, McGraw Hill Pub. Co.,.
- Nelson Leonard Nemerow,2007 Industrial Waste Treatment, Butterworth-Heinemann,
- Nelson Nemerow. Theories and Practices of Industrial waste treatment
- M. N. Rao & Datta. Waste water treatment:
- IS Standard guide for treatment and disposal of various industries.
- Industrial Waste Treatment: Contemporary Practice and Vision for the Future
- Woodard, F., Industrial Waste Treatment Handbook, Butterworth-Heinemann, Woodard & Curran

- J.D. Edwards, Industrial Wastewater Treatment CRC Press
- Government of India Publication, "Water Supply and Treatment Manual"
- Publications by renowned organizations such as WHO, NEERI, MERI, MPCB, CWPRS, etc.
- Hammer M.J., "Water and Waste Water Technology", PHI Private Limited
- Peavy and Rowe, Environmental Engineering , TMH.
- Numersorn, N.L., Liquid Waste from Industry – Theories, Practice and Treatment, Addison-Wesley,

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify and analyze the characteristics of industrial wastewater

CO2: Describe pollution effects of disposal of industrial effluent.

CO3: Identify and design treatment options for industrial handling industrial liquid waste

CO4: Formulate environmental management plan

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BTCVPE 605 B. Managerial Techniques

Teaching Scheme:(3 Lectures) hours/week

Course Contents

Module 1: Introduction to Managerial Techniques **(Lectures 06)**

Introduction, Evolution of Managerial techniques, Managerial aspects, management characteristics, Essentials of Managerial Techniques

Module 2: Process Control Techniques in Management **(Lectures 08)**

Quality- Improvement Programs, Starting a Quality Improvement Program, Experimental Designs for Quality improvement, Quality Control - Statistical process control: concepts of stable industrial processes, Systematic variation, random variation, Control Charts for Measurements, Control Charts for Attributes, Tolerance Limits, Acceptance Sampling

Module 3: Method Study and Work Study and Motion Study **(Lectures 08)**

Method Study: Analysis of Operations, job work, systems involving man and machines. Schematic methods, charts and other aids for analysis
Work Study: Method of work measurement, stopwatch study; PMTS; work sampling, setting of time standards.
Motion Study: Principles of motion economy and work center design

Module 4: Technology based Managerial Techniques **(Lectures 08)**

Introduction, Need of Technological advancements in management, MIS, Resources Management using softwares, Planning softwares, BIM, MSP, Primavera, Advantages, Applications

Module 5: Introduction to Six Sigma Technique **(Lectures 06)**

Introduction, Concept, Tools, DMAIC, DMADV, Justifying six sigma, Readiness of six sigma, Advantages, Applications

Text Books:

- Jain P. L. (2001) "Quality Control and Total Quality Management", Mc-Graw Hill Book Co.,New Delhi
- Breu G.(2002) "Six Sigma for Managers", Mc-Graw Hill Book Co., New Delhi
- Arora P. N., Arora S., Arora S. Arora A.(2007) "Comprehensive Statistical methods", S Chand Publishing, New Delhi
- Jhamb L. C. (2000) "Work Study & Ergonomics" Everest Publishing House, Pune

References:
- IS: 15883 (Part I): 2008 "Construction Project Management" BIS, New Delhi 2008
- Munro R. A. and Ramu G. (2012) "The certified six sigma green belt Handbook" American Society of Quality,

Course Outcomes: On completion of the course, the students will be able to:

CO1: Inculcate various managerial techniques in practices
CO2: Analyze process control tools and techniques to improve the outcome
CO3: Adopt modern technological advancements to suit the project characteristics, at large.

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BTCVPE605 C Open Channel Flow

Teaching Scheme: 3 Hours /week

Course Contents

Module 1: Open Channel Flow **(08 Lectures)**
Introduction, difference between pipe flow and open channel flow, types of open channels, types of flows in open channel, geometric elements, velocity distribution, measurement of velocity-(pitot lube, current meter), Discharge through open channel.

Module 2: Steady and Uniform flow (**08 Lectures)**
Chezy's & Manning's formula, Roughosity coefficient, uniform flow computations, hydraulically efficient section considerations for rectangular, triangular, trapezoidal, circular sections

Module 3: Specific energy (**06 Lectures)**
Specific energy: definition & diagram, concept of critical, sub-critical, super-critical flow, specific force, specific discharge derivation of relationships and numerical computations

Module 4: **(08 Lectures)**
Gradually varied flow
Definition, classification of channel Slopes, Back water curve and its length, Afflux, dynamic equation of G.V.F. (Assumption and derivation), classification of G.V.F. profiles-examples, direct step method of computation of G.V.F. profiles
Rapidly varied flow
Definition, examples, hydraulic jump- phenomenon, relation of conjugate depths, loss of energy, parameters, uses, types of hydraulic jump

Module 5: weir & spillway **(06 Lectures)**
Introduction, Classification, Discharge over various notches and weirs (Rectangular, Triangular, Stepped, Broad-Crested, Narrow crested), Velocity of Approach, Cipolletti Weir, calibration of weir, time of emptying tank with weir, profile of ogee spillway, flow below gates, Most economical sections in channels: Rectangular, Trapezoidal, Circular.

Text Books:
- Modi P. N. and Seth S. M.(2017) "Fluid Mechanics – Hydraulic & Hyd. Mechanics" Standard Book HouseN. Delhi
- Bansal R.K. (2017) "Fluid Mechanics", Laxmi Publications, N. Delhi
- Garde R. J.(2011) "Fluid Mechanics through Problems", New Age Publications, Hyderabad
- Jain A. K. (2003) "Fluid Mechanics", Khanna Publications, 2003, Delhi
- Rangaraju K. G. (2001) "Open Channel flow", Tata McGraw-Hill Pub. Co., Delhi
- Subramanian K. (2015) "Fluid Mechanics through Problems" Tata McGraw-Hill Pub. Co., Delhi

Reference Books
- Streeter V. (2017) "Fluid Mechanics" McGraw-Hill International Book Co., 3rd edition, Auckland
- Chaw V. T. (2009) "Flow in Open Channel", McGraw-Hill International Book Co., Auckland

Course Outcomes: On completion of the course, the students will be able to:
1. Understand phenomena of hydraulic jump.
2. Compute Discharge through various open channel sections.
3. Discuss different applications of gradually varied flow profiles.

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BTCVPE 605D Water Power Engineering

Teaching Schemes: (Lectures: 3) Hours/Week

Course Contents

Module 1 **(8 Lectures)**

Introduction, Sources of Energy, Types of Power Plants, Choice of Type of Generation, Components of Water Project, Types of Hydro Power Schemes, General Layouts, Estimation of Hydro Power, Nature of Demand: Load Curve, Load Duration Curves, Load Factor, Firm Power Secondary Power

Module 2 **(8 Lectures)**

Intake, Types, Hydraulics of Intake, Trash Rack Transition, Conduits: Types, Economic Section, Power Canals, Pen-stock Types, Hydraulic Design, Anchor Blocks

Tunnels: Classification, Location, Hydraulic Design, Tunnel Linings

Surge Tank: Functions, Behavior, Location, Types of Surge Tanks, Basic Design Criteria of Simple Surge Tank, Forebay

Module 3 **(6 Lectures)**

General Arrangements of Power Station, Power House, Sub-structure and super structure Under Ground Power Station: Necessity, Types, Development and Economics

Module 4 **(6 Lectures)**

Turbines: Classification, Characteristics of Different Types, Choice of Specific Type, Turbine Setting and Cavitation, Tail Race: Functions, Types, Channel and Tunnel Draft Tubes

Module 5 **(6 Lectures)**

Pumped Storage Plants, Purpose, General Layout, Types, Typical Arrangements of the Upper Reservoirs, Economics of Pumped Storage Plants**,** Tidal Power Stations: Necessity, Advantages, Classification, Limitations

Text Books

- Dandekar and Sharma, “Water Power Engineering”, Vikas Pub. House Pvt. Ltd.
- Bhattacharya P. K., “Water Power Engineering”, Khanna Publications, New Delhi
- Deshmukh M. M. “Water Power Engineering”, Dhanapatrai and Sons N. Delhi

References

- Creager and Justin, “Hydro – Electric Hand Book”
- Brown G., “Hydro-electric Engineering Practice”, Vol. I to III
- Mosonvi, “Water Power Development”

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify potential energy sources and adapt as per the requirement

CO2: inculcate basics of electricity generation and power plants

CO3: propose suitable energy source for running a project optimistically.

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BTCVPE605 E. Ground Improvement Techniques

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(8 Lectures)**

Dewatering: Introduction – Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage – Ground Water lowering by well points, deep wells, vacuum and electroosmotic methods. Stabilization by thermal and freezing techniques - Applications.

Module 2: **(8 Lectures)**

Compaction and Sand Drains: Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains etc. – Theories of sand drain – design and relative merits of various methods – Case studies.

Module 3: **(6 Lectures)**

Stone Column, Lime Piles and Soil Nailing: Stone column, lime piles – Functions – Methods of installation– design, estimation of load carrying capacity and settlement. Root piles and soil nailing – methods of installation – Design and Applications - Soil liquefaction mitigation methods - case studies.

Module 4 **(6 Lectures)**

Earth Reinforcement: Earth reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber-based Geotextiles and their applications. Filtration, drainage, separation, erosion control – case studies.

Module 5 **(8 Lectures)**

Grouting: Grouting – Types of grout – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods – jet grouting – grout monitoring – Electro – Chemical stabilization – Stabilization with cement, lime - Stabilization of expansive clays – case studies.

Text Books

- Pappala, A.J., Huang,J., Han, J., and Hoyos, L.R., "Ground Improvement and Geosynthetics; Geotechnical special publication No.207, Geo Institute, ASCE, 2010
- Cox, B.R., and Grifiths S.C., "Practical Recommendation for Evaluation and mitigation of Soil Liquefaction" in Arkansas, (Project Report), 2010.
- Day, R.W., "Foundation Engineering Handbook, McGraw – Hill Companies, Inc. 2006.
- Rowe, R.K., "Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.
- Das, B.M., "Principles of Foundation Engineering, Fourth Edition, PWS Publishing, 1999.

References Books

- Moseley, M.P., "Ground Treatment, Blackie Academic and Professionals, 1998.
- Koerner, R.M., "Designing with Geosynthetics, Third Edition, Prentice Hall 1997.
- Hehn, R.W., "Practical Guide to Grouting of Underground Structures, ASCE, 1996.
- Jewell, R.A., "Soil Reinforcement with Geotextiles, CIRIA, London, 1996.
- Koerner, R.M. and Welsh, J.P., "Construction and Geotechnical Engineering using Synthetic Fabrics, John Wiley, 1990.

Course Outcomes: On completion of the course, the students will be able to:

CO1: To identify and evaluate the deficiencies if any in the deposits of the given project area.

CO2: Capable of providing alternative methods to improve its quality so that the structures built on it will be stable and serve the intended purpose.

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BTCVPE 605 F. Structural Audit

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(08 Lectures)**
Introduction to Structural Audit, Objectives, Bye-laws, Importance, Various Stages involved, Visual inspection: scope, coverage, limitations, Factors to be keenly observed. Aspects of audit of Masonry buildings, RC frame buildings, Steel Structures.

Module 2: **(06 Lectures)**
Causes and types of deterioration in Structures: Permeability of concrete, capillary porosity, air voids, Micro cracks and macro cracks, corrosion of reinforcing bars, sulphate attack, alkali silica reaction.
Causes of deterioration in Steel Structures: corrosion, Uniform deterioration, pitting, crevice, galvanic, laminar, Erosion, cavitations, fretting, Exfoliation, Stress, causes of defects in connection

Module 3: **(08 Lectures)**
Elementary aspects of Non-Destructive Testing, Concrete Strength Assessment: Rebound hammer, Ultrasonic Pulse velocity, Penetration resistance, Pull out test, Chemical test: Carbonation test, Chloride test, Corrosion potential assessment, Fire damage assessment: Differential thermal analysis, X ray diffraction, Structural Integrity and soundness assessment: Radiography, Impact echo test, dynamic testing of structure, Interpretation and evaluation of test results.

Module 4 **(08 Lectures)**
Strength Evaluation of Existing Structures, Reserve strength, identification of critical sections, structural system and its validation, evaluation of damage in RC structures

Module 5: **(06 Lectures)**
Approach to conduct Structural Audits Guidelines of Statutory Bodies, Legal aspects, Responsibility of calling Structural Audit, Scope of Investigation.
Structural Audit Report, Study of sample Structural audit report for up-gradation of existing building, Audit for continuation of usage of old Buildings, Audit for Buildings damaged due to Earthquakes, Fire,

References

- Indian Standard codes related with nondestructive testing, Government Resolutions related to Structural Audits (BMC Act, etc.), Field manuals and reports by Expert Consultants.

Outcomes: Upon completion of the course the students will be able to:

- Gain the knowledge of Bye laws, procedure of Structural audit and study the typical problems in structures.
- Aware of causes and types of deterioration in structures.
- Develop skills for use of various Nondestructive tests required during auditing of structures.
- Strength evaluation of existing structures.
- Acquire knowledge of legal procedure to conduct structural audits.
- Prepare a Structural audit report.

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BTCVPE 605 G. Intelligent Transport Systems

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction **(06 Lectures)**

Definition of intelligent transport system (ITS), History of ITS, Objectives, Benefits, data collection techniques: Detectors, automatic vehicle location, automatic vehicle identification, geographic information system.

Module 2: Telecommunication in ITS **(08 Lectures)**

Importance of telecommunication, information Management, Traffic management centers, vehicle roadside communication, vehicle positioning system.

Module 3: Functional areas **(08 Lectures)**

Traffic management systems, traveler information system, commercial vehicle operations, vehicle control system, public transportation system, rural transportation system.

Module 4: User needs and services **(06 Lectures)**

Travel and traffic management, Public transportation management, electronic payment, commercial vehicle operations, emergency management, advanced vehicle safety systems, information management.

Module 5: Automated highway systems **(06 Lectures)**

Vehicles in plantoons, integration of automated highway systems, implementations in developed countries and developing countries.

Text Books

Sarkar, P. K. and Jain, A.K., Intelligent Transportation systems. PHI learning pvt.ltd.
Chen P. K., & Miles, J., Recommendations for world road Association (PIARC). Its Hand book

References

1. M A Chowdhary and A Sadek. Fundamentals of Intelligent Transportation systems planning. Artech House Inc., US, 2003.
2. Bob Williams. Intelligent transportation systems standards. Artech House, London, 2008

Outcomes: Upon completion of the course the students will be able to:

- Gain the knowledge Intelligent transport components
- Understand functional areas of ITS
- Management of ITS and correlated systems

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BTCVPE605 H. Plastic Analysis of Structures

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(8 Lectures)**

Plasticity in ductile materials, stress-strain for mild steel, elasto-plastic behavior of beam in flexure, shape factor for different cross sections, yield zones, concept of plastic hinge

Module 2: **(8 Lectures)**

Collapse loads of determinate and indeterminate structures such as beams and rectangular portal frames, statical and kinematical methods, mechanisms. Bending moment diagram at collapse

Module 3: **(6 Lectures)**

Philosophy of Limit State design, requirement of steel for design, Limit State of Strength and Serviceability, partial safety factors, design of laterally supported beams, shear resistance

Module 4: **(8 Lectures)**

Secondary design considerations, design of beams with high shear, interaction of bending and shear, interaction of bending and axial force

Module 5: **(6 Lectures)**

Design of portal frames, design of corner connection with and without haunches, Consideration of deformations, calculation of deflections for plastically deformed structures

Text Books:

- Bureau of Indian Standards, “Handbook for Structural Engineers: Application of Plastic Theory in Design of Steel Structures SP: 6 (6)”.
- Bureau of Indian Standards, “IS: 800 Code of Practice for General Construction in Steel”
- Arya A.S. and Ajmani J.L., “Design of Steel Structures”, Nemchand& Bros., Roorkee
- Ramchandra, “Design of Steel Structures Vol – II”, Standard Book House, Delhi
- Neal B.G., “Plastic Method of Structural Analysis”, Chapman & Hall
- Beedle L.S., “Plastic Design of Steel Frames”, John Wiley & Sons

References:

- Bureau of Indian Standards, “Handbook for Structural Engineers SP 6”
- INSDAG Kolkata, “Teaching Resource for Structural Steel Design”
- “Steel Designers Manual” ELBS

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand modes of structural collapse

CO2: Perform the plastic analysis and design of various determinant and in-determinant structures.

CO3: Adapt plastic theory of design for various structures

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BTCVPE605 I. Numerical Methods in Civil Engineering

Teaching Scheme :(3 Lectures) hours/week

Course Contents

Module 1 **(Lectures 8)**

Basis of Computations, Matrix Operations on Computer, Multiplication and Inversion, Solution of Simultaneous Equations, Gauss Elimination Method, Cholesky Decomposition method, Gauss Jordan and Gauss Sceidal Methods

Module 2 **(Lectures 8)**

Roots of Equation, Trial and Error, Bisection, Secant Iteration, Newton Rapson Method, Solution of Ordinary Differential Equation, Euler's Method, Modified Euler's Method and Runga Kutta Methods.

Module 3 **(Lectures 08)**

Interpolation with Newton's Divided Differences, Lagrange's Polynomial, Finite Difference Method, Central, Forward and Backward Differences, Least Square Polynomial Approximations Application in Deflection of Determinate Beams, Buckling Load of Long Columns

Module 4 **(Lectures 04)**

Numerical Integration: Trapezoidal Rule, Simpon's Rules, Gauss Quadrature Rules

Module 5 **(Lectures 08)**

Statistical Analysis of Experimental Data, Mean, Median, Mode, Deviation, Measures of Dispersion, Least Square Method, Regression Analysis: Linear, Parabolic, Curve Fitting

Text Books

- Balaguruswami E., "Numerical Methods", Tata Mc-Graw Hill
- Scheid F, "Numerical Analysis (Schaum's series)", Tata Mc-Graw Hill
- Chapra. S. C. and Canale R. P., "Numerical Methods for Engineers", by, Tata Mc-Graw Hill
- Shantha Kumar M , "Computer Based Numerical Analysis", Khanna Publication
- Grewal B.S. and Grewal J.S., "Numerical Methods in Engineering and Science", Khanna Publication, N. Delhi
- Sastry, S.S., "Introductory Methods of Numerical Analysis", Printice Hall of India, New Delhi

Reference Books

- Jain, Aryengon, "Numerical Methods for Scientific and Engineering Applications", Wiley Eastern Publication
- Numerical Recipe , Oxford Publishing
- Manuals for the Commercial Computer Programmes

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BTCVPE605 J. Engineering Management

Teaching Scheme: 3 hours/week

Course Contents

Module 1: Evolution of Management Thought **(Lectures 06)**

Scientific, human behavior, system approach, introduction to elements of systems – input, output, process restriction, feedback, contingency approach, contributions by Taylor, Frank and Lillion, Gilbreth, Henry Fayol, Elton Mayo, McGregor (theory X and theory Y), H. L. Gantt, Maslo

Module 2: Functions of Management **(Lectures 06)**

Planning – nature and purpose of planning, strategies and policies, management by objectives, formal and informal organization, centralization, decentralization, line, line and staff, functional organization, principles of site layout, leading and directing, controlling and coordination (introduction only), communication process, motivation

Module 3: Decision Making **(Lectures 06)**

Importance of decision making, steps in decision making, analysis of decision, decision under certainty, uncertainty and decision under risk, criterion of optimism and regret, sensitivity of criteria and decision under conflict, expected monitory value, decision tree, theory of games (dominance pure and mixed strategy

Module 4: Operations Research & Simulation Studies **(Lectures 12)**

Linear programming, simple l-p model, simplex method - duality, sensitivity analysis, application of linear programming in transportation and assignment models

Simulation Studies

Monte-Carlo simulation, queuing or waiting line theory (simple problems), dynamic programming.

Module 5: Material management **(Lectures 06)**

Introduction to emerging optimization techniques Material management – purchasing principles, stores, coding system function, responsibilities, record and accounting. Inventory control – an introduction, inventory cost, EOQ analysis, ABC analysis, safety stocks

Text Books:

- Deshpande S. H., 1976, "Operation Research", S Chand Delhi.
- Deshpande A. S., "A Text book of Management"
- Gopal Krishnan, 2015, "Material Management", Sudeshan.
- Taha, 1971, "Operation Research", Pearson.
- Banga and Sharma, 2017, "Engineering Management", Khanna publishing.

References:

- Stoner, 2018, "Engineering Management", Pearson education.
- Davar, 1980, "Principles of Management", Progressive corporation Pvt. Limited.
- Koontz, Dounell and Weigrick, 2015, "Essentials of Management", McGraw Hill publishers.
- Kast and Rosinweig, 1973, "Management and Organization", Tata McGraw Hill Publication.
- Wagner, "Operation Research", Wikey Easter Ltd., New Delhi
- Zhamb L.C.,1999, "Quantitative Techniques in Management", Vol. I,
- Miller and Stars, 1960, "Executive Decisions & Operation Research", Prentice Hall of India

Course Outcomes: On completion of the course, the students will be able to:

CO1: Demonstrate the nuances of management functions.
CO2: Analyze the framework of a business organization.
CO3: Adopt an empirical approach toward business situations.
CO4: Apply various Management techniques.

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BTCVOE 606 A. Environmental Impact Assessment

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction **(8 Lectures)**

The Need for EIA, Indian Policies Requiring EIA, The EIA Cycle and Procedures, Screening, Scoping, Baseline Data, Impact Prediction, Assessment of Alternatives, Delineation of Mitigation Measure and EIA Report, Components of EIA, Roles in the EIA Process. Government of India Ministry of Environment and Forest Notification (2000), List of projects requiring Environmental clearance, Application form, Composition of Expert Committee, Ecological sensitive places, International agreements.

Module 2: Identifying the Key Issues **(6 Lectures)**

Key Elements of an Initial Project Description and Scoping, Project Location(s), Land Use Impacts, Consideration of Alternatives, Process selection - Construction Phase, Input Requirements, Wastes and Emissions, Air Emissions, Liquid Effluents, Solid Wastes, Risks to Environment and Human, Health, Socio-Economic Impacts, Ecological Impacts, Global Environmental Issues

Module 3: EIA Methodologies **(6 Lectures)**

Criteria for the selection of EIA methodology, impact identification, impact measurement, impact interpretation, Methods-Adhoc methods, Checklists methods, Matrices methods, Networks methods, Overlays methods,

Reviewing the EIA Report:

Scope, Baseline Conditions, Site and Process alternatives, Public hearing, Construction Stage Impacts, Project Resource Requirements and Related Impacts, Prediction of Environmental Media Quality, Socio-economic Impacts, Ecological Impacts, Occupational Health Impact, Major Hazard/ Risk Assessment, Impact on Transport System

Module 4: Review of EMP and Monitoring **(8 Lectures)**

Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, What should be monitored? Monitoring Methods, Who should monitor? Pre-Appraisal and Appraisal.

Module 5: Case Studies **(6 Lectures)**

Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Highway project, Sewage treatment plant, Municipal Solid waste processing plant, Tannery industry.

Text Books

- Wathern. P Environmental Impact Assessment- Theory and Practice, Routledge Publishers, London, 2004.
- Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996.
- Anjaneyulu. Y and Manickam. V., Environmental Impact Assessment Methodologies, B.S. Publications, Hyderabad, 2007.
- Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
- Barthwal, R. R., Environmental Impact Assessment, New Age International Publishers, 2002

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify the environmental attributes to be considered for the EIA study

CO2: Formulate objectives of the EIA studies

CO3: Identify the methodology to prepare rapid EIA

CO4: Prepare EIA reports and environmental management plans

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BTCVOE606 B Basic Human Rights

Teaching Scheme:(3 Lectures) hours/week

Course Contents

Module 1: Basic Concepts **(Lectures 06)**

Individual, group, civil society, state, equality, justice. Human Values, Human rights & Human Duties: Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rightsof working & exploited people

Module 2: Fundamental Rights and Economic Program **(Lectures 06)**

Society, religion, culture, and their inter-relationship. Impact of social structure on human behavior, Social Structure and Social Problems: Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labour.

Module 3: Workers and Human Rights **(Lectures 08)**

Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy.

NGOs and Human Rights in India

Land, Water, Forest issues.

Module 4: Human Rights in Indian Constitution and Law **(Lectures 08)**

i) The Constitution of India: Preamble; ii) Fundamental rights; iii) Directive principles of state policy; iv) Fundamental duties; v)Some other provisions

Module 5: UDHR and Indian Constitution **(Lectures 08)**

Universal declaration of human rights and provisions of India; Constitution and law; National human rights commission and state human rights commission.

References

1) Shastry, T. S. N., "India and Human Rights: Reflections", Concept Publishing Company India (P Ltd.), 2005.

2) C. J. Nirmal, "Human Rights in India: Historical, Social and Political Perspectives (Law in India)", Oxford India.

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BTCVOE606 C. Business Communication & Presentation Skills

Teaching Scheme: (3 Lectures) hours / Week

Course Contents

Module 1: Language for Technical Purpose and Presentation Tools **(06 Lectures)**

Technical vocabulary, Sentence structures, Computer Aids, Graphical presentations
Drafting Letters, e-Mails, Memos, Notices, Circulars, Schedules.

Module 2: Project Proposals and Project Reports **(08 Lectures)**

Abstract, Aims, Background & significance, Design & methods, writing a sample proposal,
Project Report: Types of reports, planning a report, Collection & organization of information, Structure & style, Proof reading etc.

Module 3: Leadership Skill and Team Building, Working **(08 Lectures)**

Leadership Skills**:** Leadership quality and styles, Emotional intelligence, Diplomacy and Tact and effective communication, Case studies. Need of team, Effective teams, Group development

Module 4: Business Meetings **(08 Lectures)**

Understanding role of meetings, planning meetings, developing meeting agendas, scheduling meetings, Taking notes and publishing minutes

Module 5: Presentation Skills **(06 Lectures)**

Use of presentation tools, Presentation, nonverbal techniques, handling questions

References:

- Hariharan S. (2010)"Soft Skills" MJP Publishers, Chennai
- Seely S. (2009)"Oxford Guide to Effective Writing and Speaking" Oxford University Press, UK
- Huckin T. N. and Olsen L. A."Technical Writing and Professional Communication for Nonnative Speakers of English"Tata McGraw Hills, UK
- Masters A. & Harold R. W. (2011) Personal Development for Life & Work, Learning India Private Limited.

Course Outcomes: On completion of the course, the students will be able to:

- CO1: Inculcate basics of business communication skills & relevant tools.
- CO2: Understand business SOPs and essentials of the same.
- CO3: Adapt modern skills regarding communication, presentation & team working

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BTCVOE606 D. Composite Materials

Teaching Scheme :(3 Lectures) hours/week

Course Contents

Module1 Introduction: (8Lectures)

Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Polymer Matrix (Thermosets and Thermoplastics), Metal matrix, Ceramic matrix, Carbon Matrix, Glass Matrix etc.

Module2 Types of Reinforcements/Fibers (6Lectures)

Role and Selection or reinforcement materials, Types of fibres, Glass fibers, Carbon fibers, Aramid fibers , Metal fibers, Alumina fibers, Boron Fibers, Silicon carbide fibers, Quartz and Silica fibers, Multiphase fibers, Whiskers, Flakes etc., Mechanical properties of fibres. Material properties that can be improved by forming a composite material and its engineering potential

Module3 Various types of composites (8 Lectures)

Classification based on Matrix Material: Organic Matrix composites, Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC),

Ceramic matrix composites (CMC); Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites

Module 4 Fabrication methods (6Lectures)

Processing of Composite Materials: Overall considerations, Autoclave curing, Other Manufacturing Processes like filament welding, compression molding, resin-transplant method, pltrusion, pre-peg layer, Fiber-only performs, Combined Fiber-Matrix performs, Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films

Module 5 Testing of Composites (8Lectures)

Mechanical testing of composites, tensile testing, Compressive testing, Intra-laminar shear testing, Inter-laminar shear testing, Fracture testing etc

Text Books

- ASM hand book, Materials characterization, Vol. 10,
- G. Dieter, Mechanical Metallurgy, Mc-Graw Hill
- R.F. Speyer Thermal Analysis of Materials, Marcel Decker
- A.K Bhargava Engineering Materials: Polymers, Ceramics and Composites Prentice Hall India

Reference Books:

- Jones, R.M., (2015) “Mechanics of Composite Materials” McGraw Hill Co., New Delhi
- Whitney, Daniel I. M. and Pipes R. B. (1984)“Experimental Mechanics of Fibre Reinforced Composite Materials” Prentice Hall, New Jersey
- Hyer, M.W. (1998)“Stress Analysis of Fibre Reinforced Composite Materials” Mc Graw Hill Co., New Delhi
- Herakovich C. T. (1998)“Mechanics of Fibrous Composites” John Wiley Sons Inc., N. Delhi

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand fundamental knowledge in mechanical analysis
CO2: Understand design of structures made of composite materials.
CO3: Propose suitable materials in relation with the project

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BTCVOE606 E. Experimental Stress Analysis

Teaching Scheme: 3 Hours /week

Course Contents

Module 1: **(6 Lectures)**

Introduction to Theory of Elasticity, Assumptions made in strength of materials and theory of Elasticity, Necessary and sufficient conditions for analyzing a structure,

Module 2: **(8 Lectures)**

State of stress at a point, Specification of stress at a point-Determination of Normal thrust and Shear stress, Problems on specification of stress at a point.
Concept of Orthogonal Transformation of axes and Problems, Determination of Stress invariants, Determination of Principal Stresses and Planes, Determination of Maximum shear Stresses and their corresponding plane systems, Tresca's criteria.

Module 3: **(6 Lectures)**

Derivation of Equilibrium conditions in three dimensions, Concept of Strain at a point, Determination of Normal and Shear Strain, Generalized Hooke's Law and problems on interrelationship between stress and Strain in three dimensions.

Module 4: **(8Lectures)**

Formulation of a stress analysis problem using the necessary and sufficient conditions in three dimensions and modifying the same to identify the unknowns in plane cases, Derivation of Airy's Stress function using the boundary conditions, equilibrium equations, compatibility conditions.

Module 5: **(8 Lectures)**

Solution to stress analysis problems, Torsion of circular shafts, Strain Measurement- Types of Strain gauges, Characteristics of ideal strain gauges, gauge factor, Strain gauge Rosettes, Introduction to two dimensional photo elasticity, Stress-Optic law.

References:

- Timoshenko S. P. and Goodier J. N. (2010) Theory of Elasticity, 3rd Ed., McGraw Hill**.,** N. Delhi
- NPTEL Course on Experimental Stress Analysis, https://nptel.ac.in/courses/112/106/112106068/
- Swayam Course on Experimental Stress Analysis by Prof. K. Ramesh, IIT Madras, https://swayam.gov.in/nd1_noc20_me02/preview

Course Outcomes: On completion of the course, the students will be able to

1. Apply principles of elasticity theory to determine stresses and strains.
2. Apply theory of elasticity and formulate plane stress and plane strain problems.
3. Formulate the stress analysis problems using elasticity theory.
4. Apply experimental techniques to solve field problems.

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BTCVOE606 F Python Programming

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Basics of C **(8 Lectures)**

Editing, Compiling, Error Checking, executing, testing and debugging of programs. IDE commands. Eclipse for C Program development, Flowcharts, Algorithms, Variable names, Data types, sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence and order of evaluation.

Module 2: Algorithmic Problem Solving **(7 Lectures)**

Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation (pseudo code, flow chart, programming language), algorithmic problem solving, simple strategies for developing algorithms (iteration, recursion). Illustrative problems: find minimum in a list, insert a card in a list of sorted cards, and guess an integer number in a range, Towers of Hanoi.

Module 3: Data, Expressions, Statements **(7 Lectures)**

Python interpreter and interactive mode; values and types: int, float, Boolean, string, and list; variables, expressions, statements, tuple assignment, precede operators comments ;modules and functions, function definition and use, flow of execution, parameters and arguments; Illustrative programs: exchange the values of two variables, circulate the values of n variables, distance between two points.

Module 4: Control Flow, Functions **(8 Lectures)**

Conditionals: Boolean values and operators, conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, break, continue, pass; Fruitful functions: return values, parameters, local and global scope,.

Functions: Function composition, recursion; Strings: string slices, immutability, string functions and methods, string module; Lists as arrays. Illustrative programs: square root, gcd, exponentiation, sum an array of numbers, linear search, binary search.

Module 5: Lists, Tuples, Dictionaries **(6 Lectures)**

Lists: list operations, list slices, list methods, list loop, mutability, aliasing, cloning lists, list parameters; Tuples: tuple assignment, tuple as return value; Dictionaries: operations and methods; advanced list processing – list comprehension; Illustrative programs: selection sort, insertion sort, mergesort, histogram.

Files, Modules, Packages

Files and exception: text files, reading and writing files, format operator; command line arguments, errors and exceptions, handling exceptions, modules, packages; Illustrative programs: word count, copy file.

Text Books

- Martin C. Brown, Python: The Complete Reference.
- R. Nageswara Rao Core Python Programming.
- Kenneth A. Lambert, Introduction to Python.
- Vittorio Lora, Python for Civil and Structural Engineers.
- https://www.pythonforengineers.com/.
- W. Chun, Core Python Programming, Pearson.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Experience with an interpreted Language.

CO2: To build software for real needs

CO3: Prior Introduction to testing software

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BTCVOE606 G. Operation Research

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction to Operation Research (06 Lectures)

Introduction, History of operation research, Stages of development operation research, OR tools and techniques, Applications of Operation research, Modelling approach, Defining the problem and gathering data, Formulating a mathematical model, Deriving solutions from the model, Testing the model, Preparing to apply the model, Implementation, Limitations of operation research.

Module 2: Linear Programming and graphical analysis (06 Lectures)

Introduction to linear programming, Assumptions, Linear programming model, Formulation with different types of constraints, Graphical analysis of linear programming, Graphical linear programming solution.

Module 3: Simplex method and Duality method (08 Lectures)

Simplex Method: Introduction, Basics of simplex method, Simplex method computation, Algebra of the simplex method, Simplex method in tabular form, Simplex method in matrix form, Tie breaking in the simplex method, Adapting to other model forms, Post optimality analysis.

Duality: Introduction, Economic interpretation of duality, Primal–Dual relationships, Duality problems, Duality results, Dual problem and the simplex table, Role of duality theory in sensitivity analysis, Sensitivity analysis.

Module 4: Assignment Problems (08 Lectures)

Introduction, Assignment problems, Unbalanced assignment problem, Balanced assignment problem, Infeasible assignment problem, Minimization & Maximization, special algorithm for the assignment problem.

Module 5: Transportation Problems (08 Lectures)

Introduction, Methods for initial basic feasible solution, balanced transportation problem, Minimization & Maximization, Vogel's approximation method, Optimization, Modified distribution method, Streamlined simplex method for the transportation problem, Dual of the transportation problem.

Text Books

- Gupta P. K., Hira D. S. "Operation Research" S Chand Publishers, 2006
- Taha H. A. "Operation Research", Pearson, 2014
- G.Srinivasan "Operations Research:Principles and Applications", PHI Learning Pvt. Ltd.
- Ishizika A., Nemery P., "Multi-criteria Decision Analysis", John Wiley & Sons, 2013

References:

- Vohra, N. D. "Operations Research", Tata McGraw Hill Co., New Delhi.
- Wagner, "Operation Research", Wiley Eastern Ltd., New Delhi
- Zhamb L.C., "Quantitative Techniques in Management", Vol. I,
- Miller and Stars, "Executive Decisions & Operation Research", Prentice Hall of India
- Hillier and Liberman "Operations Research: Concepts and Cases" McGraw-Hill

Course Outcomes: On completion of the course, the students will be able to:

CO1: Adopt Operation Research tools and techniques while working in industry

CO2: Analyze the problem statement with computational approach

CO3: Apply various models to propose suitable outcomes.

CO4: Apply various decision-making tools to propose best suitable alternatives, at large.

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BTCVOE606 H. Applications of Remote Sensing and GIS

Teaching scheme: (3 Lectures) hour/week

Course contents

Module 1: Remote Sensing **(Lectures 8)**

Basic concepts in remote sensing, information and data collection, Remote Sensing process advantages & limitations, necessity, importance and use; basic laws of electromagnetic radiation, Atmospheric effects on radiation, Interaction of EM energy with matter

Module 2: Applications of remote sensing **(Lectures 8)**

Resolution in remote sensing, Satellite remote sensing, Problems confronting in remote sensing system. Ideal and real remote sensing systems. Applications of remote sensing in civil engineering.

Module 3: Visual Interpretation of Satellite Images **(Lectures 8)**

Elements of interpretation, Interpretation keys characteristics of digital satellite image, image enhancement, filtering, classification, integration of GIS and remote sensing, urban applications- integration of GIS and remote sensing water resources, urban analysis and watershed management.

Module 4: Geographical Information System & **Geo-referencing** **(Lectures 8)**

Introduction to Geographic Information System. Applications of GIS such as visibility analysis, slope analysis, watershed analysis & preparation of thematic maps. Limitations of GIS.

Geo-referencing; GIS data, spatial (raster & vector) & a spatial data. Introduction to vector and raster data analysis such as network analysis, overlay analysis etc. for vector, DEM, Management of a spatial data.

Module 5: Coordinate Systems and Projections **(Lectures 4)**

Geographic coordinate system: approximation of the earth, datum; map projections: types of map projections, map projection parameters, commonly used map projections, projected coordinate systems.

Text Book:

- Chandra A. M. and Ghosh S. K., 2015, "Remote sensing and Geographical Information System", Narosa Publishing House.
- Gopi S., Sathikumar R. and Madhu N., 2017, "Advanced Surveying -Total Station, GIS and Remote Sensing", Pearson publication.
- Lilles and Kiefer," Remote sensing & image interpretation", John Wiley Pub.
- Jensen J. R., "Remote sensing of the environment – An earth resources perspective" 2nd edition Pearson Education.
- Reddy M. A., 2001, "Textbook of Remote sensing and Geographical information system", B.S. Publications, Hyderabad.

References:

- Burragh P.A. and Mc Donnell R. A., 2016, "Principals of Geo physical Information system", Oxford Publications, 2004.
- Kumar A., 2016, "Basics of remote sensing & GIS", Laxmi publications.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Acquire knowledge demonstrating of earth resources management using remote sensing.
CO2: Gain skills in storing, managing digital data for planning and development.
CO3: Acquire skills in advance software's deals with remote sensing data for utilization.

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BTCVOE606

I. Civionics: Instrumentation & Sensor Technologies for Civil Engg.

Teaching scheme: (3 Lectures) hour/week

Course contents

Module 1: Instrumentation **(Lectures 8)**
Piezometer: measure pore water pressure open standpipe vibrating wire (push in). Pneumatic Inclinometers: measure tilts Strain gauges, Full Bridge, Half bridge and Quarter Bridge. Linear Variable Differential Transformer, LVDT (Linear Variable Displacement Transducer), Load Cells.

Module 2: Calibration of Instruments **(Lectures 8)**
Mechanical, electrical, electronic system and their calibration, various types of sensors for displacement, velocity, acceleration, pressure, loads, strains, full-field measurements.

Module 3: Sensor Technologies for Civil Infrastructures **(Lectures 8)**
Similitude and structural models: dimensional analysis, Buckingham's Pi theorem, scale factors and dynamic similitude; Uses and applications of models: types of model investigation, indirect and direct models, elastic and inelastic model (steel, concrete and masonry), size effects.

Module 4: Analysis of Experimental Data **(Lectures 6)**
Error and uncertainty in experiment, measurement systems, accuracy in models and reliability of results; Test planning, design and implementation: testing sequence and experimental plan, loading systems, devices, actuators and their control.

Module 5: Data Acquisition System and Data Processing **(Lectures 6)**
Analog systems, digital systems using personal computers, dynamic measurement
Data Processing: numerical and graphical data processing and archiving. Experiments to illustrate buckling of structural members; load-deformation behavior of beams, columns, joints, and frames under various loads.

Text Books:

- Wang M., Lynch L.J.P. and Sohn H., "Sensor Technologies for Civil Infrastructures, Applications in
- Structural Health Monitoring (Woodhead Publishing Series in Civil and Structural Engineering)"
- Chen H. P., 2018, "Structural Health Monitoring of Large Civil Engineering Structures", Wiley-Blackwell.
- Blake L. S., 1994, "Civil Engineer's Reference Book Butterworth-Heinemann".
- Brunelle A. and Don J., 2017, "Calibration Handbook of Measuring Instruments", the International Society of Automation (ISA).

Course Outcomes: On completion of the course, the students will be able to:
CO1: Understand workings of sensors and transducers.
CO2: Determine the in-situ characterization and various properties.
CO3: Carry out subsurface measurements and techniques of data collection.
CO4: Understand ongoing studies on use of sensors in civil engineering practice &research.

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BTCVOE606 J. Planning for Sustainable Development

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: **(Lectures 06)**
Sustainable Development-explains and critically evaluates the concept of sustainable development

Module 2: **(Lectures06)**
Environmental degradation and poverty Sustainable development: its main principles, the evolution of ideas about sustainability

Module 3: **(Lectures 06)**
Strategies for promoting sustainable development, resistances to the concept, and some alternative approaches. Examine some important current issues and areas of debate in relation to sustainable development.

Module 4: **(Lectures 06)**
Innovation for sustainable development- Environmental management and innovation strategies.

Module 5: **(Lectures 12)**
Societal transformations. Institutional theory, Governance for sustainable development. Policy responses to environmental degradation. Capacity development for innovation. Research methods.

Text/Reference Books:

- Harris, J.M., 2004, " Basic Principles for Sustainable Development, Global Development and Environment"
- Robinson, J., 2004, “Squaring the circle? Some thoughts on idea of sustainable Development” Ecological Economics
- Hjorth, P. & A. Bagheri, 2006, “Navigating towards Sustainable Development: A System Dynamics Approach”, Futures
- Mog, J.M., 2004, "Struggling with Sustainability – A Comparative Framework for Evaluating Sustainable Development Programs“, World Development 32(12): 2139–2160. IISD Commentary on the OECD's Draft Principles for International Investor Participation in Infrastructure
- Arundel, A., R. Kemp, and S. Parto, 2004,"Indicators for Environmental Innovation: What and How to Measure, forthcoming in International Handbook on Environment and Technology Management (ETM), edited by D. Annandale, J. Phillimore and D. Marinova, Cheltenham, Edward Elgar.

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BTCVOE606 K Development Engineering

Teaching Scheme: (3 Lectures) hours / Week

Course Contents

Module1 **(6 Lectures)**

Introduction to Development Engineering: need of development engineering, core disciplines and concept, major issues in development; urban development; rural development; socioeconomic development; scientific social research, formulation of research problem, field work and data collection, report drafting

Module 2 **(6 Lectures)**

Design of Sustainable Communities: Concept and development of sustainable communities; Sustainable design, principles, building regulations, codes and standards - ANSI, ASTM, ASHRAE, approval process; green buildings- green building techniques- energy solutions, site solutions, site solutions, exterior and interior solutions, Certification -BREEAM, GRIHA, NAHB, LEED, IGBC;

Module 3 **(8 Lectures)**

Town / City Planning: Town Planning- history of town planning 111 India, characteristics of city/town, town planning at national, regional and local levels, planning standards, master plan, site layout and development, zoning and density control, green belt, slum redevelopment; Smart city planning- introduction to city planning, infrastructure elements of smart city planning, dimensions of smart cities - global standards and performance benchmark; smart solutions- e governance, waste management, water management, energy management, urban mobility, citizen services, other services such as tele-medication and education, trade facilitation, skill development; GIS for planning

Module 4 **(8 Lectures)**

Planning and Development of Rural Areas: District administration, District Planning, introduction to various sectors of rural areas such as drinking water, waste water treatment, electricity, public transport, irrigation, sanitation and cooking energy; issues and challenges associated with these sectors; People's participation and role in development of rural areas; various schemes and policies floated by state and central government - phases in the schemes; life cycle costing of these schemes.

Module 5 **(8 Lectures)**

Geoinformatics for Planning and Development: Introduction to Geoinformatics; Advantages, benefits and limitations; Interdisciplinary applications; Data extraction; use of Geoinformatics for planning, mapping and preparation of layouts.

Development aspects: Urban and Rural: Planning and designing of a model town / city and using AutoCad and/ or GIS. Visit to a village or small town - The project will be carried out in groups. Problem faced by the villagers pertaining to various sectors or existing schemes; define the need, method, tools and techniques for development; deliver technology based solution.

Recommended Books:

- Chand, M. and Puri, U.K.(1983),'Regional Planning in India', Allied Publishers, N. Delhi.
- Kaiser, E. J ., et.al. (1995), 'Urban Land use Planning', (ed) Urbana, University of Illinois Press.
- Sundaram, K.V. 1985 'Geography & Planning', Concept Publishing Co., New Delhi.
- Ayyar, C.P.V. (1987), 'Town Planning in Early South India', Mittal Publications, Delhi.
- Reeder, L. Hoboken, NJ, 'Guide to green building rating systems', John Wiley &Sons, Inc., 2010.
- Longley, P.A., Michael F. Goodchild, Maguire, D.J., Rhind, D. W. (2005), 'Geographic Information Systems and Science', Second Edition 2005: John Wiley &, Sons, New York.
- Desai, V. (2005), 'Rural Development of India', Himalaya publishing house, Mumbai.
- Rau, S.K. (200 I), 'Global Search for Rural Development', NIRD, Hyderabad

References:

- Institute of Town Planners, India, Ministry of Urban Affairs & Employment, Government of India, New Delhi, UDPFI Guidelines, 1996.
- Miles R. Simon, 1970, 'Metropolitan Problems' Methuen Publications, Canada.

- B.I.S., 1980, "National Building Code of India', ISI, New Delhi.
- ANSI/ASHRAE/USGBC/IES Standard 189.1, Standard for the Design of High-Performance Green Buildings Except Low -Rise Residential Buildings
- ASHRAE Standard 90. 1, Energy Standard for Buildings Except Low-Rise Residential Buildings

Course Outcomes: The required course for emphasis in development engineering will help students

CO 1 : To develop multi scaled perspective about decisions in the built environment,

CO 2 : To expose the students to the analysis and evaluation of real world problems aiming to bring desired change in the society.

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BTHM607 Indian Constitution

Teaching Scheme: 2 Lecture / week

The constitution of India:

1. Preamble
2. Fundamental Rights
3. Directive principles of state policy
4. Fundamental Duties
5. Some other provisions

Universal declaration of Human Rights and Provisions of India, Constitution and Law, National Human Rights Commission and State Human Rights Commission.

Module.1 Introduction **(5 Lectures)**

Constitution' meaning of the term,, Indian Constitution: Sources and constitutional history, Features: Citizenship, Preamble, Fundamental Rights and Duties, Directive, Principles of State Policy

Module.2 Union Government and its Administration **(5 Lectures)**

Structure of the Indian Union: Federalism, Centre- State, relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, Lok Sabha, Rajya Sabha

Module.3 State Government and its Administration **(4 Lectures)**

Governor: Role and Position, CM and Council of ministers, State Secretariat: Organisation, Structure and Functions

Module.4 Local Administration **(5 Lectures)**

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation, Pachayati raj: Introduction, PRI: Zila Pachayat, Elected officials and their roles, CEO Zila Pachayat: Position and role, Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy

Module.5 Election Commission **(5 Lectures)**

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning, Institute and Bodies for the welfare of SC/ST/OBC and women

TEXT/REFERENCE BOOKS:

- Sastry, T. S. N., (2005). India and Human rights: Reflections, Concept Publishing Company India (P Ltd.),
- Nirmal, C.J., (1999). Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

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BTCVL608 SDD of RC Structures Lab

Term work shall consist of detailed analytical report for structural design and drawing of the following RC structures:

A) G + 2 Building

B) Any one of the following

(The introduction, analysis and design of these topics shall be studied in self-study mode. If required the subject teacher should address the student's queries during tutorials).

1) Retaining wall
2) Elevated water tank: analysis and design of staging and tank body.
3) Staircase of special form such as helicoidal stair
4) Shell roofs
5) Special foundation type such as combined footing, raft, pile foundation

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BTCVL609 Transportation Engineering Lab

Practical: 2 Hours / Week

Practical Work consists of all experiments from (a) and at least six performances among the list (b) below and detailed reporting in form of journal and Project Reports. Practical examination shall be based on above

a) Tests on Aggregates

1) Shape Test
2) Specific Gravity and Water Absorption Test
3) Stripping Value Test
4) Soundness Test
5) CBR Test on Soil and Aggregates

b) Test on Bituminous Materials

1.

1. Penetration Test
2. Softening Point Test
3. Flash and Fire Point Test
4. Ductility Test
5. Viscosity Test
6. Specific Gravity Test
7. Demonstration of Marshall Test
8. Pavement design exercise based on flexible pavement consisting of bituminous concrete.
9. Visit to Road construction site for studying different construction equipment's.

Course Outcomes: On completion of the course, the students will be able to:

Perform tests on various road construction materials.

PerformCBRtestsonlocalsoilstodeterminesubgradepropertiesneededforroadways

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BTCVM610 Mini Project

Student shall choose a topic of his interest in consultation with faculty in the department. The topic for mini projectmay be related to Civil Engineering area and/or interdisciplinary area. Student shall attempt to collect necessary informationand present a summary indicating comprehension of the topic and acquired depth of knowledge. It is desirable to obtainindustry or community sponsorship. Simplified tools or devices may be presented in form of working model and a brief reportstating development.A power point presentation shall also be submitted.

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BTCVP 611 Field Training /Internship /Industrial Training

Students are expected to undergo industrial training for at least four weeks at factory / construction site / design offices or in combination of these. Training session shall be guided and certified by qualified engineer / architect / contractor in civil engineering. A neat detailed report on activities carried out during training is expected. Students should undergo training for minimum 4 weeks which can be completed partially in V Semester and VI Semester or in at one time after VI Semester. Evaluation will be done in VII Semester.

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Dr. Babasaheb Ambedkar Technological University

(Established as a University of Technology in the State of Maharashtra)

(under Maharashtra Act No. XXIX of 2014)

P.O. Lonere, Dist. Raigad
Pin 402 103, Maharashtra
Telephone and Fax: 02140 - 275142
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Proposed Course Contents for

B. Tech. in Civil Engineering

w.e.f. June 2020

7th Semester - 8th Semester

Department of Civil Engineering

Program Objectives

Goal of the Civil Engineering at Dr. Babasaheb Ambedkar Technological University, Lonere (BATU) is to provide students with preparation to become worthy of professional careers in the field and to be motivated for lifelong learning. All prescribed courses have definite objectives and outcomes. Program objectives are expected qualities of engineers as under:

a) **Preparation:** To prepare students to excel in various educational programmes or to succeed in industry / technical profession through further education/training;

b) **Core Competence:** To provide students with a solid foundation in mathematical, scientific fundamentals required to solve real life civil engineering problems;

c) **Breadth:** To train students with a breadth of scientific knowledge to comprehend, analyze, design & create novel products and solutions for real life problems;

d) **Professionalism:** To inculcate in students professional/ethical attitude, effective team work skills, multidisciplinary approach and to relate engineering issues to a broader context;

e) **Learning Environment:** To provide students with academic environment of excellence, leadership, ethical guidelines and life-long learning needed for a long / productive career.

Program Educational Objectives

1. Taking pride in their profession and have commitment to highest standards of ethical practices and related technical disciplines;
2. Able to design various structures and systems that is safe, economical and efficient;
3. Capable of using modern tools efficiently in all aspects of professional practices;
4. Dealing successfully with real life civil engineering problems and achieve practical solutions based on a sound science and engineering knowledge;
5. Shall be engage in continuous research, development and exchange of knowledge for professional development;
6. Be honest in their control and performing their duties and promote effective use of resources through open, honest and impartial services to the public;
7. Act in such a manner which will uphold the honour, integrity, or dignity of the engineering profession, and avoid knowingly engaging in business or professional practices of a fraudulent, dishonest or unethical nature;
8. Recognize that the lives, safety, health and welfare of the general public are dependent upon engineering, decision and practices;
9. Continue their professional development throughout their careers and provide opportunities for the professional development.

Program Outcomes

At the end of the program the student will be able to:

PO 1	Apply the knowledge of mathematics, basic sciences, and civil engineering to the solution of complex engineering problems.
PO 2	Identify, formulate, research literature, and analyze complex civil engineering problems reaching substantiated conclusions.
PO 3	Design solutions for complex engineering problems and design of civil engineering structures that meet the specified needs.
PO 4	Use civil engineering research-based knowledge related to interpretation of data and provide valid conclusions.
PO 5	Create, select, and apply modern civil engineering and IT tools to complex engineering activities with an understanding of the limitations.
PO 6	Apply reasoning acquired by the civil engineering knowledge to assess societal and safety issues.
PO 7	Understand the impact of engineering solutions on the environment, and demonstrate the knowledge for sustainable development.
PO 8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	Communicate effectively on complex engineering activities with the engineering community and with society at large.
PO 11	Understand the engineering and management principles and apply these to the multidisciplinary environments.
PO 12	Recognize the need for life-long learning in the broadest context of technological change.

Program-Specific Outcomes (PSOs)

PSO 1	Make the students employable in engineering industries.
PSO 2	Motivate the students for higher studies and research.
PSO 3	Motivate the students for various competitive examinations.

Abbreviations

PEO:	Program Educational Objectives
PO:	Program Outcomes
CO:	Course Outcomes
L:	No. of Lecture hours (per week)
T:	No. of Tutorial hours (per week)
P:	No. of Practical hours (per week)
C:	Total number of credits
BSH:	Basic Science and Humanity
BSC:	Basic Sciences Course
PCC:	Professional Core Course
OEC:	Open Elective Course
PEC:	Professional Elective Course
BHC:	Basic Humanity Course
ESC:	Engineering Science Course
HSMC:	Humanity Science and Management Course
NCC:	National Cadet Corps
NSS:	National Service Scheme
CA:	Continuous Assessment
MSE:	Mid Semester Exam
ESE:	End Semester Exam
SS:	Self Study Course

B. Tech. Civil Engineering

Course Structure for Semester VII (Fourth Year) w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
BTCVC701	**Core**	Design of Concrete Structures - II	2	1	--	20	20	60	100	3
BTCVC702	**Core**	Infrastructure Engineering	3	--	--	20	20	60	100	3
BTCVC703	**Core**	Water Resources Engineering	3	1	--	20	20	60	100	4
BTCVC704	**Core**	Professional Practices	2	1	--	20	20	60	100	3
BTCVE705A	**Elective IV**	Construction Techniques	3	--	--	20	20	60	100	3
BTCVE705B		Engineering Economics								
BTCVE705C		Finite Element Method								
BTCVE705D		Limit State Design of Steel Structures								
BTCVE705E		Plastic Analysis and Design								
BTCVE705F		Water Power Engineering								
BTCVOE706A	**Open Elective V**	Advanced Structural Mechanics	3	--	--	--	--	--	--	Audit (AU/ NP)
BTCVOE706B		Air Pollution Control								
BTCVOE706C		Bridge Engineering								
BTCVOE706D		Introduction to Earthquake Engineering								
BTCVOE706E		Town and Urban Planning								
BTCVOE706F		Tunneling and Underground Excavations								
BTCVL707	Laboratory	Design & Drawing of RC & Steel Structures	--	--	2	30	--	20	50	1
BTCVL708	Laboratory	Professional Practices	--	--	2	30	--	20	50	1
BTCVT709	Training	Field Training /Internship/Industrial	--	--	--	--	--	50	50	1
BTCVS710	BTS	Seminar	--	--	2	--	--	50	50	1
BTCVP711	BTP	Project Stage-I**	--	--	6	--	50	50	100	3
		Total	**16**	**3**	**12**	**160**	**150**	**490**	**800**	**23**

***In case of students opting for Internship and Industry Project in the eighth semester, the Project must be industry-based.*

B. Tech. Civil Engineering

Course Structure for Semester VIII [Fourth Year] w.e.f. 2020-2021

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme$				Credits
			L	T	P	CA	MSE	ESE	Total	
BTCVSS801A	(Self-Study Course) #	Characterization of Construction Materials	03**	--	--	20	20	60	100	3
BTCVSS801B		Geosynthetics and Reinforced Soil Structures								
BTCVSS801C		Higher Surveying								
BTCVSS801D		Maintenance and Repair of Concrete Structures								
BTCESS801E		Structural Dynamics								
BTCESS802A	(Self-Study Course) #	Energy Efficiency Acoustics and Daylighting in Building	03**	--	--	20	20	60	100	3
BTCESS802B		Environmental Remediation of Contaminated Sites								
BTCESS802C		Remote Sensing Essentials								
BTCESS802D		Mechanical Characterization of Bituminous Materials								
BTCESS802E		Soil Structure Interaction								
BTCEP803	Project Stage-II	In-house Project or Internship and Project in Industry*	--	--	30	50	--	100	150	15
Total			04	--	30	90	40	220	350	21

 # The subjects are to be studied on self-study mode using SWAYAM/NPTEL/any other online source approved by the University.

*****If required Coordinator may be appointed for each Self study course and an administrative load of 03 hours per week may be considered for monitoring and assisting the students, and to conduct examination (if required), evaluation and preparation of result.***

$ If the examination schedule for the online Self study course chosen by student do not match with the University's Academic Schedule, the University/Institute have to conduct exam for such courses.

**** Six months of Internship and Project in the Industry. One Faculty guide from the Institute and one Mentor from the Industry should be identified to monitor the progress of work. During the Project/Internship period of work, a review of work should be taken twice followed by a final presentation at the end of Project period.***

Detailed Syllabus (VII Semester)

BTCVC701 Design of Concrete Structures - II

Teaching Scheme: (2 Lectures + 1 Tutorial) hours/week

Course Contents

Limit State Method for RC Structures

Module 1: **(6 Lectures)**

Limit State of Collapse (Torsion) - Types of torsion, behavior of R.C. rectangular sections subjected to torsion, Design of sections subjected to combined bending and Torsion

Module 2: **(6 Lectures)**

Analysis and design of axially and eccentrically loaded short columns (Circular and Rectangular), detailing of reinforcement, and construction of Interaction diagrams for uni-axial bending, concept of bi-axial bending Prestressed Concrete

Pre-stressed Concrete

Module 3: (5 Lectures)

Introduction to prestressed concrete, concepts, types, systems and methods of pre stressing,

Module 4: (5 Lectures)

Stress analysis for rectangular and symmetrical I sections, Pressure Line, Cable Profiles

Module 5: **(4 Lectures)**

Losses in Prestressing for Pre-tensioned & Post tensioned members

Module 6: **(6 Lectures)**

Design of Rectangular and Symmetrical I sections, Design of End Block

Structural audit of various structures such as load bearing wall type, RCC, Steel Framed, Prestressed Concrete, etc.:

conceptual introduction to elaborate necessity, implementation of audit, format of reporting, consequences

Text Books

- IS: 456, IS 1343, SP16, SP24, SP34 of Recent Editions, Bureau of Indian Standards, New Delhi
- Karve& Shah, “Limit State Theory & Design”, Structures Publications, Pune
- Lin T.Y., “Prestressed Concrete”, John Willey & Sons New York
- Jain A.K., “Reinforced Concrete Design (Limit State)”, Nemchand Brothers, Roorkee
- Sinha S.N., “Reinforced Concrete Design”, Vol. I, II, Tata Mc-Graw Hill
- Sinha& Roy, “Fundamentals of Reinforced Concrete”, S. Chand & Co. New Delhi
- Sinha& Roy, “Prestressed Concrete”, S. Chand & Co. New Delhi
- Krishnaraju N., “Prestressed Concrete”, Tata Mc-Graw Hill

Reference Books

- Punmia B.C., “Reinforced Concrete Design”, Vol. I, II, Laxmi Publications
- Varghese P.C., “Limit State Design of Reinforced Concrete”, Prentice Hall of India, New Delhi
- Relevant Publications by Bureau of Indian Standards, New Delhi
- Indian Standard codes related with nondestructive testing, Government Resolutions related to Structural Audits (BMC Act, etc.), Field manuals and reports by Expert Consultants.

Course Outcomes: On completion of the course, the students will be;

- Able to identify the behavior, analyze and design of the beam sections subjected to torsion.

- Able to analyze and design of axially and eccentrically loaded column and construct the interaction diagram for them.
- Understand various concepts, systems and losses in pre-stressing.
- Able to analyze and design the rectangular and symmetrical I-section pre-stressed beam/girders.

BTCVC702 Infrastructure Engineering

Teaching Scheme :(4 Lectures) hours/week

Course Objectives:

a. To discuss elements of Railway Engineering, tunnel engineering, Docks &Harbours
b. To discuss elements of Bridge Engineering and Airport Engineering
c. To provide information about their processing, Construction and maintenance
d. To make students understand function of infrastructural components and their significance

Course Contents

Module 1 (5 Lectures)
Railway Engineering: Permanent Way, gauges, rails, sleepers, ballast, sub grade formation, fixtures and fastenings, Geometric Design of tracks- Horizontal Alignment, Vertical Alignment

Module 2 (5 Lectures)
Points and Crossings: Standard types, Design of simple turnout, various types of Junctions, Stations and Yards: Purpose, Location, Site selection, general layouts of Terminus and Junction, Signaling and Interlocking, Construction and Maintenance of Track, Modern trends in Railways

Module 3: (10 Lectures)
Bridge Engineering: Sub-structures

Determination of design discharge, Linear Water Way, Economical Span, Afflux, Scour depth, Indian Road Congress Bridge Code
Abutments: Definition, Functions, Dimensions, Types, Forces acting on an abutment, Conditions of stability
Piers: Definition, Function, Types, Forces acting on a pier, Conditions of stability, Dimensions, Location, Abutment pier
Wing walls: Definition, Functions, Types, Forces acting on a wing wall, Conditions of stability, Dimensions, Precautions
Materials for sub-structures: Cement concrete, Masonry, Steel

Module 4: (10 Lectures)
Bridge Engineering: Super-structures

Simple bridges or beam bridges: Deck bridges, Through bridges, Semi-through bridges

Introduction, advantages and disadvantages: Continuous bridges, Cantilever bridges, Arch bridges, Bow-string girder type bridges, Rigid frame bridges, Portal frame bridges, Suspension bridges, Cable-stayed bridges, Composite bridges

Materials for super-structures: Cement concrete, Masonry, Steel, Timber

Module 5: (10 Lectures)
Tunnel Engineering: Shape and Size of Tunnel Shafts, Pilot Tunnels, Tunneling in Hard Rock, Tunneling in Soft Materials, Drilling-Patterns, Blasting, Timbering, Mucking, Tunnel Lining, Advances In Tunneling Methods, Safety Measures, Ventilation, Lighting and Drainage of Tunnels

Module 6: (5 Lectures)

Dock and Harbor Engineering: Inland Water Transport in India, Tides, Winds and Waves Erosion, Transport of Sediments, Beach Drift, Littoral Drift, Sand Bars, Coast Protection, Classification of Ports and Harbors, Site Selection, Features of Break Waters, Jetties, Wharves, Piers, Facilities required, Dry Docks, Wet Docks, Lift Docks, Floating Docks, Spillways, Navigational Aids, Lighthouses, Terminal Buildings, and Dredging- Special Equipment

Airport Engineering: Planning, Airport Surveys, Site Selection, Zoning Laws, Runways, Geometric Design, Airport Capacity, Terminal Buildings, Parking Systems, Taxiways, Hangers, Airport Drainage, Air Traffic Control, Airport Lighting

Text Books

1. Saxena S. C. and Arora S. (2003) “A Course in Railway Engineering,” DhanpatRai& Sons, Delhi
2. Quinn A. D. “Planning and Construction of Docks and Harbours”, Tata McGraw Hill, New Delhi
3. Oza H. P. and Oza G. H. (2012) “Dock and Harbour Engineering”, Chartor Publishing House, Anand
4. Shrinivasan R. (2016) “Dock, Harbour and Tunnel Engineering”, Chartor Publishing House, Anand
5. Arora N. L. (1995) “Transportation Engineering”, IPH New Delhi
6. Bindra S. P. “Bridge Tunnel and Railway Engineering”, Dhanpatrai and Sons, New Delhi
7. Khanna S. K. and Arora N. L. (1999), “Airport Engineering” Nemchand& Bros., Roorkee
8. Rangawala S. C. (2012) “Airport Engineering”, Charotar Publishing House Pvt. Limited, Anand
9. Rangawala S. C. “Bridge Engineering”, Charotar Publishing House Pvt. Limited, Anand
10. Hariharan K. V. (2002) “Multimodal Transport & Infrastructure Development in India”, Shroff Publishers, Mumbai

References

1. Publications of Bureau of Indian Standards, New Delhi, Relevant To the Syl Laboratories
2. Cormick H. F. (1975) “Dock and Harbour Engineering” Giffin Publishers
3. Raina V K. (2012) “Handbook for Concrete Bridges” Vol. 1 and 2, Shroff Publishers, Mumbai
4. Horonjeff R. (2012) “Planning and Design of Airports”, Tata McGraw Hill, New Delhi

Course Outcomes: On completion of the course, the students will be able to:

- Know about the basics and design of various components of railway engineering
- Understand the types and functions of tracks, junctions and railway stations.
- Know about the aircraft characteristics, planning and components of airport
- Understand the types and components of docks and harbors.

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BTCVC703 Water Resources Engineering

Teaching Scheme :(3 Lectures+ 1 Tutorial) hours/week

Course objectives:

1) To study occurrence movement and distribution of water that is a prime resource for development of a civilization.

2) To know diverse methods of collecting the hydrological information, which is essential, to understand surface and ground water hydrology.

3) To know the basic principles and movement of ground water and properties of ground water flow.

Course Contents

Module 1: Introduction **(10 Lectures)**

Introduction, definition, scope, necessity, ill-effects of irrigation, advantages, types of irrigation systems, difference between weir, barrage and dam, methods of distribution of water, development of irrigation in India Introduction to hydrology: hydrologic cycle, rain, surface and ground water

Water Requirement of Crops

Water requirement of crops, base, delta and duty, methods of improving duty, types of soil, types of soil water, soil moisture, consumptive use, irrigation frequency, irrigation methods, crops season, crop pattern

Module 2: Reservoirs and Dams **(10 Lecturers)**

Planning of Reservoirs: Classification of Reservoir, Selection of site for Reservoir, Investigation works for Reservoir, Yield and Capacity of Reservoir, Mass Curve and Demand Curve, Storage Calculations, Control Levels, Useful Life of Reservoir, Silting of Reservoirs, Losses in Reservoirs

Gravity Dams – Estimation of Loading, Design Criteria, Causes of Failure of Gravity Dam, Precaution against Failure, Theoretical and Practical Profile, Stability Calculations, Galleries, Joints, and Earth Dams: Components and their Functions, Design Criterion, Inverted Filters, Downstream Drainage, Causes of Failure of Earthen Dam. Arch Dams – Types, Forces on Arch Dam,

Module 3: Spillway Weirs and Canals **(8 Lectures)**

Spillway, Necessity and Different Types, Location of Spill Ways, Selection Criterion, Gates for Spillways,

Weirs on Permeable Foundations: Theories of Seepage, Bligh's Creep Theory, Limitations of Bligh's Creep Theory, Khosla's Theory, Piping and Undercutting Canals: Types, Alignment, Kennedy's and Lacey's Silt Theories, Canal Losses, Typical Canal Sections, Canal Lining: Necessity and Types, Canal Structures: Cross Drainage Works and Canal Regulatory Works

Module 4: Lift Irrigation **(8 Lectures)**

Lift irrigation, wells and tube wells, introduction, classification of well, specific yield, deep and shallow wells, comparative advantage of well and canal irrigation, duty of well water, types of tube wells, types of strainers, boring methods. Darcy's law, permeability, safe yield of basin. Lift irrigation schemes: Various components and their design principles (Only concepts).

Module 5: Hydrology **(6 Lectures)**

Hydrology, measurement of rainfall, peak flow, base flow, precipitation and its measurement, average depth of precipitation, water losses, flood frequency, catchment area formulae, flood hydrograph, rainfall analysis, infiltration, run off, estimation of runoff, unit hydrograph and its determination, s- hydrograph

Module 6: Water logging and drainage **(6 Lectures)**

Causes of water logging, preventive and curative measures, drainage of irrigation of lands, reclamation of water logged, alkaline and saline lands, Preventive and Curative Measures

Water Conservation: Rain water Harvesting, Ground Water Recharge, small scale techniques of surface water detention such as: Soil embankments, field ponds, concrete bandhara.

Text Books

1. Varshney R. S., Gupta & Gupta, 1987, "Theory and Design of Irrigation Structures", Vol. I & II
2. Punamia B. C. Pandey B. B. and Lal, 1992, "Irrigation and Water Power Engineering", Standard Publishers, New Delhi
3. Garg S. K., 1976, "Irrigation Engineering & Hydraulic Structures",Khanna Publishers, N. Delhi,
4. Priyani, 1982, "Irrigation and Water Power", Charotar Publishing House, Anand
5. Bharat Singh,1979, "Irrigation", Nemchand Brothers, Roorkee
6. Subramanya K., 1984, "Engineering Hydrology", Tata Mc-Graw Hill Company Limited, N. Delhi

References Books

1. USBR, "Design of Small Dam", OXFORD & IBH, Publishing Company
2. Justinn, 1961, "Engineering for Dam" Vol. I, II, III, Creager and Hinds
3. Leliavsky, "Design of Hydraulic Structures" Vol. I & II,

4. C B I & P “River Behaviour, Management and Training”
5. Circular of Government of Maharashtra, 18 February 1995, “Design of Canals”

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand need of Irrigation in India and water requirement as per farming practice in India.

CO2: Understand various irrigation structures and schemes.

CO3: Develop basis for design of irrigation schemes.

BTCVC704 Professional Practices

Teaching Scheme :(2 Lectures + 1 Tutorial) hours/week

Pre Requisites: Building Construction

Course Objectives:

1. To discuss introduce methods of quantity surveying, costing, and valuation
2. To facilitate students with concepts of costing involved in infrastructures
3. To make students familiar with process involved during tendering & contracting

Course Contents

Module 1: Introduction **(04 Lectures)**

Introduction to estimating, purpose, types, items of inclusion, modes of measurement for different works, administrative approval and technical sanction to estimates

Module 2: Quantity Surveying **(06 Lectures)**

Introduction to estimating, purpose, types, items of inclusion, modes of measurement for different works, administrative approval and technical sanction to estimates, specifications: purpose general and detailed specifications for various items of work, prime cost, provisional sums and provisional quantities, taking out quantity, P.W.D. method, recording of measurements

Module 3: Costing **(10 Lectures)**

Analysis of rates for various items of construction of civil engineering works, standard schedule of rate, price escalation, detailed and approximate estimates for buildings, R.C.C works, culverts, earthwork for canals, roads including hill roads and other civil engineering works

Module 4: Tendering **(6 Lectures)**

Types, preparation of tender papers, conditions of contracts, competitive bidding, types of bids, invitation of tenders, scrutiny and acceptance of tenders, award of jobs, introduction to B.O.T. and similar other basis of execution,

Module 5: Contracts **(8 Lectures)**

Essentials of legally valid contract, types and forms of contract between various agencies, organizational set up of P.W.D. classification of works, method of carrying out work in P.W.D. mode of payment, bill forms, introduction to arbitration

Module 6: Valuation **(6 Lectures)**

Principles, types, price and cost, attributes of value, valuer and his duties, factors affecting the valuation of properties, methods of valuation, different types of lease

Valuation from yield and from life, gross yield and net yield, sinking fund, depreciation, different methods of calculating depreciation, depreciated cost, obsolescence

Text Books

1. Dutta B. N. (2012) “Estimating and Costing”, UBS Publishers Distributors, New Delhi

2. Namavati R. H. (2016) “Professional Practice Estimating and Valuation”, Lakhani book Depot, Mumbai
3. Patil B. S. (2015) “Civil Engineering Contracts and Estimates”, Universities Press, Hyderabad
4. Bhasin P. L. (1987) “Quantity Surveying”, S. Chand & Co. Ltd., Mumbai
5. Rangwala S. C. (1990), “Elements of Estimating and Costing”, Charotar Publication, Anand
6. Birdi G. S. (2014) “Estimating and Costing”, DhanpatRai& Sons, N. Delhi
7. Chakroborty M. (2010) “Estimating, Costing & Specification in Civil Engineering”, M.Chakraborty Publication, Nepal
8. Rangwala S. C. (2011) “Valuation of real Properties”, Charotar Publication, Anand

References

1. Govt. of Maharashtra P.W. and Housing Department Publication edition 1979 and 1981
2. P. W. D. Maharashtra, “Standard Specifications”, Volumes I & II
3. C.P.W.D. Specifications
4. C.P.W.D. Schedule of Rates
5. P.W.D. Maharashtra Schedule of Rates
6. Publications of Bureau of Indian Standards: IS 1200 all parts, and other relevant

Course Outcomes: On completion of the course, the students will be able to:

Understand the importance of preparing the types of estimates under different conditions for various structures.

Know about the rate analysis and bill preparations and to study about the specification writing.

Know the various types of contract, accounts in PWD, methods for initiating the works in PWD and tendering.

Understand the valuation of land and buildings, various methods and factors affecting valuation.

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BTCVE705A Construction Techniques

Course Objectives:

The main objectives of the course are:

1. To study different methods of construction to successfully achieve the structural design with recommended specifications.
2. To involve the application of scientific and technological principles of planning, analysis, design and management to construction technology.

Teaching Scheme: (3 Lectures+1Tutorials) hours/week

Course Contents

Module 1: (8 Lectures)

Introduction, planning of a new project, site access and services, mechanical and manual construction, excavation in earth: Understanding basics and functions of equipment, earthmoving equipment - Tractors, Bulldozers, Scrappers, Power shovel, Hoes, simple numerical problems based on cycle time and production rates, drag line, Clamshell, Trenchers, Compactors- types and performance, operating efficiencies, lifting capacities

Module 2:(8 Lectures)

Excavation in hard rock, Rippers, jack hammers, drills, compressors and pneumatic equipment, blasting explosives, detonators, fuses, drainage in excavation – necessity and methods of dewatering

Module 3:(8Lectures)

RMC Plant, layout and production capacity, type of concrete mixers, machinery for vertical and horizontal transportation of concrete, grouting, Shotcreting, under water concreting, Type of formwork, Slip formwork, equipment for placing of concrete in normal and difficult situations

Module 4: (8 Lectures)

Prefabricated construction: Relative economy, steel construction: planning and field operations, erection equipment, cranes of various types such as tower, crawler, luffing jib tower crane, floating and dredging equipment

Module 5: (4 Lectures)

Road construction aspects, asphalt mixing and batching plant (Hot Mix Plant), sensor paver for rigid roads, crushing plants belt conveyers, cableway, construction of a new railway track, aspects of bridge construction

Module 6: (4 Lectures)

Diaphragm walls: purpose and construction methods, safety measures in construction, prevention of accidents and introduction to disaster management

Text Books

1. Peurifoy R.L. (2010). *Construction, Planning, Equipment & Methods*, McGraw hill Book Co. N. Delhi
2. Verma Mahesh, (1975). *Construction Equipment*, Metropolitan book Co., New York
3. Singh J., (2006). *Heavy Construction - Planning, Equipment & Methods*, Oxford & IBH Pub., N. Delhi

Reference Books

1. Quin A. (1961), Planning and Construction of Docks and Harbors, Mc-Graw Hill Company, New York.
2. Stubbs F. W., (1971). Hand Book of Heavy Construction, Mc-Graw Hill Inc, US 2nd edition.
3. Boyes R.G.H, (1975). Structural & cut off Diaphragm Walls, Applied Science Publishers Ltd. London.
4. Ataev S. S., (1999). Construction Technology, Mir Publishers, Mascow.

Course Outcomes: On completion of the course, the students will be able to:

1. Understand the planning of new project with site accessibility and services required.
2. Comprehend the various civil construction equipment's.
3. Familiar with layout of RMC plant, production, capacity and operation process.
4. Recognize various aspect of road construction, construction of diaphragm walls, railway track construction etc.

BTCVE705B Engineering Economics

Course Objectives:

The main objectives of the course are:

1. To learn the economics behind any constructional activities.
2. To Emphasis upon develop interest in investment evaluation and financing projects.

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1 **(04 Lectures)**

Introduction to engineering economics, importance, demand and supply, types of costs, types of interests, value of money – time and equivalence, tangible and intangible factors, introduction to inflation,

Module 2 **(06 Lectures)**

Cash Flow diagram, Nominal and effective interest – continuous interest, Single Payment Compound Amount Factor, Uniform series of Payments, comparing alternatives, Present worth Analysis, Annual worth Analysis, Future worth Analysis, Rate of Return Analysis, Break Even Analysis, Benefit/Cost Analysis

Module 3 **(06 Lectures)**

Economics of Project Parameters, Equipment Economics, Operating Costs, Buy, Rent and Lease Options, |Replacement Analysis, Cost Estimates, Type of Estimates, Parametric Estimate, Management Accounting, Financial accounting principles, basic concepts, Financial statements, accounting ratios

Module 4 **(06 Lectures)**

Investment Evaluation and Financing Projects, Taxation, Depreciation, switching between different depreciation methods, Inflation, Sources of finance, equity, debit, securities, borrowings, debentures, Working capital requirement, financial institutes

Module 5 **(08 Lectures)**

Financial Management, Introduction, Charts of Accounts, Balance Sheet, Financial Ratios, Working Capital Management, Budgeting and budgetary control, Performance budgeting. Profit & Loss, statement, Ratio analysis, Appraisal through financial statements, International finance forward

Module 6 **(06 Lectures)**

PPP in Projects Public Private Participation in Projects- PPP Models, BOOT, BOT, Joint Ventures, BOOT, BOT, Annuity, DBFO, External Commercial Borrowings, International Finance, FIDIC.

Text Books

1. Blank, L.T., and Tarquin, A. J., (1988). *Engineering Economy*, Mc-Graw Hill Book Co.
2. Collier C. and GlaGola C. (1998). *Engineering Economics & Cost Analysis*, Addison Wesley Education Publishers,
3. Patel, B. M., (2000). *Project management- strategic Financial Planning, Evaluation and Control*,Vikas Publishing House Pvt. Ltd. New Delhi,
4. Shrivastava, U. K., (2000). *Construction Planning and Management*, Galgotia Publications Pvt. Ltd. New Delhi.

References

1. Van Horne, J.C. (1990). Financial Management and Policy, Prentice-Hall of India Ltd.
2. Taylor, G.A. (1968). Managerial and Engineering Economy. East-West Edition.
3. Thuesen, H.G. (1959). Engineering Economy, Prentice-Hall, Inc.
4. Brigham, E.F. (1978). Fundamentals of Financial Management, the Dryden Press, Hinsdale, Illinios,
5. Kolb, R.W. and Rodriguez, R.J. (1992). Financial Management, D.C. Heath & Co.
6. Walker, E.W. (1974). Essentials of Financial Management, Prentice Hall of India Private Limited, New Delhi.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Adopt as per principles of economics and financing

CO2: Analyze available alternatives and propose best suitable among them

CO3: Apply various models of financial management and accounting

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BTCVE705C Finite Element Method

Course Objectives:

The main objectives of the course are:

1. To solve 1 D, 2 D and dynamic problems using Finite Element Analysis approach.
2. To learn and apply finite element solutions to structural, thermal, dynamic problem to develop the knowledge and skills needed to effectively evaluate finite element analyses.

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction to FEM & Approximate Methods **(06 Lectures)**

Introduction, Overview of Various Methods to Solve Integral & Differential Equations (Point Collocation Method, Method of Least Square, Weighted Residual Method, Galerkin's Method), Variational Calculus (Hamilton's

Variational Principle, Minimum Potential Energy Principle, Euler Lagrange Equation), Partial FEM (Kentorvich Method/ Finite Strip Method/ Semi-Analytical Method), Local & Global Finite Element Methods (Rayleigh-Ritz Method), Stepwise Procedure.

Module 2: One Dimensional FE Analysis (06 Lectures)

Application of FEM to Solve various 1-D problems (Shape Functions for 1-D Elements, Properties of Shape Functions, Lagrange Interpolating Polynomials), C^0 Continuity, 1-D FE Analysis (Discretization, Selection of Shape Function, Defining Gradients of Primary Unknowns & Constitutive Equations, Derivation of Element Equations, Assembly & Application of Boundary Conditions, Computation of Primary and Secondary Unknowns), Direct Approach for Assembly, Boundary Conditions (Geometric, Natural), Concept of Sub-Structuring (Static Condensation), Stiffness Matrix for Basic Bar & Beam Element, Representation of Distributed Loading, The Assembly Process within the PMPE Approach, Element Stresses)

Module 3: FE Analysis by Direct Approach (06 Lectures)

C^1 Continuity, Formulation of 1-D Beam Element, Classical Beam Theory, Element Equation Formulation (Galerkin's Approach, Rayleigh-Ritz Approach), Derivation of Scalar Functional from Differential Equation and Vice Versa, Simple applications to Beams.

Module 4: Two Dimensional FE Analysis (06 Lectures)

Conditions of Symmetry & Anti Symmetry (Applications), 2-D FE Analysis, Review of Theory of Elasticity, CST Element (3-Node Triangular Element), Pascal's Triangle and Pyramid, Area Co-ordinate, Stepwise Formulation, Equivalent Load Vector, Plane Stress Problems using CST Elements, 2-D Stress Analysis using 4-noded Rectangular Element, Stepwise Formulation, Effect of Aspect Ratio, Explicit & Implicit Iso-parametric Formulation, Iso-parametric Elements for Plane Problems

Module 5: Three Dimensional FE Analysis (04 Lectures)

3-D Stress Analysis using FEM, Iso-parametric Formulation, 3-D Brick Element, FEA of Axi-symmetric Solids Subjected to Axi-symmetric and Asymmetric Loads (all contents at introductory level)

Module 6: Applications of FEA (04 Lectures)

Computer Implementation of FEM, Application of FEM to Time Dependent Problems, Partial FEM, h-version of FEM, p-version of FEM, Adaptive Meshing, Exposure to Hybrid FEM (Mixed/ Hybrid Formulation, Unidirectional Composites), Introduction to software's, elementary problem-solving using freeware

Guidelines for Assignments: Minimum six assignments consisting theoretical as well as numerical aspects of the course shall be performed by the candidate.

Guidelines for Class Test: Class test shall cover syllabus of any three consecutive Modules.

References:

1. Mukhopdhyay, M., (1984). *Concept and Application of Finite Element Analysis*, Oxford and IBH Publishing Co. Pvt. Ltd.

2. Zienkiewicz, O.C and Taylor R.L., (2000). *The Finite Element Method*, Vol 1 & 2; 5th Ed, Butterworth-Heinemann,

3. Reddy J. N. (2005). *An Introduction to Finite Element Method*, McGraw Hill , 3rd Ed,
4. Cook R.D., Malcus D.S. and Plesha, (1997). *Concepts and Applications of Finite Element Analysis*,4th Ed, Wiley.
5. Hutton D.V., (2004). *Fundamentals of Finite Element Analysis*, Tata McGraw Hill Pub.
6. Desai C. S. & Abel J. F., (1974). *Introduction to the Finite Element Method*, CBS Pub.
7. Krishnamoorthy C. S, (1994). *Programming in the Finite Element Method*, Tata McGraw Hill.

8. Chandrupatla T. R. and Belegundu,(2002). *Introduction to the Finite Element in Engineering,* Pearson Education.
9. Bathe K.J., (1996). *Finite Element Procedures,* PHI learning pvt.ltd
10. Desai Y.M., and Eldho T.I, (2011). *Finite Element Method with application in Engineering*, Pearson, Delhi
11. Bhavikatti S. S. (2015). *Finite Element Analysis*, New Age International Publication.

Course Outcomes: Upon completion of the course the students will be able to:

1. Understand the different energy methods in structural analysis and basic concepts of finite element method.
2. Analyze 1-D problems related to structural analysis like Bars, Trusses, Beams and Frames using finite element approach.
3. Find solution to problems using direct approach methods like Rayleigh – Ritz or Galerkin's Method.
4. Solve 2-D problems using knowledge of theory of elasticity.
5. Students will be able to implement the knowledge of numerical methods in FEM to find the solution to the various problems in statics and dynamics.
6. Analyze 1D, 2D, and 3D structures using different software packages based on FEM.

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BTCVE705D Limit State Design of Steel Structures

Teaching Scheme: (3 Lectures) hours/week

Pre Requisites: Engineering Mechanics, Mechanics of Solids, Design of Steel structures

Course Objectives:

- To introduce the design loads and the stresses developed in the steel member
- To discuss the various connections and identify the potential failure modes
- To provide guidelines for various tension, compression and flexural members.
- To make students aware of various guidelines set by Standards & Codes

Course Contents

Module 1: Introduction **(4 Lectures)**

Introduction, advantages & disadvantages of steel structures, permissible stresses, factor of safety, methods of design, types of connections, various types of standard rolled sections, types of loads and load combinations

Module 2: Connections **(4 Lectures)**

Types: Riveted, Bolted, Welded; Analysis of axially & eccentrically loaded connections (subjected to bending & torsion), Permissible Stresses, Design of connections, failure of joints

Module 3: Axially Loaded Members **(6 Lectures)**

Tension members: Common sections, net effective area, load capacity, connection using weld / bolts, design of tension splice

Compression members: Common sections used, effective length and slenderness ratio, permissible stresses, load carrying capacity, connection using weld / bolt

Module 4: Beams **(6 Lectures)**

Laterally supported & unsupported beams, design of simple beams, built up beams using flange plates, curtailment of flange plates, web buckling & web crippling, secondary and main beam arrangement, beam to beam connections

Module 5: Industrial Roofing **(6 Lectures)**

Gantry girder: Forces acting on a gantry girder, commonly used sections, introduction to design of gantry girder as laterally unsupported beam, connection details

Roof trusses: Components of an industrial shed, types of trusses, load calculations and combinations, design of purlins, design of truss members, design of hinge & roller supports

Module6: Columns and Column Bases **(8 Lectures)**

Simple and built up section; lacing, battening, column subjected to axial force and bending moment, column splices. Column bases: Analysis and design of: Slab base, gusseted base and moment resisting bases, grillage foundation, design of anchor bolt.

Note: Contents in Module 1 to part of 5 shall be taught with help of relevant text or reference books based on elastic design **concept and shall be taught with reference to IS 800 2007**

Use of IS 800: 1984 and 2007, IS 875 (All Parts), IS: Handbook No.1 for Steel Section and Steel Table is permitted for theory examination.

Text Books

1. Duggal S. K. (2017) "Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
2. Gambhir M. L. (2017) "Fundamentals of Structural Steel Design", Tata McGraw Hill Pub. Co. Ltd., New Delhi
3. Negi L. S. (2017) "Design of Steel Structures", Tata McGraw Hill Pub. Co. Ltd., New Delhi
4. Chandra Ram (2016) "Design of Steel Structures", Vol. I & Vol. II, Standard Book House, New Delhi
5. Subramanian N. (2010) "Steel Structures: Design and Practice" Oxford Univ. Press, Delhi
6. Sai Ram K. S. (2015) "Design of Steel Structures", Pearson Education, Delhi

Reference Books

1. Arya A. S. and Ajamani J.L. (2014) "Design of Steel Structures", Nemchand and Brothers, Roorkee
2. Vazirani V.N. and Ratwani M.M. (1988) "Design of Steel Structures", Standard Book House, New Delhi
3. Publications of Bureau of Indian Standards, New Delhi, IS 800:1984, 2007, IS 875 (Part I to V)
4. Gaylord E.H. and Gaylord C.N. (1991) "Design of Steel Structures" McGraw Hill, New York
5. Salmon C. G. and Johnson J. E. (2008) "Steel Structures: Design and Behaviour", Harper and Row, New York
6. Steel Designers Manual.

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify and compute the design loads and the stresses developed in the steel member.

CO2: Analyze and design the various connections and identify the potential failure modes.

CO3: Analyze and design various tension, compression and flexural members.

CO4: Understand provisions in relevant BIS Codes.

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BTCVE705E Plastic Analysis and Design

Teaching Scheme: (3 Lectures) hours/week

Pre Requisites: Engineering Mechanics, Mechanics of Solids, Structural Mechanics I, Structural Mechanics-II, Design of Steel Structures

Course Objectives:

1. To introduce plasticity in various materials & components and their behavior.

2. To understand analysis of determinate and indeterminate members for collapse load
3. To understand philosophy of limit state design
4. To introduce potential design considerations for design calculations

Course Contents

Module 1 **(8 Lectures)**

Plasticity in ductile materials, stress-strain for mild steel, elasto-plastic behavior of beam in flexure, shape factor for different cross sections, yield zones, concept of plastic hinge

Module 2: **(8 Lectures)**

Collapse loads of determinate and indeterminate structures such as beams and rectangular portal frames, statical and kinematical methods, mechanisms. Bending moment diagram at collapse

Module 3: **(6 Lectures)**

Philosophy of Limit State design, requirement of steel for design, Limit State of Strength and Serviceability, partial safety factors, design of laterally supported beams, shear resistance

Module 4: **(6 Lectures)**

Secondary design considerations, design of beams with high shear, interaction of bending and shear, interaction of bending and axial force

Module 5 **(4 Lectures)**

Design of portal frames, design of corner connection with and without haunches.

Module 6 **(4 Lectures)**

Consideration of deformations, calculation of deflections for plastically deformed structures

Text Books:

- Bureau of Indian Standards, "Handbook for Structural Engineers: Application of Plastic Theory in Design of Steel Structures SP: 6 (6)".
- Bureau of Indian Standards, "IS: 800 Code of Practice for General Construction in Steel"
- Arya A.S. and Ajmani J.L., "Design of Steel Structures", Nemchand& Bros., Roorkee
- Ramchandra, "Design of Steel Structures Vol – II", Standard Book House, Delhi
- Neal B.G., "Plastic Method of Structural Analysis", Chapman & Hall
- Beedle L.S., "Plastic Design of Steel Frames", John Wiley & Sons

References:

- Bureau of Indian Standards, "Handbook for Structural Engineers SP 6"
- INSDAG Kolkata, "Teaching Resource for Structural Steel Design"
- "Steel Designers Manual" ELBS

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand modes of structural collapse

CO2: Perform the plastic analysis and design of various determinant and in-determinant structures.

CO3: Adapt plastic theory of design for various structures

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BTCVE705F Water Power Engineering

Teaching Schemes: Lectures: 3 Hours/Week

Course Objectives:

1. To introduce hydraulic energy sources and methods of generation'
2. To provide information of components, layout, and arrangements of power station
3. To inculcate the knowledge of essential collateral components and their practical significance.

Course Contents

Module 1 **(08 Lectures)**

Introduction, Sources of Energy, Types of Power Plants, Choice of Type of Generation, Components of Water Project, Types of Hydro Power Schemes, General Layouts, Estimation of Hydro Power, Nature of Demand: Load Curve, Load Duration Curves, Load Factor, Firm Power Secondary Power

Module 2 **(08 Lectures)**

Intake, Types, Hydraulics of Intake, Trash Rack Transition, Conduits: Types, Economic Section, Power Canals, Pen-stock Types, Hydraulic Design, Anchor Blocks

Tunnels: Classification, Location, Hydraulic Design, Tunnel Linings

Surge Tank: Functions, Behavior, Location, Types of Surge Tanks, Basic Design Criteria of Simple Surge Tank, Forebay

Module 3 **(06 Lectures)**

General Arrangements of Power Station, Power House, Sub-structure and super structure Under Ground Power Station: Necessity, Types, Development and Economics

Module 4 **(06 Lectures)**

Turbines: Classification, Characteristics of Different Types, Choice of Specific Type, Turbine Setting and Cavitation, Tail Race: Functions, Types, Channel and Tunnel Draft Tubes

Module 5 **(04 Lectures)**

Pumped Storage Plants, Purpose, General Layout, Types, Typical Arrangements of the Upper Reservoirs, Economics of Pumped Storage Plants

Module 6 **(04 Lectures)**

Tidal Power Stations: Necessity, Advantages, Classification, Limitations

Text Books

1. Dandekar and Sharma, "Water Power Engineering", Vikas Pub. House Pvt. Ltd.

2. Bhattacharya P. K., "Water Power Engineering", Khanna Publications, New Delhi

3. Deshmukh M. M. "Water Power Engineering", Dhanapatrai and Sons N. Delhi

References

1. Creager and Justin, "Hydro – Electric Hand Book"

2. Brown G., "Hydro-electric Engineering Practice", Vol. I to III

3. Mosonvi, "Water Power Development"

Course Outcomes: On completion of the course, the students will be able to:

CO1: Identify potential energy sources and adapt as per the requirement

CO2: inculcate basics of electricity generation and power plants

CO3: propose suitable energy source for running a project optimistically.

BTCVOE706 A Advanced Structural Mechanics

Teaching Schemes: Lectures: 3 Hours/Week

Course Contents

Module 1:Review of basic concepts in structural analysis (06 Lectures)
structure, loads, response, statically determinate structures, principle of virtual work and displacement-based and force-based energy principlesderiving stiffness and flexibilitycoefficients,Force method, Displacement Methods

Module 2: Matrix concepts and Matrix analysis of structures (06 Lectures)
Matrix; vector; basic matrix operations;rank; solution of linear simultaneousequations; eigenvalues andeigenvectors.Introduction; coordinate systems;displacement and force transformationmatrices;Contra-gradient principle; element andstructure stiffness matrices;Element and structure flexibilitymatrices; equivalent joint loads;stiffness and flexibility approaches

Module 3:Matrix analysis of structures with axialelements: (08 Lectures)
Introduction:Axial stiffness and flexibility; stiffnessmatrices for an axial element (two dof),plane truss element (four dof) andspace truss element (six dof);One-dimensional axial structures:Analysis by conventional stiffnessmethod (two dof per element) andreduced element stiffness method(single dof); Analysis by flexibilitymethod;

Plane trusses:Analysis by conventional stiffness, method (four dof per element) andreduced element stiffness method(single dof); Analysis by flexibilitymethod;

Space trusses:Analysis by conventional stiffnessmethod (six dof per element) andreduced element stiffness method(single dof).

Module 4:Matrix analysis of beams and grids (10 Lectures)

Conventional stiffness method forbeams:Beam element stiffness (four dof);generation of stiffness matrix forcontinuous beam; dealing with internalhinges, hinged and guided-fixed endsupports; accounting for sheardeformations;

Reduced stiffness method for beams:Beam element stiffness (two dof);dealing with moment releases, hingedand guided-fixed end supports;

Flexibility method for fixed andcontinuous beams:Force transformation matrix; elementflexibility matrix; solution procedure (including support movements);Stiffness method for grids:Introduction; torsional stiffness of gridelement and advantage of torsionrelease; analysis by conventionalstiffness method using grid elementwith six dof; analysis by reducedstiffness method (three dof perelement);

Module 5:Matrix analysis of planeframes: (06 Lectures)
Conventional stiffness method for planeframes:Element stiffness (six dof); generationof structure stiffness matrix andsolution procedure; dealing withinternal hinges and various endconditions;

Reduced stiffness method for planeframes:Element stiffness (three dof); ignoringaxial deformations; dealing withmoment releases, hinged and guidedfixedend supports;

Flexibility method for plane frames:Force transformation matrix; elementflexibility matrix; solution procedure(including support movements);Ignoring axial deformations;

Module 6:Matrix analysis of spaceframes: (04 Lectures)
Stiffness method for space frames:Introduction; element stiffness matrixof space frame element with 12 dofand 6 dof; coordinate transformations;analysis by reduced stiffness method(six dof per element);

References

1. DevdasMenon, "Advanced Structural Analysis", Narosa Publishing House, 2009.
2. AsslamKassimali, "Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
3. Amin Ghali, Adam M Neville and Tom G Brown, "Structural Analysis: A Unified Classical and Matrix Approach", Sixth Edition, 2007, Chapman & Hall.
4. DevdasMenon, "Structural Analysis", Narosa Publishing House, 2008.

BTCVOE706B Air Pollution Control

Teaching Scheme: Lectures: 3 Hours / Week

Course Objectives:

a. To discuss the sources of air pollutants and their effect on human, plants and materials
b. To get the knowledge of meteorology for controlling air pollution
c. To facilitate students with design methodologies of air pollution control equipment
d. To make aware of legislation for prevention and control of air pollution

Course Contents

Module 1: Introduction to Air Pollution (04 Lectures)

The Structure of the atmosphere, Composition of dry ambient air and properties of air. BIS Definition and scope of Air Pollution, Scales of air pollution, Types of exposures.Air Pollutants,

Module 1: Classification (04 Lectures)

Classifications, Natural and Artificial, Primary and Secondary, point and Non-Point, Line and Area Sources of air pollution. Stationary and mobile sources, composition of particulate& gaseous pollutant, units of measurement.Effect of different air pollutants on man, animals, vegetation, property, aesthetic value and visibility, air pollution episodes. Global effects of air pollution- global warming, ozonedepletion, acid rain and heat island effect.

Module3: Meteorology and Air pollution (06 Lectures)

Solar radiation, wind circulation, factors affecting dispersion of pollutants, Lapse rate, stabilityconditions, wind velocity profile, Maximum mixing depth (MMD), visibility, Windrosediagram,General characteristics of stack plume (Plume behaviour). Gaussion diffusion modelfor finding groundlevel concentration. Plume rise. Formulae for stack height and determinationof minimum stack height.

Module4: Air Sampling and Analysis (06 Lectures)

Air pollution survey, basis and statistical considerations of sampling sites. Devices and methods used for sampling gases and particulates. Stack emission monitoring, isokinetic sampling. Analysis of air samples chemical and instrumental methods. Ambient air quality monitoring.

Module5: Photochemical Smog, Odour Pollution & Indoor Pollution (08 Lectures)

Chemistry of air pollution, Chain reactions of hydrocarbons, nitrogen oxide, Sulphuric oxidesand intermediates, photochemical smog formation, air pollution indices -aerosols, fog, smog index. Odour pollution: Theory, sources, measurement and methods of control of odour pollution. Indoor air pollution: Causes of air pollution, sources and effects of indoor air pollutants, changes in indoor air quality, control of indoor air pollutants and air cleaning systems.

Module6: Control of Air Pollution (08 Lectures)

By process modification, change of raw materials, fuels, process equipment and process operation by use of air pollution control equipment for particulate and gaseous pollutants. Design of control equipment as Settling chamber, cyclone, fabric filter, Electrostatic precipitator and Wet scrubber. Principles of removal of gaseous pollutants, design of incineration, absorption adsorption systems. Control of air pollution from automobiles.Vehicular pollution, composition, quantityandcontrol.Air (Prevention and Control) Pollution Act, 1981.Emission standards for stationary and mobile sources.National Ambient air quality standards, 2009 (NAAQS).

Text Books

1. Wark K. and Warner C. F. (1997) “Air pollution: Its Origin and Control” Pearson Education, Delhi
2. Rao M. and Rao H. V. N. (2017) “Air Pollution” Tata McGraw Hill Pub. Co. Ltd., New Delhi
3. Peavy S. H. and Rowe D. R. (2017) “Environmental Engineering” Tata McGraw Hill Pub. Co. Ltd., New Delhi
4. Muralio Krishna K. V. S. G. (2017) “Air Pollution and Control” Jain Brothers, Mumbai

Reference Books

1. Crawford M. (1984) “Air pollution Control Theory” McGraw Hill, New York
2. Anjaneyulu Y. (2002) “Air Pollution and Control Technologies” Allied Publishers, Mumbai
3. Raju B. S. N. (2018) “Fundamentals of Air Pollution” CBS Publishers and Distributors Pvt. Ltd., N. Delhi

Course Outcomes:On successful completion of this course the students will be able to

- Identify the sources of air pollutants and their effect on human, plants and materials.
- Apply knowledge of meteorology for controlling air pollution
- Design air pollution controlling equipment.
- Apply knowledge of legislation for prevention and control of air pollution.

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BTCVOE706C Bridge Engineering

Teaching Scheme: (3 Lectures) hours/week

Course Contents

Module 1: Introduction (4 Lectures)

History of bridges, components and definitions, classification of road bridges, span length, classical examples of each type, people involved in the total process, history of analysis

Module 2: Selection of site and initial decision process (8 Lectures)

Survey and alignment, geotechnical investigations and interpretations

River Bridge: Selection of bridge site and planning, collection of bridge design data, hydrological calculation, waterway calculation, scour calculation, depth of foundation, freeboard.

Road Bridge: Selection of bridge site and planning, collection of bridge design data, vertical clearance.

Module 3: Standard loading for bridge design as per different codes (6 Lectures)

Road Bridges: IRC, BS code, AASHTO code. dead load, live load, impact factor, centrifugal force, wind loads, hydraulic forces, longitudinal forces, seismic forces, earth pressure, buoyancy, lane concept, equivalent loads, trafficload, width of roadway and footway, use of influence lines for maximum forces in members, transverse distribution of live loads among deck longitudinal,load combinations for different working state and limit state designs.

Railway Bridges: Loadings for railway bridges, rail road data, pre-design considerations, rail road v/s highway bridges.

Module 4: Superstructures (6 Lectures)

Selection of main bridge parameters, design methodologies, choices of superstructure types: orthotropic plate theory, load distribution techniques, grillage analysis, finite element analysis (Preferable), different types of superstructure (RCC and PSC), Longitudinal analysis of bridge, slab bridge and voided slab bridge, beam-slab bridge, box girder bridge.

Transverse analysis of bridge: Slab bridge and voided slab bridge, beam-slab bridge, box girder bridge, temperature analysis, distortional analysis, effects of differential settlement of supports, reinforced earth structures.

Typical details: Slab bridge, slab-girder bridge (straight/skew), box girder bridge (straight/skew).

Module 5: Substructure (4 Lectures)

Pier, abutment, wing walls, importance of soil structure interaction

Foundations:open foundation, pile foundation, well foundation, examples - simply supported bridge, continuous bridge.

Module 6: Bearings and deck joints (6 Lectures)

Different types of bridge bearings and expansion joints, Design of bearings and joints.

Parapets for highway bridges: Definitions, classification of bridge parapets, various details

Text/Reference Books

- Victor D. J., Essentials of Bridge Engineering, Oxford & IBH.
- Raju N. K., Design of Bridges, Oxford & IBH.
- Ponnuswamy S., Bridge Engineering, Tata McGraw Hill
- Raina V K, "Handbook for Concrete Bridges" Vol. 1 and 2, Shroff Publishers, Mumbai
- Raina V. K., Concrete Bridge Practice, (Analysis, Design Economics), 4^{th} Edition, Shroff Publishers, Mumbai
- Raina V. K., Concrete Bridge Practice, (Construction, Maintenance, Rehabilitation),, 2^{nd} Edition, Shroff Publishers,
- Raina V. K., Field Manual for Highway and Bridge Engineers", 3^{rd} Edition, Shroff Publishers, Mumbai
- Raina V. K., "World of Bridges", Shroff Publishers, Mumbai

Course Outcomes: On completion of the course, the students will be able to:

1. Understand components of bridges and its various types.
2. Understand site selection criteria and comprehend various forces acting on bridges.
3. Analyze bridge structures using different analysis techniques.
4. Understand the importance of different types of bridge bearings.

BTCVOE706D Introduction to Earthquake Engineering

Course Objectives:

The main objectives of the course are:

1. To provide a coherent development to the students for the courses in sector of earthquake engineering.
2. To involve the application of scientific and technological principles of planning, analysis, design of buildings according to earthquake design philosophy.

Teaching Scheme: (3 Lectures) hours/week

Pre-Requisites: Structural Mechanics I & II

Course Contents

Module 1 **(6 Lectures)**

Elements of seismology: Terminology, structure of the earth, causes of an earthquake, seismic waves, magnitude and intensity, seismograph, strong motion earthquakes, Accelerogram, prominent earthquakes of India.

Module 2 **(6 Lectures)**

Structural dynamics: Free and forced vibrations of single degree of freedom systems, un-damped and viscously damped vibrations, equations of motion, Duhamel integral.

Module 3:(6 Lectures)

Response Spectrum Theory: construction of Design Response Spectrum, effect of foundation and structural damping on design spectrum, design spectrum of IS 1893, evaluation of lateral loads.

Module 4 **(6 Lectures)**

Principles of Earthquake Resistant Design (EQRD), planning aspects, resistance of structural elements and structures for dynamic load, design criteria, ductile detailing of RCC members, energy absorption, provisions of IS 13920.

Module 5 **(6 Lectures)**

Construction aspects of masonry and timber structures, retrofitting and strengthening techniques of low cost and low-rise buildings, provisions of IS 4326.

Module 6 (6 Lectures)

Dynamic properties of soils, field and Laboratory tests, site evaluation, behavior under dynamic loads, effect on bearing capacity, settlement, liquefaction.

Text Books

1. IS 456, IS 1498, IS 1893, IS 1905, IS 2131, IS 13920, IS 4326 of recent editions, Bureau of Indian Standards, New Delhi.

2. Chopra A.K. (2001). *Dynamics of Structures*, 2nd Edi, Pearson Education Pvt. Ltd., India, ISBN 81-7808-472-4.

3. Mario Paz,(1985). *Structural Dynamics*, CBS Publication.

4. Arya A.S., (1987). *Elements of Earthquake Engineering*, South Asian Pub., New Delhi.

Reference Books

1. Clough R.W. and Penzien J.(1993), Dynamics of Structures, McGraw Hill New York

2. Humar J. L., (2002). Dynamics of Structures, 2nd Edition Swets and Zeitlinger, Netherlands.

3. FarzadNaiem, (2001). The Seismic Design Handbook, Kluwer Academic Pub. Massachusetts, ISBN: 0-7923-7301-4.

4. Dowrick D. J., (1977). Earthquake Resistant Design for Engineers & Architects, John Wiley and Sons Ltd.
5. Pauley T. and Priestley M.J.N., (1992). Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons Inc., USA, ISBN 0-471-54915-0.
6. Nayak N. V., (1985). Foundation Design Manual, Dhanpatrai and Sons, Delhi.
7. Housner G.W. & Hudson D. E., (1950). Applied Mechanics- Dynamics, East-West Edition, N. Delhi.
8. Kramer S. L., (2003). Geotechnical Earthquake Engineering, Pearson Education.

Course Outcomes: On completion of the course, the students will be able to:

CO1 Capture complexities in earthquake resistant design of structures

CO2 Grasp Nature of earthquake vibration and associated forces on structures

CO3 Understand importance of designing the building to targeted seismic performance.

BTCVOE706E Town and Urban Planning

Teaching Scheme: Lectures: 3 Hours / Week

Course Objectives:

1. To discuss town and Urban planning with essential attributes
2. To provide information of various aspects involved town and Urban planning
3. To make students familiar with various standards, acts, laws and guidelines

Course Contents

Module 1: **(06 Lectures)**

Necessity and scope of Town Planning, Brief history, Greek and Roman Towns, Planning in ancient India - Indus Valley Civilization, Vedic Period, Buddhist Period, Medieval Period, Mogul Period, British Period, Post-Independence Period, Theories in urban and regional planning

Module 2: **(06 Lectures)**

Town Planners in Modern Era such as Sir Patrick Geddes, Sir Ebenezer Howard, Clarence stein, Sir Patrick Abercrombie, Le Corbusier, Present Status of Town Planning in India, Efficiency Measures, Planners skills, Integrated Area Planning in India. Distribution and sizes of Settlements

Module 3: **(06 Lectures)**

Layout of Residential Units, Neighborhood Unit Planning, Radburn Plan, Grid Iron Pattern, Shoe String Development, Growth Pattern of Towns, Concentric Satellite, Ribbon Development, Scattered growth

Module 4: **(08 Lectures)**

Elements of Town, Various Zones, Development Control Rules and Building Bye Laws, Urban Roads: Objective, Classification, Road Networks, Data Collection Surveys, Analysis of data,

Town aesthetics, Landscape Architecture, Suitability of Trees, Treatment of Traffic Islands, Open Spaces Walkways Public Sit-outs, Continuous Park System, Green ways

Module 5: **(04 Lectures)**

Town Planning works with reference to M.R.T.P. Act, Land Acquisition Act, Necessity and procedure of acquisition

Module6: **(04 Lectures)**

Village Planning, Multilevel Planning, Decentralization Concepts, Rural Developments, Planning Methodology, Growth Centre Approach, Area Development Approach, Integrated Rural Development Approach

Text Books:

1. Hiraskar G.K. (2018) “Town and country Planning”DhanpatRai Publication, N. Delhi
2. Rangawala S.C. (2015) “Town Planning”, Charotar Publications, Anand
3. Sundaram K.V. (1978) “Urban and Regional Planning in India”, Vikash Publishing House Pvt. Ltd.
4. MRTP Act 1966 & 2002
5. Land Acquisition Act - 1894
6. Misra S. N. (1984) “Rural Development Planning-Design and Method”, Satvahan Publications, N. Delhi

Reference Books

1. Eisner S. and Gallion A. (1993) “The Urban Pattern”, John Wiley & Sons, N. Delhi

Outcomes: Upon completion of the course the students will be able to:

1. Understand town and Urban planning and their essential attributes
2. Identify elements of planning and regulations of the same
3. Implement guidelines provided by standard authorities

BTCVOE706F Tunneling and Underground Excavations

Course Objectives:

The main objectives of the course are:

1. To understand the need of utilization of Underground Space for various applications.
2. To develop the plan for infrastructure for transport.

Teaching Scheme: Lectures: 3 hours/week

Course Contents

Module 1 **(06 Lectures)**

Tunneling Methods: Types and purpose of tunnels; factors affecting choice of excavation technique; Methods - soft ground tunneling, hard rock tunneling, shallow tunneling, deep tunneling; Shallow tunnels – cut and cover, cover and cut, pipe jacking, jacked box excavation techniques, methods of muck disposal, supporting, problems encountered and remedial measures.

Module 2 **(08 Lectures)**

Tunneling by Drilling and Blasting: Unit operations in conventional tunneling; Drilling – drilling principles, drilling equipment, drilling tools, drill selection, specific drilling; Blasting - explosives, initiators, blasting mechanics, blast holes nomenclature; types of cuts- fan, wedge and others; blast design, tunnel blast performance - powder factor, parameters influencing, models for prediction; mucking and transportation equipment selection.

Module 3 **(06 Lectures)**

Tunneling by Road headers and Impact Hammers: Cutting principles, method of excavation, selection, performance, limitations and problems.Tunneling by Tunnel Boring Machines: Boring principles, method of excavation, selection, performance, limitations and problems; TBM applications.

Module 4 **(06 Lectures)**

Excavation of large and deep tunnels Introduction; purpose and use of large and deep tunnels; excavation issues governing large and deep tunnels; excavation methods of large and deep tunnels - unit operations, different equipment, types of rock

pressure and methods to deal, roof and wall supports, case studies from hydel, road and rail tunnels.

Module 5 **(6 Lectures)**

Shield Tunneling: Introduction; advantages of shield tunneling; classification; different types of shield tunneling techniques – open shield, close shield, half shield; conventional shields, special features in shield tunneling; factors affecting selection of a shield; slurry shield, earth pressure balance shield, slime shields, other shield development methods, problems encountered with possible remedies.

Module 6 **(4 Lectures)**

Submerged and Floating Tunnels; Micro-tunneling; Trenchless excavation. Novel Excavation Techniques: Penetrating Cone Fracture, Bottom-hole pressurization, expanding cements, Diamond wire saw.

Text Books:

1. Srinivasan R., (2016). *Harbour, Docks and Tunnel Engineering*, Charotar Pub. House.
2. Saxena S. C. (2015). *Tunnel Engineering*, DhanpatRai Publications.
3. Tatiya R. R., (2013), *Surface and Underground Excavation*, CRC Press.

References:

2. Stack, B. (1982). Handbook of Mining and Tunnelling Machinery, Wiley, New York.
3. Chugh, C.P., (1977). Drilling Technology Handbook, Oxford & IBH Publication.
4. Bickel J.O. and. Kuesel T.R, (2018). Tunnel Engineering Handbook, CBS Publishers and Distributors Pvt. Ltd.
5. Brebbia C.A., Kaliampakos D., Prochazka P., (2008). Underground Spaces Design, Engineering and EnvironmentalAspects, WIT Press,

Web links:

1. https://www.isrm.net
2. www.nirm.in
3. http://umich.edu/~gs265/tunnel.html
4. http://se.sze.hu/images/ngm_se108_1/Tunnels_2015-03-20_Toth_1-Excavation.pdf
5. https://www.usbr.gov/ssle/safety/RSHS/sec23.pdf
6. https://www.osha.gov/Publications/osha3115.html

Course Outcomes: On completion of the course, the students will be able to:

CO1: Understand types of tunnels and tunneling methods conforming to site conditions

CO2: Investigate various tunneling operations and relevant machinery required

CO3: Understand methods and operations of excavating large and deep tunnels

CO4: Propose suitable tunneling and excavations methods to optimize the same.

BTCVL707 Design Drawing of RC & Steel Structures

Practical: 2 Hours / Week Term Work: 50 Marks

Part A -Design and Drawing of Steel Structures

Term work shall consist of detailed analytical report for structural design and drawing of any one of the following steel structures. Student may use IS 800 1984 or 2007.

1) Industrial Shed: Roof Truss with Necessary Bracing System, Purlins, Column and Column Bases

2) Industrial Shed: With Portal or Gable Frames of Solid or Open Web Sections with Necessary Bracing System, Purlins, Column and Column Bases

3) Industrial Shed: Gantry Girder, Columns with Necessary Bracing System, Purlins, Column and Column Bases

4) G + 3 Building Structure

Part B - Design and Drawing of RC Structures

Term work shall consist of detailed analytical report for structural design and drawing of any one of the following RC structures:

1) G + 2 Building

2) Elevated water tank: analysis and design of staging and tank body.

Course Outcomes: On completion of the course, student will be able to simulate a practical design requirement in to a theoretical statement to solve mathematically to arrive at a safe economical and realistic feasible solution that can be executed.

BTCVL708 Professional Practices Laboratory

Practical:2 Hours / Week

Term work include detailed study and working of following set of assignments
1) Detailed estimate for a two storied RCC or load bearing wall building
2) Preparing detailed estimate for any four of the following:
- a) A small culvert
- b) A stretch of a road about 1 Km. long including earthwork
- c) A reach of canal about 1 Km. long
- d) A percolation tank
- e) A factory shed of steel frame

f) Water supply scheme
g) Drainage scheme
h) Water Treatment plants.

3) Valuation report including valuation certificate for any one of the following:
a) A building for residential purpose or commercial purpose
b) A hotel
c) A theatre
d) Any one construction machine.

4) Drafting of Detailed specification for any five civil engineering items. This shall include at least one item each from Roads, Irrigation works, Water Supply, Sanitation and buildings

Assignment (1) and (2) shall include Rate Analysis of at least two items.

BTCVT709 Field Training /Internship/Industrial

Students are expected to undergo industrial training for at least four weeks at factory / construction site / design offices or in combination of these after VI semester. Training session shall be guided and certified by qualified engineer / architect / contractor in civil engineering. A neat detailed report on activities carried out during training is expected. Students should undergo training in Summer Vacation after Semester VI and appear at examination in Semester VII. A brief report of field training shall be submitted. Evaluation shall be based on report and power point presentation.

BTCVS710 Seminar

Student shall choose a topic of his/her interest in consultation with faculty in the department. The topic for seminar may be related to Recent Developments in Civil Engineering area and/or interdisciplinary area. Student shall attempt to collect necessary information and present a summary indicating comprehension of the topic and acquired depth of knowledge. A brief report on topic of seminar shall be submitted. Evaluation shall be based on report and power point presentation.

BTCVP711 Project Stage I

Term work shall consist of detailed report for chosen topic and output of final working proposed. Report shall summarise the literature survey, spell out the scope of work, methodology and results. Viva-voce Examination shall be based on work carried out by the student. In case of students opting for Internship in the eighth semester, the Project must be industry-based.

Detailed Syllabus (VIII Semester)

BTCVSS801 Characterization of Construction Materials

By Prof. Manu Santhanam, Prof. PiyushChaunsali IIT Madras

The objective of the course is to introduce students to the characterization of construction materials and their behaviour, with a view of developing their understanding of the mechanisms that govern the performance of these materials. The course will be focused primarily on cement and concrete, and include the following techniques; the physics of the techniques and their application to cement science, including lab demonstrations and experiments will be covered.

Week 1: Introduction to course; Structure of Construction Materials – An Overview
Week 2: Calorimetry
Week 3: X-ray diffraction
Week 4: X-ray diffraction
Week 5: Thermal analysis
Week 6: Surface area measurement
Week 7: Optical microscopy
Week 8: Scanning electron microscopy
Week 9: Image analysis
Week 10: Spectroscopic techniques
Week 11: Mercury intrusion porosimetry
Week 12: Impedance analysis and ultrasonic methods

1. Karen Scrivener, Ruben Snellings, Barbara Lothenbach, A Practical Guide to Microstructural Analysis of Cementitious Materials, CRC Press, 2015.
2. V. S. Ramachandran and James J. Beaudoin, Eds., Handbook of Analytical Techniques in Concrete Science and Technology, William Andrew Publishing, New York, 2001.
3. D A St. John, A. W. Poole, and I. Sims, Concrete Petrography – A Handbook of Investigative Techniques, Arnold Publishing.London, 1998.
4. William D. Callister, Materials Science and Engineering: An Introduction, Sixth Edition, John Wiley and Sons, 2003.
6. J. M. Illston and P. L. J. Domone, Construction Materials – Their Nature and Behaviour, Third Edition, Spon Press, 2001.
5. Jan Skalny, Editor, Materials Science of Concrete, Volumes I – VII, American Ceramic Society, 1989 – 2005.
7. J.F. Young, S. Mindess, R.J. Gray and A. Bentur, The Science and Technology of Civil Engineering Materials, Prentice Hall, 1998.

Link - https://swayam.gov.in/nd1_noc20_ce01/preview

BTCVSS801B Geosynthetics and Reinforced Soil Structures

Link - https://nptel.ac.in/content/syllabus_pdf/105106052.pdf

BTCVSS801C Higher Surveying

Link - https://swayam.gov.in/nd1_noc20_ce16/preview

BTCVSS801D Maintenance and Repair of Concrete Structures

Link-https://nptel.ac.in/content/syllabus_pdf/105106202.pdf

BTCVSS801E Structural Dynamics

Link- https://swayam.gov.in/nd1_noc20_ce21/preview

BTCVSS802A Energy Efficiency Acoustics & Daylighting in Building

Link-https://swayam.gov.in/nd1_noc20_ce08/preview

BTCVSS802B Environmental Remediation of Contaminated Sites

Link-https://swayam.gov.in/nd1_noc20_ce31/preview

BTCVSS802C Remote Sensing Essentials

Link-https://swayam.gov.in/nd1_noc20_ce29/preview

BTCVSS802D Mechanical characterization of Bituminous Materials

Link- https://swayam.gov.in/nd1_noc20_ce04/preview

BTCVSS802E Soil Structure Interaction

Link-https://swayam.gov.in/nd1_noc20_ce22/preview

BTCVC803 Project Stage II or Internship

Term work shall consist of detailed report for chosen topic and output of final working proposed in previous semester. Report shall summarise the literature survey, spell out the scope of work, methodology and results.

Viva-voce Examination shall be based on work carried out by the student.

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Dr. Babasaheb Ambedkar Technological University
(Established as University of Technology in the State of Maharashtra) (Under Maharashtra Act No. XXIX of 2014)
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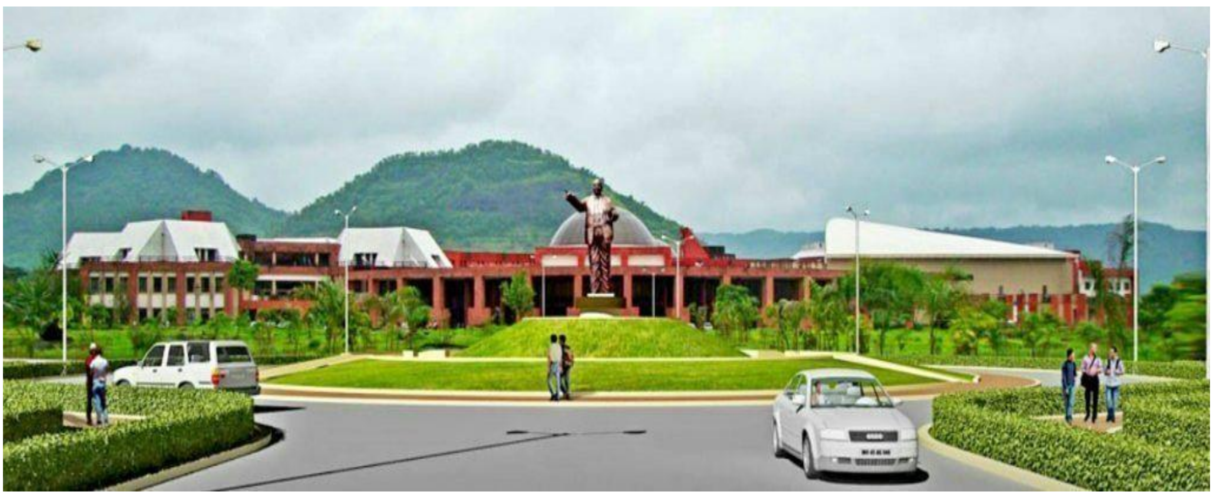
CURRICULUM

UNDER GRADUATE PROGRAMME

B.TECH.

Final Year MECHANICAL ENGINEERING/MECHANICAL ENGINEERING(SANDWICH)

ACADEMIC YEAR 2023-2024



Abbreviations

BSC: *Basic Science Course*

ESC: *Engineering Science Course*

PCC: *Professional Core Course*

PEC: *Professional Elective Course*

OEC: *Open Elective Course*

HSSMC: *Humanities and Social Science including Management Courses*

PROJ: *Project work, seminar and internship in industry or elsewhere*

Course Structure for Semester VII
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) (2023-24)

Semester VII										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC15	BTMC701	Mechatronics	3	-	-	20	20	60	100	3
HSSMC4	BTHM702	Industrial Engineering and Management	3	-	-	20	20	60	100	3
PEC5	BTMPE703A-G BTPPE703D	Elective-V	3	-	-	20	20	60	100	3
OEC3	BTMOE704A-C	Open Elective-III	3	-	-	20	20	60	100	3
OEC4	BTMOE705A-C	Open Elective-IV	3	-	-	20	20	60	100	3
PCC16	BTMCL706	Mechanical Engineering Lab –V	-	-	4	60	-	40	100	2
PROJ-6	BTMP 707	Mini Project			6	30		20	50	3
PROJ-7	BTMI609	IT – 3 Evaluation	-	-	-	-	-	100	100	1
		Total	**15**	-	**10**	**190**	**100**	**460**	**750**	**21**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Elective V:

Sr. No	**Course code**	**Course Name**
1	BTMPE703A	Design of Air Conditioning Systems
2	BTMPE703B	Biomechanics
3	BTMPE703C	Non-conventional Machining
4	BTMPE703D	Advanced IC Engines
5	BTMPE703E	Additive Manufacturing
6	BTMPE703F	Surface Engineering
7	BTPPE703D	Processing of Polymers
8	BTMPE703G	Stress Analysis

Open Elective III:

Sr. No	**Course code**	**Course Name**
1	BTMOE704A	Sustainable Development
2	BTMOE704B	Entrepreneurship Development
3	BTMOE704C	Plant Maintenance

Open Elective IV:

Sr.No	Course code	Course Name
1	BTMOE705A	Engineering Economics
2	BTMOE705B	Biology for Engineers
3	BTMOE705C	Intellectual Property Rights

Course Structure for Semester VIII

B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) 2023-24

Semester VIII										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**Credit**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
		Choose any two subjects from ANNEXURE-A#				20	20	60	100	3
						20	20	60	100	3
PROJ-8	BTMP801/ BTMI801	Project OR Internship	-	-	16	60	-	40	100	08
		Total	**-**	**-**	**16**	**100**	**40**	**160**	**300**	**14**

ANNEXURE-A# (Provisional)

Recommendations of 8th Semester Courses in Self-study Mode from NPTEL/ SWYAM Platform,

THE LIST MAY ALTER AND MODIFY AS PER THE AVAILABILITY OF THE SUBJECTS ON THE NPTEL/ SWYAM Platform AND USEFULNESS, EVERY YEAR

Sr No	Course Code	Course Name	Duration (Weeks)	Institute Offering Course	Name of Professor
1	BTMEC801A	Fundamentals of Automotive Systems	12 Weeks	IITM	Prof. C. S. Shankar Ram
2	BTMEC801B	Mechanics of Fiber Reinforced Polymer Composite Structures	12 Weeks	IITG	Prof. Debabrata Chakraborty
3	BTMEC801C	Explosions and Safety	12 Weeks	IITM	Prof. K. Ramamurthi
4	BTMEC801D	Material Characterization	12 Weeks	IITM	Prof. Sankaran.S
5	BTMEC801E	Dealing with materials data : collection, analysis and interpretation	12 Weeks	IISc	Prof. M P Gururajan
6	BTMEC801F	Non-Conventional Energy Resources	12 Weeks	IITM	Prof. Prathap Haridoss

Six months of Internship in the industry

 # These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source

 # Student doing project in Industry will give NPTEL Examination/Examination conducted by the University i.e. CA/MSE/ESE

 # Students doing project in the Institute will have to appear for CA/MSE/ESE

Total Credits: 161 (Batch 20-24)

Semester - VII

Mechatronics

BTMC701	PCC15	Mechatronics	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define sensor, transducer and understand the applications of different sensors and transducers
CO2	Explain the signal conditioning and data representation techniques
CO3	Design pneumatic and hydraulic circuits for a given application
CO4	Write a PLC program using Ladder logic for a given application
CO5	Understand applications of microprocessor and micro controller
CO6	Analyse PI, PD and PID controllers for a given application

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	3	2				2	1		1
CO2	3	2			3	3	2				1	3
CO3	1	1		3	3	2	1		3		1	3
CO4	3	3	1	1	3		1	1	1			
CO5	3			1	3	2	3					2
CO6		3	3		3	3	1	1	3			2

Course Contents:

Unit 1: Introduction **[07 Hours]**

Introduction to Mechatronic systems, elements, advantages; practical examples of Mechatronic systems.

Sensors and Transducers: Various types of sensors and transducers used in Mechatronic system such as pressure sensors, temperature sensors, velocity sensors, Acceleration sensors, proximity sensors, position sensors, force sensors, Optical encoders, Capacitive level sensor, tactile sensors, Selection of sensors.

Unit 2: Signal Conditioning and Data Representation **[07 Hours]**

Types of electronic signals, Need for signal processing,Operational amplifiers: Types, classification and applications, Opto-isolators, Protection devices, Analogue to Digital and Digital to Analog Converters, Interfacing devices, Electro-magnetic Relays.

Data representation systems, Displays, Seven segment displays, LCD displays, Printers, Data loggers, Data Acquisition Cards/Systems

Unit 3: Drives **[07 Hours]**

Electrical Drives: Types of Electrical Motors, AC and DC motors, DC servomotors, Stepper motors, linear motors, etc.

Pneumatics and Hydraulics: Components of Pneumatic systems, actuators, direction control valves, pneumatic air preparation, FRL unit, methods of actuation of valves, Sequencing of Pneumatic cylinders using Cascade and shift register methods. Electro-pneumatic valves, Electro- pneumatic circuits using single and double solenoid methods.
Hydraulic cylinders, design of cylinder, Design of Piston and piston rod, Valves, poppet valve, house pipes and design of tubing, Meter-in and Meter-out circuits.

Unit 4: Microprocessor and Microcontroller [07 Hours]

8085 microprocessor: architecture, various types of registers and their functions in 8085µP, Instruction sets, interfacing, applications. 8081 microcontroller: architecture, Instruction sets, various pins and their functions interfacing, applications.

Programmable Logic Controller: Introduction, Architecture, Types of inputs/outputs, Specifications, guidelines for Selection of PLCs, Programming: Ladder logic and FBD

Unit 5: Control Systems and its Stabilty [07 Hours]

Open and closed loop system; block diagram manipulation/reduction, Transfer function, modeling of Mechanical Systems using Spring, Dashpot and Mass equivalence.

Stability of Systems

On/Off controller, Proportional Control, Integral control, Derivative Control; PI, PD and PID Controllers, Introduction to control using state variable system models, Bode Plots and stability criteria.

Texts:

1. HMT Limited, "Mechatronics", Tata McGraw Hill Publications, 1998.
2. W. Bolton, "Mechatronics; Electronic Control System in Mechanical Engineering", Pearson Education Asia, 1999.
3. Raven, "Automatic Control Engineering", Tata McGraw Hill Publications, New York, 1986.

References:

1. R. K. Rajput, "A textbook of Mechatronics", S. Chand and Co., 2007.
2. Michael B. Histand, David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", Tata McGraw Hill International Editions, 2000.
3. D. A. Bradley, D. Dawson, N. C. Buru, A. J. Loader, "Mechatronics", Chapman and Hall, 1993

Industrial Engineering and Management

BTHM702	HSSMC4	Industrial Engineering and Management	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Impart fundamental knowledge and skill sets required in the Industrial Management and Engineering profession, which include the ability to apply basic knowledge ofmathematics, probability and statistics, and the domain knowledge of IndustrialManagement and Engineering
CO2	Produce ability to adopt a system approach to design, develop, implement and innovate

	integrated systems that include people, materials, information, equipment and energy.
CO3	Understand the interactions between engineering, businesses, technological and environmental spheres in the modern society.
CO4	Understand their role as engineers and their impact to society at the national and global context.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											2	1
CO2									2	2	2	
CO3								2				
CO4								2				2

Course Contents:

Unit 1: Introduction [07 Hours]
Managing and managers, management- science, theory and practice, functions of management, evolution of management theory, contributions of Taylor, Fayol and others.
Planning: The nature and purpose of planning, objectives, strategies, policies and planning premises, decision making.
Organizing: The nature and purpose of organizing, departmentation, Line/ staff authority and decentralization, effective organizing and organizational culture.

Unit 2: Human Resource Management [07 Hours]
Staffing: Human resource management and selection, orientation, apprentice training and Apprentice Act (1961), performance appraisal and career strategy, job evolution and merit rating, incentive schemes.
Leading: Managing and human factor, motivation, leadership, morale, team building, and communication.
Controlling: The system and process of controlling control techniques, overall and preventive control.

Unit 3: Production/Operations Management [07 Hours]
Operations management in corporate profitability and competitiveness, types and characteristics of manufacturing systems, types and characteristics of services systems.
Operations planning and Control: Forecasting for operations, materials requirement planning, operations scheduling.

Unit 4: Design of Operational Systems [07 Hours]
Product/process design and technological choice, capacity planning, plant location, facilities layout, assembly line balancing, and perspectives on operations systems of the future.

Unit 5: Introduction to Industrial Engineering and Ergonomics [07 Hours]
Scope and functions, history, contributions of Taylor, Gibreth, Gantt and others.
Work Study and Method Study: Charting techniques, workplace design, motion economy principles.
Work Measurement: Stopwatch time study, micromotion study, predetermined time system (PTS), work sampling.
Ergonomics
Basic principles of ergonomics
Concurrent Engineering: Producibility, manufacturability, productivity improvement.
Total Quality Management: Just in time (JIT), total quality control, quality circles, six sigma.

Texts:

1. H. Koontz, H. Weirich, "Essentials of Management", Tata McGraw Hill book Co., Singapore, International Edition, 5th edition, 1990.
2. E. S. Buffa, R. K. Sarin, "Modern Production/Operations Management", John Wiley and Sons, New York, International Edition, 8th edition, 1987.
3. P. E. Hicks, "Industrial Engineering and Management: A New Perspective", Tata McGraw Hill Book Co., Singapore, International Edition, 2nd edition, 1994.

References:

1. J. L. Riggs, "Production Systems: Planning, Analysis and Control", John Wiley & Sons, New York, International Edition, 4th edition, 1987.
2. H. T. Amrine, J. A. Ritchey, C. L. Moodie, J. F. Kmec, "Manufacturing Organization and Management", Pearson Education, 6th edition, 2004.

International Labour Organization (ILO), "Introduction to Work Study", International Labour Office, Geneva, 3rd edition, 1987.

Elective V

Design of Air-Conditioning Systems

BTMPE703A	PEC5	Design of Air-Conditioning Systems	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Basic Air conditioning

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the cooling load calculation
CO2	Explain concept of ventilation and its implementation
CO3	Learn duct design applied to real life situation
CO4	Learn and differentiate the various modern air conditioning systems/units

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2		2	1	1	1			1	
CO2	3	3				1	2					
CO3	3	3	3	2	2	1	1	1			2	
CO4		1	1	1		1	1	1				

Course Contents:

Unit1: Introduction **[07 Hours]**

Moist Air properties, Psychrometry of various air condition processes, SHF, dehumidified air quantity, HVAC Equipment

Unit2: Human Comfort **[07 Hours]**

Human comfort, environment comfort indices, clothing resistance, metabolisms, indoor air quality, ventilationair,insidedesignconditions, outsidedesign conditions.

Unit3: Heat Flow **[07 Hours]**

Heat Flow in Buildings, Building Heat Transfer, Cooling Load Calculation, Ventilation load, Effective sensible heat factor and selection of air conditioning apparatus.

Unit4: Air Diffusion **[07 Hours]**

Room air diffusion, filtration, duct design, pressure drop, air distribution design, outlets

Unit 5: Air Conditioning Systems and its equipment **[07 Hours]**

Air conditioning systems; constant volume, VAV, terminal reheat systems, single zone and multi zone systems, dual duct system, fan coil unit, noise control.

Air Conditioning Equipment: Fans, pumps and blowers, performance & selection

Texts:

1. W. F. Stoecker, J. P. Jones, "Principles of Refrigeration and Air Conditioning", Tata McGraw Hill Publications.
2. C. P. Arora, "Refrigeration and Air Conditioning",Tata McGraw Hill Publications.
3. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International, 3rd edition, 2011.
4. R. C. Arora, "Refrigeration and Air Conditioning", PHI Learning Pvt. Ltd., 2010.

References:

1. "Handbook of Air Conditioning System Design", Carrier Air Conditioning Co., 1965.
2. W. P. Jones,"AirConditioning Engineering",EdwardArnoldPublishersLtd., London,1984.
3. JamesL. Threlkeld, "ThermalEnvironmentalEngineering",PrenticeHall, New York, 1970.

Biomechanics

BTMPE703B	PEC 5	Biomechanics	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain various forces and mechanisms and define Newton's law of motion, work and energy, moment of inertia
CO2	Describe forces and stresses in different human joints
CO3	Discuss bio fluid mechanics in cardiovascular and respiratory system in human body
CO4	Differentiate between hard tissues and soft tissues
CO5	Understand concepts of implants and Identify different techniques used in biomechanics implants

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1			1	1	1	1		1	1
CO2	2	2	2			1	2		1		1	1
CO3	2	2	2			1	1	1	1			1
CO4	1	1	1				1	1	1			1
CO5	1	1	2				1	1			1	1

Course Contents:

Unit 1: Introduction **[07 Hours]**
Review of principle of mechanics, vector mechanics-resultant forces of coplanar and non-coplanar and concurrent and non-concurrent forces, parallel forces in planes, equilibrium of coplanar forces, Newton's law of motion, work and energy, moment of inertia.

Unit 2: Biomechanics of Joints **[07 Hours]**
Skeletal joints, forces and stresses in human joints, type of joints, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle.

Unit 3: Bio-fluid Mechanics **[07 Hours]**
Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, cardiovascular and respiratory system.

Unit 4: Hard Tissues **[07 Hours]**
Bone structure and composition, Mechanical properties of bones, cortical and cancellous bones, visco-elastic properties, Maxwell and Vigot model – Anisotropy

Unit 5: Soft Tissues and Biomechanics of Implant **[07 Hours]**
Structure and functions of soft tissue: cartilage, tendon, ligament and muscle, Material properties of cartilage, tendon and ligament and muscle

Biomechanics of Implant: Specification for prosthetic joints, biocompatibility, requirement of biomaterial, characterization of different type of biomaterials, fixation of implants.

Texts/References:
1. Y. C. Fung, "Biomechanics: Mechanical properties of living tissues", Springer-Verlag, 2nd edition, 1993.

D. J. Schneck, J. D. Bronzino, "Biomechanics: Principle and Applications", CRC Press, 2nd edition, 2000.

Non-conventional Machining

BTMPE703C	PEC5	Non-conventional Machining	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks

	End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Manufacturing Processes

Course Outcomes: At the end of the course, students will be able to:

CO1	Classify Non-conventional machining processes.
CO2	Understand working principle and mechanism of material removal in various non-conventional machining processes.
CO3	Identify process parameters their effect and applications of different processes.
CO4	Summarized merits and demerits of non-conventional machining processes.
CO5	Explain the mechanism to design hybrid processes such as ELID grinding, EDCG, EDCM, etc.
CO6	Understand mechanism and working principle of micro machining using non-conventional processes.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	1	1	1				1		1
CO2	2	2	1		2	1	1			1		1
CO3	2	2	1	1	2	1	1			1		1
CO4	2	2	1		2	1	1			1		1
CO5	3	2	1	1	2	2	1			1		1
CO6	2	2	1	1	1	2	1			1		1

Course Contents:

Unit 1: Introduction to Non-Conventional Machining Processes [07 Hours]

An overview, Trends in manufacturing, Classification of Non-Conventional Machining processes.

Unit 2: Chemical and Electrochemical Processes [07 Hours]

Introduction, Types: CHM, ECM, Electrochemical grinding, electrochemical deburring, electrochemical honing, Mechanism of material removal, Process characteristics, Process parameters, Equipment and Tooling (maskants and etchants), Advantages, applications and limitations.

Unit 3: Thermo-Electrical Processes [07 Hours]

Electrical discharge machining, Electron beam machining, Ion beam machining, Plasma arc machining, Hot machining, Mechanism of material removal, Process characteristics, Process parameters, Equipment and Tooling, Advantages, applications and limitations.

Unit 4: Mechanical Processes[07 Hours]

Ultrasonic machining, Abrasive jet machining, Abrasive flow machining, Water Jet cutting, Mechanism of material removal, Process characteristics, Process parameters, Equipment and Tooling, Advantages, applications and limitations.

Unit 5: Laser Based Machining Processes and Hybrid Processes [07 Hours]

Types of lasers, Laser beam generation, Equipment and machining procedure, Process characteristics, Process parameters, Advantages and limitations of LBM, Applications.

Hybrid Processes

Concept, Mechanism of material removal, Process characteristics, Process parameters, Equipment and Tooling, classification, applications, advantages, Shaped tube electrolytic machining, Electrical discharge wire cutting, ELID grinding, Micro machining: Micro EDM, Micro ECM, Electro discharge chemical grinding (EDCG).

Texts:

1. P. C. Pande, H. S. Shan, "Modern Machining Process", Tata McGraw-Hill Publications, New Delhi, 1980.
2. V. K. Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd., New Delhi, 2002.
3. P. K. Mishra, "Non-Conventional Machining", Narosa Publishing House, New Delhi, 2007

References:

1. P. C. Wellar, "Non-Traditional Machining Processes", SME, Michigan, 1984.
2. Gary F. Benedict, "Non-traditional Manufacturing Processes", Marcel Dekker, 1987.

Advanced IC Engines

BTMPE703D	PEC 5	Advanced IC Engines	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: IC Engines

Course Outcomes: At the end of the course, students will be able to:

CO1	Define and Distinguish between Spark ignition and Compression ignition system. Describe Air- fuel supply systems in ic engines.
CO2	Identify and Demonstrate normal and abnormal combustion in combustion chambers of IC engines. According to which able to analyse and Design combustion chambers.
CO3	Recognize and discuss engine emissions formation, effects and various methods to reduce emissions and their measuring equipment's.
CO4	Understand combustion and emission characteristics of an alternative energy sources and suggest appropriate applications of alternative fuels such as bio diesels, natural gas, LPG, hydrogen, etc. and their Engine modifications for using these fuels.
CO5	Apply and interpret with the recent trends IC engine techniques such as HCCI, CRDI, GDI, etc. with latest measuring equipments.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		1		1							
CO2		2	3									
CO3		1				2	2					
CO4		1		2	1		1					
CO5					2	2	1					

Course Contents:

Unit 1: Spark Ignition Engines **[07 Hours]**

Mixture requirements, Fuel injection systems, Monopoint, Multipoint & Direct injection, Stages of combustion: Normal and Abnormal combustion, Knock: Factors affecting knock, Combustion chambers.

Unit 2: Compression Ignition Engines **[07 Hours]**
Diesel Fuel Injection Systems, Stages of combustion, Knocking, Factors affecting knock, Direct and Indirect injection systems, Combustion chambers, Fuel Spray behaviour, Spray structure and spray penetration, Air motion, Introduction to Turbo charging.

Unit 3: Pollutant Formation and Control **[07 Hours]**
Pollutant, Sources, Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particulate matter, Methods of controlling Emissions, Catalytic converters, Selective Catalytic Reduction and Particulate Traps, Methods of measurement, Emission norms and Driving cycles.

Unit 4: Alternative Fuels and Multi-fuel Engines **[07 Hours]**
Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel: Properties, Suitability, Merits and Demerits, Engine Modifications.
Multi-fuel Engines: Multi-fuel engines, HCCI, GDI, and Exhaust after processing devices.

Unit 5: Recent Trends/Developments **[07 Hours]**
Air assisted Combustion, Homogeneous charge compression ignition engines, Variable Geometry turbochargers, Common Rail Direct Injection Systems, Hybrid Electric Vehicles – NOxAdsorbers, Onboard Diagnostics.

Unit 6: Multi-fuel Engines

Texts:
1. V. Ganesan, "Internal Combustion Engines", TMH, 2nd edition, 2002.
2. R. B. Mathur, R. P. Sharma, "Internal Combustion Engines", DhanpatRai& Sons 2007.
3. E. F. Obert, “Internal Combustion Engines”.

References:
1. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.
2. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995.

Additive Manufacturing

BTMPE703E	PEC5	Additive Manufacturing	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the importance of Additive Manufacturing
CO2	Classify the different AM processes
CO3	Design for AM processes
CO4	Understand the applications of AM
CO5	Differentiate the post processing processes

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	2	2					1
CO2	2	2	3	3	3	3	1					1
CO3	2	2	3	3	3		2					1
CO4	3	3	3	2	2	2	2					1
CO5	2	3	3	2	2	2	2					1

Course Contents:

Unit 1: Introduction to Additive Manufacturing (AM) [07 Hours]

Introduction to AM, AM evolution, Distinction between AM and CNC machining, Advantages of AM.

AM process chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machine setup, build , removal and clean up, post processing.

Classification of AM processes: Liquid polymer system, discrete particle system, molten material systems, and solid sheet system.

Unit 2: Design for AM [07 Hours]

Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools for AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturing Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markings/ numbers etc.

Unit 3: Guidelines for Process Selection [07 Hours]

Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control

Unit 4: AM Applications [07 Hours]

Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analysis models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples for Aerospace, defence, automobile, Bio-medical and general engineering industries

Unit 5: Post Processing of AM Parts and Future Directions of AM [07 Hours]

Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

Future Directions of AM

Introduction, new types of products, employment and digiproneurship.

Texts:

1. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles and Applications", World Scientific, 2003.
2. Ian Gibson, David W. Rosen, Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2nd edition, 2010.

References:

1. Ali K. Kamrani, EmandAbouel Nasr, "Rapid Prototyping: Theory and Practice", Springer, 2006.
2. D. T. Pham, S. S. Dimov, "Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling", Springer, 2001.
3. Andreas Gebhardt, "Understanding Additive Manufacturing", Hanser Publishers, 2011.

Surface Engineering

BTMPE703F	PEC5	Surface Engineering	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Learn the importance and need of surface engineering
CO2	Describe various surface cleaning and modification techniques
CO3	Understand the concepts of surface integrity
CO4	Compare various surface coating technologies
CO5	Select appropriate method of coating for a given application
CO6	Apply measurement techniques and carry out characterization of coated surfaces.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2		1							1		1
CO2	2				2							
CO3	2	2	1	2						1		
CO4	2				1	1		1		1		
CO5	2	2	1		1		1	1	1	1	1	
CO6	2	2	1	2	2			1	1	1		

Course Contents:

Unit 1: Introduction **[07 Hours]**

Definition, Significance, Role of surface Engineering in creating high performance product, Functional characteristics of a surface, Nature of surfaces: Deformed layer, Beilby layer, chemically reacted layer, Physisorbed layer, Chemisorbed layer; Classification of Surface Engineering Techniques.

Unit 2: Surface Preparation Techniques **[07 Hours]**

Factors affecting selection of cleaning process, Significance of surface preparation, Classification of cleaning processes, Chemical cleaning processes; Mechanical Processes; Substrate considerations, Surface contaminants or soils, Tests for cleanliness.

Unit 3: Surface Integrity **[07 Hours]**

Definition, Importance, Surface alterations, Factors in Surface Integrity: Visual, Dimensional, Residual stress, Tribological, Metallurgical; Measuring Surface Integrity effects: Minimum and Standard data set, Macroscopic and microscopic examination.

Unit 4: Surface Modification Techniques **[07 Hours]**

Classification, Thermal treatments: Laser and electron beam hardening, Mechanical treatments: Short peening: Peening action, surface coverage and peening intensity, Types and sizes of media, Control of process variables, equipment;
Ion Implantation: Basic Principle, Advantages and disadvantages, equipment.

Unit 5: Surface Coating Techniques and Characterization of Coatings [07 Hours]

Thermal Spraying: Types and applications; Chemical Vapour Deposition: Principles, Reactions, Types and applications; Physical Vapour Deposition: Basic principle, Evaporation, Sputtering, Ion Plating, Applications; Electroplating: Principle of working and applications; Types of Coatings: Hard, Soft, Single layer, Multi-layer.

Characterization of Coatings

Physical characteristics and their measurements: Coating thickness, Surface Morphology and Microstructure. Mechanical properties and their Measurements: Hardness, Adhesion, Friction and Wear.

References:

1. ASM Handbook, "Volume 5: Surface Engineering", ASM International.
2. K. G. Budinski, "Surface Engineering for Wear Resistance", Prentice Hall.
3. T. Burakowski, T. Wierschon, "Surface Engineering of Metals: Principles, Equipment, Technologies", CRC Press.
4. B. Bhushan, B. K. Gupta, "Handbook of Tribology: Materials, Coatings, and Surface Treatments", Tata McGraw Hill Publications.

ASM Handbook, "Volume 16: Machining", ASM International.

Processing of Polymers

BTPPE703D	PEC5	Processing of Polymers	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Unit 1: Basic Concept: **[07 Hours]**

Plastic Additives and Compounding: Various additives and their purpose (e.g.antioxidants, plasticizers, antistatic agents, blowing agents etc.), Principle of mixing and mixers,types.

Extrusion

Basic operation and analysis, solids conveying, drag induced conveying, melting mechanism,power consumption in metering zone. Overall extruder performance.Design of extrusion screws,modeling of extrusion process and computer simulation.Overall working of single screw and twinscrew extruders.

Unit 2: Polymer Devolatilization **[07 Hours]**

Basic analysis of the process, functional design considerations, screw geometry and design Devolatilization in single screw and twin screw extruders and their design.

Extruded products

Such as films, pipes, profiles, coating, foamed products, design of sizing systems, haul off Systems, cooling and / or chilling units, winders, auxiliary equipment's used, measurement and Control of parameters. Types of dies used for the production of extruded products. Analysis of theflow through the dies. Manufacture of flat films, co extruded films, oriented films, drawing andstretching units.

Unit 3: Reactive extrusion and resident time distribution (RTD) **[07 Hours]**

Process details, basic principles, equipment used, effective residence time and residence time Distribution (RTD), point measurements: characterization of melting and mixing time with the RTD, applications.

Extrusion blow molding

Types of blow molding techniques, flow analysis in the die, wall thickness control, parison swell, parison sag. Continuous and intermittent blow molding CAE of blow molding operation.

Unit 4: Thermoforming **[07 Hours]**

Types, various techniques, materials, heat transfer analysis of the process, effect of plugs on article Thickness, continuous heating of a thin moving sheet.CAE in thermoforming.

Unit 5: Injection molding **[07 Hours]**

Role of rheology in injection molding, melt flow in feed system, flow in mould cavity, mould Filling.Control of politicizing and injection process.

Reaction injection molding

Overall molding cycle, metering system for components, mixing head design, mould construction,Materials used and their applications.

Other Processing techniques: Calendering and milling, compression and transfer molding, casting,rotational molding, fabrication, decoration of polymers.

References:

1. Handbook of Plastics Test Method, R.B. Brown, George Godwin Limited, 1981.
2. Handbook of Plastic Testing Technology, Brown and Vishnu Shah, A. Wiley, Inter science Publication, 2007
ME (Polymer Engineering) Syllabus Page 26
3. Handbook of Plastics Test Methods, G.V. Eves, J.A. Mead, M.M. Riky.
4. Volume 8 of ASTM Standards, BIS Standards.
5. Polymer Extrusion, Chris Rauwendal SPE, Hanser Publishers.
6. Polymer Missing and Extrusion Technology – Nich olas Cheremisinoff, Marcel Dekker 1987
7. Modeling Of Polymer Processing, Isayav, Hanser Publishers, 1991.
8. Plastics Waste Management, Mustafa.
9. Plastics Extrusion Technology – Hanser SPE, 199 6
10. Thermoforming – J.L. Throne, Hanser Publishers 1987
11. Blow Molding Handbook – Rosato, Hanser Publish ers 1987
12. Mixing and Compounding of Polymers: Theory and Practice, Ica Manas-Zloczower, Hanser Verlag, 2009.
13. Extrusion of Polymers: Theory and Practice, Chan I. Chung, Hanser Verlag, 01-Apr-2000
14. Rotational Molding of Plastics – R. J. Crawfor d, Research Studies Press Ltd.
15. Engineering with Polymers - Powell.

Stress Analysis

BTMPE703G	PEC5	Stress Analysis	3-0-0	3 Credits

Teaching Scheme:	**Evaluation Scheme:**
Lecture: 3 hrs/ week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hours)

Pre-Requisites: Strength of Materials, Machine Design-I

Course Outcome: At the end of course, student will be able to:

CO1	Explain the concept of stress, strain & their relationships & will also be able to choose suitable coordinate system for problems of stress analysis.
CO2	Explain the concept of Plane stress, plane strain, Stress & Strain at a point & will be able to derive the differential equation of equilibrium, Compatibility equation.
CO3	Apply the concept of stress function to solve the stress analysis problems involving simple

	components in Cartesian & Polar coordinate systems.
CO4	Explain basic principles of optics, describe polariscope & explain the effect of stressed model on behaviour of light vector in polariscope, compensation technique, separation techniques & Stress Freezing in photoelasticity
CO5	Describe various types of strain gage. Will be also able to describe & apply the theory of Wheatstone bridge for strain measurement using strain gages & to explain the technique for measurement of strain & stresses in rotary components.
CO6	Describe other techniques like Grid technique & Brittle coating method

Mapping of Course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	2										1
CO2	2	2										1
CO3	2	3	3	2								1
CO4	2	1										1
CO5	1	2	1	1								1
CO6	1	2										1

Course Contents:

UNIT 1: Two dimensional problems in Cartesian coordinate System [7 Hours]

Fundamentals of stress & strain, Stress & strain components, stress-strain relationship, Elastic constant, Plane stress, Plane strain, differential equation of equilibrium, Saint Venant`s principle, Compatibility condition, Compatibility equations for plane stress and plane strain conditions, Airys stress function.

UNIT 2: Two dimensional problems in Polar coordinate System [7 Hours]

General equations of equilibrium in polar coordinate, compatibility equation, relationship between stress components in polar and rectangular coordinate system, stress distribution about symmetric axis.

UNIT 3: Applications of theory of elasticity [7 Hours]

Stress analysis of cantilever subjected to end point load, Stress analysis of simply supported beam subjected to UDL, Stress analysis of cylinder subjected to internal & external pressure, Pure bending of curved beams.

UNIT 4: Photoelasticity [7 Hours]

Two-Dimensional Photo elasticity – Introduction to basic optics related to photo elasticity, stress-optic law, plane & circular polariscope arrangements, effect of stressed model in plane & circular polariscope, Isoclinic & Isochromatic, calibration of photo elastic material (determination of fringe constant using circular disk), photo elastic materials & their properties. Casting & preparation of photo elastic models, Tardy`s compensation technique. Separation techniques like, shear difference, oblique incidence & electrical analogy.
Introduction to 3 – D photo elasticity - Phenomenon of Stress freezing, Stress freezing cycle, Introduction to Reflection polariscope, fringe sharpening & fringe multiplication.

UNIT 5: Strain Gages [7 Hours]

Strain gage technique for stress & strain analysis – Introduction to electrical resistant strain gage, gage factor, Wheatstone bridge circuit, bridge balance, output voltage of Wheatstone bridge, various bridge configurations, determination of principle strains & stresses using strain rosettes. Introduction to Strain measurement on rotating components.

Grid technique of strain analysis, Brittle coating method for stress & strain analysis.

Text Books:

1. Theory of Elasticity, S.P. Timoshenko, Mc-Graw Hill.
2. Experimental Stress Analysis, Daily & Riley, Mc-Graw Hill.

Reference Books:

1. Experimental Stress Analysis, L.S. Srinath, TMH.
2. Experimental Stress Analysis, T.K. Ray, S. Chand publications.
3. Theory of Elasticity, Sadhu Singh, Khanna publishers.
4. Experimental Stress Analysis, U.C. Jindal, Pearson publications.
5. Experimental Stress Analysis, Sadhu Singh. Khanna publishers.
6. Experimental Stress Analysis, Adel Mubeen, Dhanpat Rai & Sons.

Open Elective-III

Sustainable Development

BTMOE704A	OEC3	Sustainable Development	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the difference between development and sustainable development
CO2	Explain challenges of sustainable development and climate change
CO3	Explain sustainable development indicators
CO4	Analyze sustainable energy options
CO5	Understand social and economic aspects of sustainable development

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3		2	3	3	3	2	2		2
CO2	1	1	3	1	2	3	3	3	2	2		2
CO3	2	1	1				3	2		1		2
CO4	3	3			2	3	3	2				1

CO5			3			2	3	2				1

Course Contents:

Unit 1: Introduction [07 Hours]
Status of environment, Environmental, Social and Economic issues, Need for sustainability, nine ways to achieve sustainability, population, resources, development and environment.

Unit 2: Global Warming and Climate Change [07 Hours]
Global Warming and climate Change since industrial revolution, Greenhouse gas emission, greenhouse effect, Renewable energy, etc.

Unit 3: Challenges of Sustainable Development and Global Environmental Issues[07 Hours]
Concept of sustainability, Factors governing sustainable development, Linkages among sustainable development, Environment and poverty, Determinants of sustainable development, Case studies on sustainable development, Population, income and urbanization Health care, Food, fisheries and agriculture , Materials and energy flows.

Unit 4: Sustainable Development Indicators and Environmental Assessment [07 Hours]

Need for indicators, Statistical procedures Aggregating indicators, Use of principal component analysis, Three environmental quality indices.

Environmental Assessment

National environmental policy act of 1969, Environmental Impact Assessment, Project categories based on environmental impacts, Impact identification methods, Environmental impact assessment process.

Unit 5: Environmental Management and Social Dimensions [07Hours]
Revisiting complex issues, Sector policies concerning the environment, Institutional framework for environmental management, Achievements in environmental management, People's perception of the environment, Participatory development, NGOs, Gender and development, Indigenous peoples, Social exclusion and analysis.

Texts:

1. J. Sayer, B. Campbell, "The Science of Sustainable Development: Local Livelihoods and the Global Environment", Biological Conservation, Restoration and Sustainability, Cambridge University Press, London, 2003.
2. J. Kirkby, P. O‟Keefe, Timberlake, "Sustainable Development", Earth scan Publication, London, 1993.
3. Peter P. Rogers, Kazi F. Jalal, John A. Boyd, "An introduction to sustainable development", Glen Educational Foundation, 2008.

References:

1. Jennifer A. Elliott, "An introduction to sustainable development". London: Routledge: Taylor and Francis group, 2001.
2. Low, N. "Global ethics and environment", London, Rout ledge, 1999.
3. Douglas Muschett, "Principles of Sustainable Development", St. Lucie Press, 1997.

Entrepreneurship Development

BTMOE704B	OEC 4	Entrepreneurship Development	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**

Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	enlarge the supply of entrepreneurs for rapid industrial development
CO2	Develop small and medium enterprises sector which is necessary for generation of employment
CO3	Industrialize rural and backward regions
CO4	Provide gainful self-employment to educated young men and women
CO5	Diversify the sources of entrepreneurship.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									2			
CO2									2			
CO3											2	
CO4											2	3
CO5												3

Course Contents:

Unit 1: Introduction to Entrepreneurship **[07 Hours]**

Evolution of the Concept of Entrepreneur Functions of Entrepreneur, Characteristics of an Entrepreneur, Types of Entrepreneur, Concept of Entrepreneurship, Growth of Entrepreneurship, Barriers of Entrepreneurship, Role of Entrepreneurship in India, Entrepreneurial Motivation, Major Entrepreneurial Competencies.

Unit 2: Small Scale Industries (SSI) **[07 Hours]**

Characteristics of Small Scale Industry, Basis for Classification of Small Scale Industry: Resource Based, Demand Based, Ancillary, Subsidiary Based or Sub-Controlled Type, Technology Based etc. Government Policy for Small Scale Industry, Growth of SSI in Developing Countries, Role of National and State Agencies Providing Assistance To SSI's, Relationship between Small and Big Industries, Ownership Structure, Registration of SSI.

Unit 3: Project Identification and Project Formulation **[07 Hours]**

Meaning of Project, Project Identification and Selection, Elements of Project Formulation, Concept and Significance of Project Formulation, Meaning, Significance and Contents of Project Report.

Accounting for Small Enterprises: Objective of Accounting, Accounting Process, Journal, Ledger, Preparation of Balance Sheet and Assessment of Economic Viability

Unit 4: Project Appraisal **[07 Hours]**

Concept of Project Appraisal, Project Appraisal Methods, Cash Flows as Costs and Benefits, Payback Period, Average Rate of Return. Discounted Cash Flow Techniques, Working Capital Management, Cost of Capital, Financing of Enterprises, Project Sickness & Corrective Measures.

Unit 5: Marketing Management **[07 Hours]**

Market Segmentation, Marketing Mix, and Packaging, Pricing Policy, Distribution Channels, and Govt. Purchases from

SSIS.

Laws Concerning Entrepreneur: Income Tax Laws, Excise Duty ,The Central Sales Tax Act, Professional Tax, Value Added Tax (VAT), Service Tax, The Workmen Compensation Act, The Minimum Wages Act, The Maternity Benefit Act, The Payment of Bonus Act

Institutional Support

Government Policies for Small Scale Entrepreneurs, Institutional Setup, District Industries Centers, Industrial Estates , SIDCO, NSIC, Directorate of Industries, Commercial Banks, New Entrepreneurial Development Agencies.

Women Entrepreneurship: Growth, Problems, Recent Trends.

References:

1. S. S. Khanka, "Entrepreneurial Development", S. Chand and Company Ltd.
2. C. B. Gupta, N. P. Srinivasan, "Entrepreneurship Development in India", S. Chand and Sons.
3. B. Badhai, "Entrepreneurship Development Programme", Mansell Publishing Ltd.
4. V. Desai, "Dynamics of Entrepreneurial Development and Management", Hindustan Publishing House.
5. David H. Holt, "Entrepreneurship", PHI Learning.
6. Roy Rajeev, "Entrepreneurship", Oxford University Press.

Plant Maintenance

BTMOE704C	OEC3	Plant Maintenance	3-0-0	3Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Objectives: To exemplify different types of plants and its function and analyse the principles used in plants maintenance. To understand various basic aspects related to running of industry the safety methods in plants. This course provides problems based techniques related with location, layout, maintenance, replacement of machines, etc.

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Recognize and enlist probable failures in mechanical elements.
CO2	Dismantle, assemble and align mechanisms in sequential order for given assembly.
CO3	Compare maintenance practices like on-line, shut down, corrosion, productive and preventive maintenance.
CO4	Analyze economics of plants and list factors affecting the maintenance of a plant.
CO5	Correlate the linkages between different maintenance aspects and how they impact on overall maintenance effectiveness.
CO6	Analyze different maintenance techniques and select an appropriate technique for a particular plant.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		2	2		1	2	1	1	2			2
CO2	2			1	1	2	2					2

CO3	2	2	1	1	1		1	1	1			
CO4	1	1		2	1	2	1		2		1	2
CO5	2	2			1	2	2				1	2
CO6	1					1					1	1

Course Contents:

Unit 1: Introduction
Introduction to concept of maintenance, Type of maintenance; Preventive, Productive, corrective, online, shut down and their significance.
Unit 2: Preventive Maintenance
Preventive maintenance and its importance, Repair cycle, systematic recording, preventive maintenance, Programming and types of schedules, Manpower and machine planning, Lubrication methods and practice, Color code schedule.
Unit 3: Online Maintenance and Shut down Maintenance
On-line maintenance, attending to joints, Valves, Pumps and other equipment's leakages,
Making shaft arrangement, stand-by unit, repairing damage to insulation, etc. without stopping the plant, attending faulty equipment, Fault finding and troubleshoots.
Shut down Maintenance
Shut down maintenance, Economic aspects of timing, duration of Timing and duration of shut down maintenance, Execution by using PERT and CPM.
Unit 5: Maintenance of Mechanical Equipment
Maintenance of major equipment like boiler, furnaces, kilns, shells and tube heat exchangers, pump and compressor, Towers, Cooling vessels, Valves piping.
Unit 6: Plant Condition Monitoring
Plant condition monitoring systems, instrumentation, Data collection and analysis, life expectancy and maintenance scheduling.The economics of maintenance management.

Text:
1. Lindley R. Hinggin, L.C. Morrow, "Maintenance Engineering Handbook", Tata McGraw Hill Book Company.

References:
1. Duncan C. Richardson, PE, "Plant Equipment and Maintenance Engineering Handbook", McGraw Hill Education, New York, Chicago, 2014.

Open Elective-IV
Engineering Economics

BTMOE705A	OEC4	Engineering Economics	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, Benefit-cost ratio.
CO2	Evaluate the cost effectiveness of individual engineering projects using the methods learned and draw inferences for the investment decisions.
CO3	Compare the life cycle cost of multiple projects using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
CO4	Compute the depreciation of an asset using standard Depreciation techniques to assess its impact on present or future value.
CO5	Apply all mathematical approach models covered in solving engineering economics problems: mathematical formulas, interest factors from tables, Excel functions and graphs. Estimate reasonableness of the results.
CO6	Examine and evaluate probabilistic risk assessment methods.
CO7	Compare the differences in economic analysis between the private and public sectors. Recognize the limits of mathematical models for factors hard to quantify.
CO8	Develop and demonstrate teamwork, project management, and professional communications skills

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1											3	
CO2											3	
CO3											3	
CO4											3	
CO5					3						3	
CO6											3	
CO7											3	
CO8									2		3	

Course Contents:

Unit 1: Introduction to Economics [07 Hours]

Introduction to Economics: Flow in an economy, Law of supply and demand, Concept of Engineering Economics: Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis: V ratio, Elementary economic Analysis: Material selection for product Design selection for a product, Process planning.

Unit 2: Value Engineering [07 Hours]

Make or buy decision, Value engineering: Function, aims, and Value engineering procedure. Interest formulae and their applications: Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor: equal payment series capital recovery factor:

Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

Unit 3: Cash Flow [07 Hours]

Methods of comparison of alternatives: present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all the methods.

Unit 4: Replacement and Maintenance Analysis [07 Hours]

Replacement and Maintenance analysis: Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset: capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

Unit 5: Depreciation and Evaluation of Public Alternatives [07 Hours]

Depreciation: Introduction, Straight line method of depreciation, declining balance method of depreciation, sum of the years digits method of depreciation, sinking fund method of depreciation/annuity method of depreciation, service output method of depreciation-

Evaluation of Public Alternatives

Introduction, Examples, Inflation adjusted decisions: procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

Texts:

1. PanneerSelvam R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.

References:

1. Chan S. Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2. Donald G. Newman, Jerome P. Lavelle, "Engineering Economics and analysis", Engineering Press, Texas, 2010.
3. E. P. Degarmo, W. G. Sullivan and J. R. Canada, "Engineering Economy", Macmillan, New York, 2011.
4. Zahid A. Khan, "Engineering Economy", Dorling Kindersley, 2012

Biology for Engineers

BTMOE705B	OEC 4	Biology for Engineers	3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain origin of life and Evolution, Cells, Biomolecules-Lipids
CO2	Understand Biomolecules
CO3	Understand Cell structure and function and cell cycle
CO4	Explain Mendelian genetics
CO5	Understand and Explain DNA structure, DNA replication, Transcription, Translation

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3		1		1			1		1
CO2	1	2	3		1		1			1		1
CO3	1	2	3		1		1			1		1
CO4	1	2	3		1		1			1		1
CO5	1	2	3		1		1			1		1

Course Contents:

Unit 1: Introduction **[07 Hours]**
Origin of life and Evolution, Cells, Biomolecules-Lipids

Unit 2: Biomolecules **[07 Hours]**
Carbohydrates, water, Amino acids and proteins, Enzymes, Nucleotides

Unit 3: Cell structure **[07 Hours]**
Cell structure and function, Prokaryotes, Eukaryotes

Unit 4: Cell cycle **[07 Hours]**
Cell division, mitosis, meiosis, culture growth,

Unit 5: Genetics and DNA **[07 Hours]**
Mendelian genetics, genetic disorders, Mendelian inheritance principle, pedigree analysis, Non- Mendelian inheritance
DNA
Chromatin, DNA structure, DNA replication, Transcription, Translation.
Texts:
1. Arthur T. Johnson, "Biology for Engineers", CRC Press.

References:

1. N. A. Campbell, J. B. Reece, "Biology", International edition, Benjamin Cummings, New York, 7th edition or later, 2007 or later.
2. G. Karp, "Cell and Molecular Biology: Concepts and Experiments", Wiley, New York, 7th edition, 2013.

Intellectual Property Rights

BTMOE705C	OEC4	Intellectual Property Rights	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State the basic fundamental terms such as copyrights, Patents, Trademarks etc.,
CO2	Interpret Laws of copy-rights, Patents, Trademarks and various IP registration Processes.
CO3	Exhibit the enhance capability to do economic analysis of IP rights, technology and innovation related policy issues and firms commercial strategies.
CO4	Create awareness at all levels (research and innovation) to develop patentable technologies.
CO5	Apply trade mark law, copy right law, patent law and also carry out intellectual property audits.
CO6	Manage and safeguard the intellectual property and protect it against unauthorized use.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1											
CO2								1				
CO3		1						1				
CO4										1		
CO5	1							1				
CO6								2				

Course Contents:

Unit 1: Introduction to Intellectual Property **[07 Hours]**

Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellectual property rights.

Unit 2: Trade Marks **[07 Hours]**

Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

Unit 3: Law of Copy Rights **[07 Hours]**

Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Unit 4: Law of Patents and Trade Secrets **[07 Hours]**

Foundation of patent law, patent searching process, ownership rights and transfer.

Trade Secrets

Trade secretes law, determination of trade secretes status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

Unit 5: New Development of Intellectual Property **[07 Hours]**

New developments in trade mark law; copy right law, patent law, intellectual property audits.

International overview on intellectual property, international trade mark law, copy right law, international patent law, and international development in trade secrets law.

Texts:

1. Deborah, E. Bouchoux, "Intellectual Property Right", Cengage learning.

2. Prabuddha Ganguli, "Intellectual property right: Unleashing the knowledge economy", Tata McGraw Hill Publishing Company Ltd.

References:

1. Ajit Parulekar, Sarita D'Souza, "Indian Patents Law-Legal and Business implications", Macmillan India Ltd., 2006.
2. B. L. Wadhera, "Law related to patents, Trademarks, Copyrights, Designs and Geographical indications", Universal law Publishing Pvt. Ltd., India, 2000.
3. P. Narayanan, "Law of copyright and Industrial Designs", Eastern Law house, Delhi, 2010.

Mechanical Engineering Lab –V

BTMCL706	PCC16		0-0-4	2 Credit

Practical Scheme:	Examination Scheme:
Practical: 4 hrs/batch	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

Group A (Mechatronics Lab)

List of Practical's/Experiments/Assignments (Any SIX)

1. Study and demonstration of various types of sensors
2. Speed control of various types of Electrical Motors
3. MinimumtwocircuitsonPneumaticstobedevelopedonPneumatictrainerkit
4. Minimum two circuits on Electro-Pneumatics to be developed on Electro- Pneumatic trainer kit
5. Minimum two circuits on Hydraulics and Electro-hydraulics to be developed on Hydraulic trainer kit
6. Programming of Microprocessor and Microcontroller
7. Programming on PLC
8. Demonstration of Process control such as temperature, level, flow, etc. control using PID controller

Group B

Perform any THREE Practical's/ Assignments on Elective – V

SEMESTER VII
Mini Project

BTMP707	Mini Project	PROJ-6	0L-0T-6P	3 Credits

Teaching Scheme:	Examination Scheme:
Practical: 6 hrs/week	Continuous Assessment: 30 Marks Mid Semester Exam: -- End Semester Exam: 20 Marks

IT – 3

BTMI608 (IT – 3)	IT – 3 Evaluation	PROJ-7	0L-0T-0P	1 Credits

Teaching Scheme:	Examination Scheme:
Practical: -- hrs/week	Continuous Assessment: -- Mid Semester Exam: -- End Semester Exam: 100 Marks

SEMESTER VIII
Project /Internship

BTMP801/ BTMI801	Project / Internship	PROJ-8	0L-0T-16P	8 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 16 hrs/week	Continuous Assessment: 60 Marks Mid Semester Exam: -- End Semester Exam: 40 Marks

- BTMP707 Mini Project and BTMP801/ BTMI801 Project /Internship are independent and allotment will also be done independently in respective semester.
- BTMP707 Mini Project will be done in-house only.
- Evaluation of both will be done independently as per the time schedule in AC.
- In case student(s) choose in-house project, it may be an extension of the Mini Project, however, Mini Project should be completed in all respect in semester VII itself.

Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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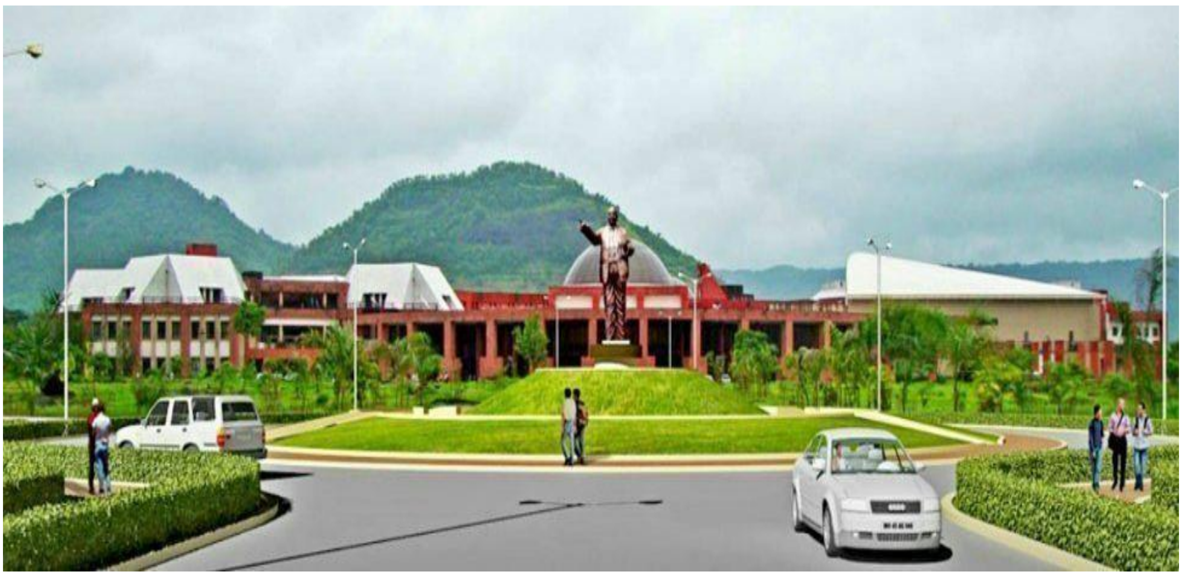
PROPOSED CURRICULUM UNDER GRADUATE PROGRAMME

B.TECH

(COMPUTER ENGINEERING/COMPUTER SCIENCE & ENGINEERING)

WITH EFFECT FROM THE ACADEMIC YEAR 2020-2021
S.Y. B.Tech 2021-22
T.Y. B.Tech 2022-23
Final B.Tech 2023-24



Rules and Regulations

1. The normal duration of the course leading to B. Tech degree will be EIGHT semesters.
2. The normal duration of the course leading to M. Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid- July to November is calledthe ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well. For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra-curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

REGISTRATION:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme:

   A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maxi- mum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.

2. Mandatory Pre-Registration for higher semesters:

   In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.

3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.

4. Under Graduate students may be permitted to register for a few selected Post Graduatecourses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

COURSE PRE-REQUISITES:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specifiedcourses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the following conditions:
   (a) Satisfied all the Academic Requirements to continue with the programme of Studies without termination
   (b) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;
   (c) Paid all required advance payments of the Institute and hostel for the current semester;
   (d) Not been debarred from registering on any specific ground by the Institute**.**

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below will be implemented from academic year 2019-20, starting from I year B.Tech.

Percentage of Marks	**Letter grade**	**Grade point**
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. **Class is awarded based on CGPA of all eighth semester of B.Tech Program.**

CGPA for pass is minimum 5.0	
CGPA upto < 5.50	Pass Class
CGPA ≥ 5.50 & < 6.00	Second Class
CGPA ≥ 6.00 & < 7.50	First Class
CGPA ≥ 7.50	Distinction
[Percentage of Marks = CGPA*10.0]	

3. **A total of 100 Marks for each theory course are distributed as follows:**

1	Mid Semester Exam (MSE) Marks	20
2	Continuous Assessment Marks	20
3	End Semester Examination (ESE)Marks	60

4. A total of 100 Marks for each practical course are distributed as follows:

1	Continuous Assessment Marks	60
2	End Semester Examination (ESE) Marks	40

It is mandatory for every student of B.Tech to score a minimum of 40 marks out of 100, with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.

This will be implemented from the first year of B.Tech starting from Academic Year 2019-20.

5. Description of Grades:

EX Grade: A _EX‘grade stands for outstanding achievement.
EE Grade: The _EE‘grade stands for minimum passing grade.
The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.
If any of the student remain absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.
FF Grade: The _FF‘grade denotes very poor performance, i.e. failure in a course due to poor performance. The students who have been awarded _FF‘grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

(A) Semester Grade Point Average (SGPA): The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{[\sum_{i=1}^{n} c_i g_i]}{[\sum_{i=1}^{n} c_i]}$$

Where
_n‘ is the number of subjects for the semester,
_ci‘ is the number of credits allotted to a particular subject, and
_gi‘ is the grade-points awarded to the student for the subject based on his perfor- mance as per the above table.
-SGPA will be rounded off to the second place of decimal and recorded as such.

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall per- formance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since she entered theInstitute. CGPA is also calculated at the end of every semester (upto two decimal places). Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{[\sum_{i=1}^{m} c_i g_i]}{[\sum_{i=1}^{m} c_i]}$$

Where

_m' is the total number of subjects from the first semester onwards up to and including the semester S,

_ci' is the number of credits allotted to a particular subject, and

_gi' is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

-CGPA will be rounded off to the second place of decimal and recorded as such.

AWARD OF DEGREE OF HONOURS (MAJOR) DEGREE

The concept of Major and Minors at B.Tech level is introduced, to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

A. Eligibility Criteria for Majors

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester.
2. Student willing to opt for majors has to register at the beginning of 5th Semester.
3. The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL / SWAYAM courses do not match with the existing subject proper scaling will be done.)

Student complying with these criteria will be awarded B.Tech (Honours) Degree.

B. Eligibility Criteria for Minors

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester.
2. Student willing to opt for minors has to register at the beginning of 5th Semester.
3. The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.
4. Student may opt for the courses from NPTEL / SWAYAM platform. (if the credits of NPTEL / SWAYAM courses do not match with the existing subject proper scaling will be done.)

Student complying with these criteria will be awarded with B.Tech Degree in

-------Engineering with Minor in -------------Engineering.

(For e. g.: B. Tech in Civil Engineering with Minor in Computer Engineering)

For applying for Honours and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (eg. Representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.

   If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.
   The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.
   In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.
3. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.
4. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

TRANSFER OF CREDITS

The courses credited elsewhere, in Indian or foreign University / Institutions / Colleges /Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

(a) 20% of the total credit will be considered for respective calculations.

(b) Credits transferred will be considered for overall credits requirements of the programme.

(c) Credits transfer can be considered only for the course at same level i.e. UG, PG etc.

(d) A student must provide all details (original or attested authentic copies) such as course contents, number of contact hours, course instructor / project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

(e) A student has to get minimum passing grades / marks for such courses for which the credits transfers are to be made.

(f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

(g) In exceptional cases, the students may opt for higher credits than the prescribed.

Different Categories of Courses and Credits for Degree Requirements

a) Basic Science Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTBS101	Engineering Mathematics – I	(3-1-0) 4
2	BTBS102	Engineering Physics	(3-1-0) 4
3	BTBS107L	Engineering Physics Laboratory	(0-0-2) 1
4	BTBS201	Engineering Mathematics-II	(3-1-0) 4
5	BTBS202	Engineering Chemistry	(3-1-0) 4
6	BTBS207L	Engineering Chemistry Laboratory	(0-0-2) 1
7	BTBS301	Engineering Mathematics-III	(3-1-0) 4
8	BTBSC404	Probability and Statistics	(3-0-0) 3
		TOTAL	**25**

b) Engineering Science Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTES103	Engineering Graphics	(2-0-0) 2
2	BTES105	Energy and Environment Engineering	(2-0-0) 2
3	BTES106	Basic Civil and Mechanical Engineering	(2-0-0) Audit
4	BTES108L	Engineering Graphics Laboratory	(0-0-4) 2
5	BTES203	Engineering Mechanics	(2-1-0) 3
6	BTES204	Computer Programming	(3-0-0) 3
7	BTES205	Workshop Practices	(0-0-4) 2
8	BTES206	Basic Electrical and Electronics Engineering	(2-0-0) Audit
9	BTES208L	Engineering Mechanics Laboratory	(0-0-2) 1
10	BTES209L	Basic Computer Programming Laboratory	(0-0-2) 1
11	BTES405	Digital Logic Design & Microprocessors	(3-1-0) 4
		TOTAL	**20**

c) Humanities and Social Science including Management Courses

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTHM104	Communication Skills	(2-0-0) 2
2	BTHM109L	Communication Skills Laboratory	(0-0-2) 1
3	BTHM403	Basic Human Rights	(3-0-0) 3
4	BTHM605	(A) Development Engineering (B) Employability and Skills Development (C) Consumer Behaviour	(3-0-0) 3
5	BTHM505	(A) Economics and Management (B) Business Communication	(3-0-0) 3
6	BTHM706	Foreign Language Studies	Audit
		TOTAL	**12**

d) Professional Core Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTCOC302	Discrete Mathematics	(3-1-0) 4
2	BTCOC303	Data Structures	(3-1-0) 4
3	BTCOC304	Computer Architecture & Organization	(3-1-0) 4
4	BTCOL306	Data Structures Lab & Object Oriented Programming Lab	(0-0-4) 2
5	BTCOC401	Design & Analysis of Algorithms	(3-1-0) 4
6	BTCOC402	Operating Systems	(3-1-0) 4
7	BTCOC501	Database Systems	(3-1-0) 4
8	BTCOC502	Theory of Computation	(3-1-0) 4
9	BTCOC503	Software Engineering	(3-1-0) 4
10	BTCOL506	Database Management System & Software Engineering Lab	(0-0-4) 2
11	BTCOC601	Compiler Design	(3-1-0) 4
12	BTCOC602	Computer Networks	(3-1-0) 4
		TOTAL	**44**

e) Professional Elective Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTCOE504	(A) Human Computer Interaction (B) Numerical Methods	(3-0-0) 3
2	BTCOE604	(A) Geographic Information System (B) Internet of Things (C) Embedded Systems	(3-0-0) 3
3	BTCOE703	(A) Bioinformatics (B) Distributed System (C) Big Data Analytics	(3-0-0) 3
		TOTAL	**09**

f) Open Elective Course

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTCOE704	(A) Cryptography and Network Security (B) Business Intelligence (C) Block Chain Technology	(3-0-0) 3
2	BTCOE705	(A) Virtual Reality (B) Deep Learning (C) Design Thinking	(3-0-0) 3
		TOTAL	**06**

g) Seminar / Mini Project / Internship

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTES211P	Field Training / Internship / Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time).	Audit
2	BTCOS307	Seminar-I	(0-0-4) 2
3	BTCOS407	Seminar-II	(0-0-4) 2
4	BTCOM507	Mini Project-I	(0-0-4) 2
5	BTCOM607	Mini Project-II	(0-0-4) 2
6	BTCOS708	Project Phase-I	(0-0-4) 2
7	BTCOF801	Project Work / Internship	(0-0-24) 12
		TOTAL	**22**

h) Emerging Courses

Sr. No.	Course Code	Course Name	(L-T-P) Credits
1	BTCOL305	Object Oriented Programming in Java	(3-1-0) 4
2	BTCOL406	Operating Systems & Python Programming Lab	(1-0-4) 3
3	BTCOC603	Machine Learning	(3-1-0) 4
4	BTCOL606	Competitive Programming & Machine Learning Lab	(1-0-4) 3
5	BTCOC701	Artificial Intelligence	(3-0-0) 3
6	BTCOC702	Cloud Computing	(3-0-0) 3
7	BTCOC707	Artificial Intelligence & Cloud Computing Lab	(0-0-4) 2
		TOTAL	**22**

Category – wise total number of credits

Sr. No.	Category of courses	Minimum credits to be Earned
1	Basic Science Course (BSC)	25
2	Engineering Science Course (ESC)	20
3	Humanities and Social Science including Management Courses (HSSMC)	12
4	Professional Core Course (PCC)	44
5	Professional Elective Course (PEC)	09
6	Open Elective Course (OEC)	06
7	Seminar / Mini Project / Internship / Major Project	22
8	Emerging Courses	22
	TOTAL	**160**

Programme Educational Objectives (PEO)

Name of Programme: Bachelor of Technology (Computer Engineering)

A graduate in the discipline of Computer Engineering is generally expected to have three kinds of knowledge. First, the graduate should have conceptual knowledge of the core topics of Computer Science. Second, she/he should have knowledge of mathematical formalism underlying various programming concepts. Third, graduates in the discipline of Computer Engineering should have the knowledge of the state of the technologies and tools so that he/she can apply the principles of Computer Science to solve real-life problems from diverse application domains. The programme of B.Tech in Computer Engineering atDr. Babasaheb Ambedkar Technological University (DBATU) essentially aims to meet these broad expectations. At the same time, the program intends to comply with the courses and syllabus available at National Program on Technology Enhanced Learning (NPTEL) and SWAYAM. The following specific educational objective aims to achieve these global and regional expectations.

Objective Identifier	Objectives
PEO1	To provide knowledge of sound mathematical principles underlying various programming concepts.
PEO2	To develop an ability to understand complex issues in the analysis, design, implementation and operation of information systems.
PEO3	To provide knowledge of mechanisms for building large-scale computer-based systems.
PEO4	To develop an ability to provide computer-based solutions to the problems from other disciplines of science and engineering.
PEO5	To impart skills necessary for adapting rapid changes taking place in the field of information and communication technologies.
PEO6	To provide knowledge of ethical issues arising due to deployment of information and communication technologies in the society on large scale.

Programme Outcomes (PO)

After undergoing the learning process of four years, students of B.Tech. (Computer Engineering) at Dr. Babasaheb Ambedkar Technological University will have an ability to build information systems and provide computer based solutions to real life problems. The graduates of this programme will demonstrate following abilities and skill sets.

Outcome Identifier	Outcomes
PO1	The graduates will possess the knowledge of various discrete mathematical structures, Logic and numerical techniques.
PO2	The graduates will have an ability to apply mathematical formalism of Finite Automata and Probability in modeling and analysis of systems.
PO3	The graduates will have knowledge of core programming paradigms such as database orientation, object orientation, and agent orientation and concepts essential to implement software based system.
PO4	The graduates will have an ability to analyze problem, specify algorithmic solutions to them and to evaluate alternative solutions.
PO5	The graduate will have broad understanding of the impact of a computer based solutions in economic, environmental and social context and will demonstrate use of analytical tools in gathering requirements and distilling relevant information to provide computer based solutions.
PO6	The graduates will demonstrate the ability to build human centric interfaces to computers.
PO7	The graduates will posses the knowledge of advanced and emerging topics in the fields of operating systems, databases and computer networks.
PO8	The graduates will posses skills necessary to communicate design engineering ideas. The skills set include verbal, written and listening skills.
PO9	The graduates will understand ethical issues in providing computer based solutions also they will have an ability and attitude to address the ethical issues.
PO10	The graduates will understand the role of system software such as operating systems, database management systems, compilers, middle-ware and internet protocols in realizing distributed information environment

Graduate Attributes / ABET's Criteria

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

(a) Engineering knowledge: An ability to apply knowledge of mathematics, science and engineering.

(b) Problem analysis: An ability to design and conduct experiments as well as to analyze and interpret data.

(c) Design / development of solutions: An ability to design a system, a component, or process, to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

(d) Individual and team work: An ability to function on multidisciplinary teams.

(e) Problem Solving: An ability to identify, formulate and solve engineering problems.

(f) Ethics: An understanding of professional and ethical responsibility.

(g) Communication: An ability to communicate effectively.

(h) Environment and sustainability: The broad education necessary to understand the impact of engineering solutions in a global, economical, environmental and social context.

(i) Life-long learning: Recognition of the need for and an ability to engage in life-longlearning.

(j) A knowledge of technology: Aknowledge of contemporary issues, and state of art technology

(k) Modern tool usage: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

(l) Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply in multidisciplinary environments.

Mapping of Programme Outcomes with Graduate Attributes / ABET's Criteria

	A	B	C	D	E	F	G	H	I	J	K	L
PO1	X											
PO2	X								X			
PO3		X	X									
PO4			X		X							
PO5			X					X				X
PO6					X							
PO7										X		
PO8							X					
PO9						X						
PO10											X	

Semester –III (Second Year)
Proposed Scheme w.e.f. July – 2021

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
	BTCOC302	Discrete Mathematics	3	1	-	20	20	60	100	4
	BTCOC303	Data Structures	3	1	-	20	20	60	100	4
	BTCOC304	Computer Architecture & Organization	3	1	-	20	20	60	100	4
	BTCOC305	Elective –I (a) Object - oriented Programming in C++ (b) Object Oriented Programming in Java	3	1	-	20	20	60	100	4
	BTCOL306	Data Structures Lab & Object Oriented Programming Lab	-	-	4	60	-	40	100	2
	BTCOS307	Seminar – I	-		4	60	-	40	100	2
	BTES211P	Field Training / Internship / Industrial Training –I Evaluation	-	-	-	-	-	-	-	Audit
		TOTAL	**15**	**5**	**8**	**220**	**100**	**380**	**700**	**24**

Semester –IV (Second Year)
Proposed Scheme w.e.f. January – 2022

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC401	Design & Analysis of Algorithms	3	1	-	20	20	60	100	4
	BTCOC402	Operating Systems	3	1	-	20	20	60	100	4
	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
	BTBSC404	Probability and Statistics	3	-	-	20	20	60	100	3
	BTES405	Digital Logic Design & Microprocessors	3	1	-	20	20	60	100	4
	BTCOL406	Operating Systems & Python Programming Lab	1*	-	4	60	-	40	100	3
	BTCOS407	Seminar – II			4	60	-	40	100	2
	BTCOF408	Field Training / Internship / Industrial Training –II Evaluation						-	-	Audit to be evaluated in V Sem.
		TOTAL	**16**	**3**	**8**	**220**	**100**	**380**	**700**	**23**

*Note: Lecture should be conducted only for Python Programming

Semester –V (Third Year)
Proposed Scheme w.e.f. July – 2022

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC501	Database Systems	3	1	-	20	20	20	100	4
	BTCOC502	Theory of Computation	3	1	-	20	20	20	100	4
	BTCOC503	Software Engineering	3	1	-	20	20	20	100	4
	BTCOE504	Elective – II (A) Human computer Interaction (B) Numerical Methods	3	-	-	20	20	20	100	3
	BTHM505	Elective – III (A) Economics and Management (B) Business Communication	3	-	-	20	20	20	100	3
	BTCOL506	Database Systems & Software Engineering Lab	-	-	4	60	-	40	100	2
	BTCOM507	Mini-project – I	-	-	4	60	-	40	100	2
	BTCOF408	Field Training / Internship / Industrial Training-II (Evaluation)	-	-	-	-	-	-	-	Audit
TOTAL			**15**	**3**	**8**	**220**	**100**	**380**	**700**	**22**

Semester –VI (Third Year)
Proposed Scheme w.e.f. January – 2023

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC601	Compiler Design	3	1	-	20	20	60	100	4
	BTCOC602	Computer Networks	3	1	-	20	20	60	100	4
	BTCOC603	Machine Learning	3	1	-	20	20	60	100	4
	BTCOE604	Elective – IV (A) Geographic Information System (B) Internet of Things (C) Embedded Systems	3	-	-	20	20	60	100	3
	BTHM605	Elective – V (A) Development Engineering (B) Employability and Skill Development (C) Consumer Behaviour	3	-	-	20	20	60	100	3
	BTCOL606	Competitive Programming & Machine Learning Lab	1*	-	4	60	-	40	100	3
	BTCOM607	Mini-project – II	-	-	4	60	-	40	100	2
	BTCOF608	Field Training / Internship / Industrial Training-III	-	-	-	-	-	-	-	Audit to be Evaluated in VII Sem.
TOTAL			**16**	**3**	**8**	**220**	**100**	**380**	**700**	**23**

*Note: Lecture should be conducted only for Competitive Programming

Semester –VII (Final Year)
Proposed Scheme w.e.f. July – 2023

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOC701	Artificial Intelligence	3	-	-	20	20	60	100	3
	BTCOC702	Cloud Computing	3	-	-	20	20	60	100	3
	BTCOE703	Elective – VI (A) Bioinformatics (B) Distributed System (C) Big Data Analytics	3	-	-	20	20	60	100	3
	BTCOE704	Open Elective – VII (A) Cryptography and Network Security (B) Business Intelligence (C) Block chain Technology	3	-	-	20	20	60	100	3
	BTCOE705	Open Elective – VIII (A) Virtual Reality (B) Deep Learning (C) Design Thinking	3	-	-	20	20	60	100	3
	BTHM706	Foreign Language Studies*	-	-	4	-	-	-	-	Audit
	BTCOL707	Artificial Intelligence & Cloud Computing Lab	-	-	4	60	-	40	100	2
	BTCOS708	Project Phase – I	-	-	-	60	-	40	100	2
	BTCOF608	Field Training / Internship / Industrial Training –III (Evaluation)	-	-	-	-	-	-	-	Audit
		TOTAL	**15**	**-**	**8**	**220**	**100**	**380**	**700**	**19**

*Any Foreign language can be opted by the students as per their need /demand conducted in online or offline mode by the institute.

Semester –VIII (Final Year)
Proposed Scheme w.e.f. January – 2024

Course Category	Course Code	Course Title	Weakly Teaching Hrs			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTCOF801	Project phase – II (In-house) / Internship and Project in Industry	-	-	24	60	-	40	100	12
		TOTAL	**-**	**-**	**24**	**60**	**-**	**40**	**100**	**12**

BTBS 301: Engineering Mathematics-III

Subject: Engineering Mathematics III (BTBS 301) **Semester: III**

Teaching Scheme
Theory: 03 Hrs./Week
Tutorial: 01 Hr./Week
Credits: 04
Duration: 03 Hrs.

Examination Scheme
Mid-term Test : 20 Marks
Internal Assessment: 20 Marks
End Semester Exam: 60 Marks

Unit 1: Laplace Transform **[09 Hours]**

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform **[09 Hours]**

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit 3: Fourier Transform **[09 Hours]**

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ;Complex form of Fourier integrals ; Fourier sine and cosine transforms; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications **[09 Hours]**

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation $\frac{\partial u}{\partial t} = C^2 \frac{\partial^2 u}{\partial x^2}$ and one dimensional wave equation (i.e. $\frac{\partial^2 y}{\partial t^2} = C^2 \frac{\partial^2 y}{\partial x^2}$).

Unit 5: Functions of Complex Variables **[09 Hours]**

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs)

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy. Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill, New York.

BTCOC302: Discrete Mathematics

[UNIT 1] Fundamental Structures and Basic Logic **[7 Hours]**

Sets, Venn diagram, Cartesian product, Power sets, Cardinality and countability, Propositional logic, Logical connectives, Truth tables, Normal forms, Validity, Predicate logic, Limitations of predicate logic, Universal and existential quantification, First order logic, Principles of Mathematical Induction: The Well-Ordering Principle, Recursive definition, The Division algorithm: Prime Numbers, The Greatest Common Divisor: Euclidean Algorithm, The Fundamental Theorem of Arithmetic.

[UNIT 2] Functions and Relations **[7 Hours]**

Subjective, Injective, Bijective and inverse functions, Composition of function, Reflexivity, Symmetry, Transitivity and equivalence relations.
Combinatorics: Counting, Recurrence relations, generating functions.

[UNIT 3] Graph **[7 Hours]**

Basic terminology, Multi graphs and weighted graphs, Paths and circuits, Shortest path problems, Euler and Hamiltonian paths, Representation of graph, Isomorphic graphs, Planar graphs, Connectivity, Matching Colouring.

[UNIT 4] Trees **[7 Hours]**

Trees: Rooted trees, Path length in rooted tree, Binary search trees, Spanning trees and cut set, Minimal spanning trees, Kruskal‘s and Prim‘s algorithms for minimal spanning tree.

[UNIT 5] Algebraic Structures and Morphism **[7 Hours]**

Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient Structures, Free and Cyclic Monoids and Groups, Permutation Groups, Substructures, Normal Subgroups, Algebraic Structures with two Binary Operation, Rings, Integral Domain and Fields, Boolean Algebra and Boolean Ring, Identities of Boolean Algebra, Duality, Representation of Boolean Function, Disjunctive and Conjunctive Normal Form.

Text Books:

1. C. L. Liu, Elements of Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2008.

Reference Books:

1. Lipschutz, Discrete Mathematics, McGraw-Hill Publication, 3rd Edition, 2009.
2. V. K. Balakrishnan, Schaum's Outline of Graph Theory, McGraw-Hill Publication, 1st Edition, 1997.
3. Eric Gossett, Discrete Mathematics with Proof, Wiley Publication, 2nd Edition, 2009.
4. Kenneth H. Rosen, Discrete Mathematics and its Applications, McGraw-Hill Publication, 6th Edition, 2010.Y. N. Singh, Discrete Mathematical Structures, Wiley Publication, 1st Edition, 2010.
5. Dr. Sukhendu Dey, Graph Theory with Applications, SPD Publication, 1st Edition, 2012.

BTCOC303: Data Structures

[UNIT 1] Introduction **[7 Hours]**

Data, Data types, Data structure, Abstract Data Type (ADT), representation of Information, characteristics of algorithm, program, analyzing programs. Arrays and Hash Tables Concept of sequential organization, linear and non-linear data structure, storage representation, array processing sparse matrices, transpose of sparse matrices, Hash Tables, Direct address tables, Hash tables, Hash functions, Open addressing, Perfect hashing.

[UNIT 2] Stacks and Queues **[7 Hours]**

Introduction, stack and queue as ADT, representation and implementation of stack and queue using sequential and linked allocation, Circular queue and its implementation, Application of stack for expression evaluation and expression conversion, recursion, priority queue.

[UNIT 3] Linked list **[7 Hours]**

Concept of linked organization, singly and doubly linked list and dynamic storage management, circular linked list, operations such as insertion, deletion, concatenation, traversal of linked list, dynamic memory management, garbage collection.

[UNIT 4] Trees and Graphs **[7 Hours]**

Basic terminology, binary trees and its representation, insertion and deletion of nodes in binary tree, binary search tree and its traversal, threaded binary tree, Heap, Balanced Trees, Terminology and representation of graphs using adjacency matrix, Warshall‘s algorithm.

[UNIT 5] Searching and Sorting **[7 Hours]**

Sequential, binary searching, skip lists – dictionaries, linear list representation, skip list representation, operations– insertion, deletion and searching. Insertion sort, selection sort, radix sort, File handling.

Text Book:

1. Weiss, Data structures and algorithms analysis in C++, Pearson Education, 4th Edition,2013

Reference Books:

1. S. Lipschutz, Data Structures, McGraw-Hill Publication, Revised 1st Edition, 2014.
2. Y. Langsm, M. Augenstin, A. Tanenbaum , Data Structure using C and C++, Prentice Hall India Learning Private Limited,2nd edition,1998.
3. Horowitz and Sahani, Fundamentals of Data Structures, Universities Press, 2nd Edition,2008.
4. Thomas Cormen, Introduction to Algorithms, PHI Publication, 2nd Edition,2002.
5. Venkatesan& Rose, Data Structures, Wiley Publication, 1st Edition,2015.
6. Goodrich &Tamassia, Data Structure & Algorithm in C++, Wiley Publication, 2nd Edition,2011.
7. R. G. Dromey, How to Solve it by Computer, 2nd Impression, PearsonEducation.
8. Kyle Loudon, Mastering Algorithms with C: Useful Techniques from Sorting to Encryption, O'Reilly Media, 1st Edition,1999.

BTCOC 304: Computer Architecture and Organization

[UNIT 1] Introduction **[7 Hours]**

Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function

[Unit 2] Instruction Sets **[7 Hours]**

Characteristics, Types of operands, Types of operations, Assembly language, Addressing modes, Instruction format, Types of instruction, Instruction execution, Machine state and processor status, Structure of program, Introduction to RISC and CISC architecture.

[Unit 3] Computer Arithmetic **[7 Hours]**

The arithmetic and logic Unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.

[Unit 4] Memory Organization **[7 Hours]**

Internal Memory: Semiconductor main memory, Error correction, Advanced DRAM organization, Virtual memory systems and cache memory systems. External Memory: Organization and characteristics of magnetic disk, Magnetic tape, Optical memory, RAID, Memory controllers.

[Unit 5] Control Unit and Input / Output Organization **[7 Hours]**

Control unit operation: Micro-operations, Control of the processor, Hardwired implementation, Micro-programmed Control Unit, Basic concepts, Micro-instruction sequencing, Micro-instruction execution, Applications of micro-programming. **Input/output Organization:** External devices, I/O module, Programmed I/O, Interrupt driven I/O, Direct memory access, I/O channels and processors, External interface.Instruction pipe-lining: Concepts. Parallel processing: Multiple processor organization, Symmetric multiprocessor, Cache coherence and the MESI protocol.

Text Book:

1. William Stalling, Computer Organization and Architecture: Designing for Performance, Prentice Hall Publication, 8th Edition, 2009.

Reference Books:

1. Hayes, Computer Architecture and Organization, McGraw-Hill Publication, 3rd Edition, 2012.
2. Zaky, Computer Organization, McGraw-Hill Publication, 5th Edition, 2011.
3. Hennessy and Patterson, Computer Architecture: A Quantitative Approach, Morgan and Kaufman Publication, 4th Edition, 2007.
4. Morris Mano, Computer System Architecture, Pearson Education India, 3rd Edition,2007.
5. Mostafa Abd-El-Barr, Hesham El-Rewini, Fundamentals of Computer Organization and Architecture, Wiley Publication, 1st Edition, 2004.
6. Miles J. Murdocca, Vincent P. Heuring, Computer Architecture and Organization: An Integrated Approach, Wiley Publication, 1st Edition, 2007.
7. Sajjan G. Shiva, Computer Organization: Design, and Architecture, CRC Press, 5th Edition, 2013.

Elective –I

(A) BTCOC 305: Object Oriented Programming in C++

[Unit 1] Introduction to Object Oriented Programming and Objects and Classes [7 Hours]

Need of object oriented programming, The object oriented approach, Characteristics of object oriented languages, class, Objects as data types, Constructors, Objects as function arguments, Returning objects.

[Unit 2] Operator Overloading, Inheritance and Polymorphism [7 Hours]

Overloading unary and binary operators, Data conversion. Derived and base class, Public and private inheritance, Levels of inheritance, **multiple** inheritance Examples.

[Unit 3] Polymorphism [7 Hours]

Virtual functions, Dynamic binding, Abstract classes and pure virtual functions, Friend functions, this pointer.

[Unit 4] Streams and Files [7 Hours]

Streams, Stream output and input, Stream manipulators, Files and streams, Creating, Reading, Updating sequential and random files.

[Unit 5] Templates, Exception Handling and STL [7 Hours]

Function templates, Overloading function templates, Class templates, Exception handling overview, Need of exceptions, An exception example, Multiple exceptions, Exception specifications. Standard Template Library (STL) Introduction to STL-Containers, Iterators, Algorithms, Sequence containers, Associative containers, Container adapters.

Text Book:

1. E. Balagurusamy, Object Oriented Programming with C++, McGraw-Hill Publication, 6th Edition, 2013.

Reference Books:

1. Robert Lafore, Object Oriented Programming in C++, Sams Publishing, 4th Edition, 2001.
2. Dr. B. B. Meshram, Object Oriented Paradigms with C++ Beginners Guide for C and C++, SPD Publication, 1st Edition, 2016.
3. Rajesh R. Shukla, Object-Oriented Programming in C++, Wiley India Publication, 1stEditio,2008
4. Bjarne Stroustrup, The C++ Programming Language, Addison-Wesley Publication, 4th Edition, 2013.
5. P. J. Deitel, H. M. Deitel, C++ How to Program, PHI Publication, 9th Edition, 2012.
6. John Hubbard, Programming with C++, Schaum's Outlines, McGraw-Hill Publication, 2nd Edition, 2000.
7. Nicolai M. Josuttis, Object-Oriented Programming in C++, Wiley Publication, 1st Edition, 2002.

Elective –I
(B) BTCOC 305: Object Oriented Programming in JAVA

[Unit 1] Introduction to Java Applications **[7 Hours]**

Introduction, Java Class Libraries, Typical Java Development Environment, Memory Concepts, Arithmetic. Introduction to Classes and Objects: Introduction, Classes, Objects, Methods and Instance Variables, Declaring a Class witha Method and Instantiating an Object of a Class, Declaring a Method, Instance variables, *set* Methods and *get* Methods, Primitive Types vs. Reference type double Types ,Initializing Objects with Constructors, floating point numbers.

[Unit 2] Control Statements **[7 Hours]**

Control structures *if* single-selection statement, *if….else* double-selection statement, *while* repetition statement, *do….while* repetition statement, *switch* multi-selection statement, *break* and *continue* statements, logical operators. Methods :Introduction, Program modules in Java, *static* methods, *static* Fields and *Class Math*, declaring methods with multiple parameters, scope of declaration, method overloading and Java API packages.

[Unit3]Arrays **[7 Hours]**

Arrays,declaring and creating arrays in java, examples using arrays, passing arrays to methods, multidimensional arrays, variable-length argument lists, using command-line arguments.

[Unit 4] Inheritance and Polymorphism in Java **[7 Hours]**

Inheritance: Super classes and Subclasses, protected members, relationship between super classes and subclasses, constructors in subclasses, objectclass. Polymorphism: Abstract classes and methods, final methods and classes, polymorphism examples and Interfaces.

[Unit 5] Exception-handling and Java script **[7 Hours]**

Exception-handling overview, handling *Arithmetic Exceptions* and *Input Mismatch Exceptions*, when to use exception handling, java exception hierarchy, *finally* block. Introduction to Java Applets. Java script: Introduction to client side scripting, Syntax basics, Operators, Comparisons, Statements, Loops, Events, Objects, and User defined functions, Validations using object functions, Validations using regular expressions, JS document object model, popovers, windows

Text Book:

1. Paul Deitel and Harvey Detail, *Java: How to Program*, Pearson's Publication, 9thEdition.

Reference Books:

1. Joel Murach and Michael Urban, *Murach's Beginning Java with Eclipse*, Murach's Publication, 1st Edition, 2016. Doug Lowe, *Java All-in-One for Dummies,* Wiley Publication, 4th Edition, 2014.
2. Herbert Schildt, *Java The Complete Reference*, McGraw-Hill Publication, 9thEdition.
3. Patrick Niemeyer, Daniel Leuck, *Learning Java,* O'Reilly Media, 4th Edition, 2013.
4. ‒JavaScript: The Good Parts‖, Douglas Crockford, and O'Reilly, ISBN: 9782744055973.

   ‒Microsoft® .NET: Architecting Applications for the Enterprise‖, Microsoft Press; 1st edition, ISBN:978-0735626096

BTCOL306: Data Structure Laboratory

List of Experiments:

1. Write a program to implement stack using arrays.
2. Write a program to evaluate a given postfix expression using stacks.
3. Write a program to convert a given infix expression to postfix form using stacks.
4. Write a program to implement circular queue using arrays.
5. Write a program to implement double ended queue (dequeue) using arrays.
6. Write a program to implement a stack using two queues such that the push operation runs in constant time and the pop operation runs in linear time.
7. Write a program to implement a stack using two queues such that the push operation runs in linear time and the pop operation runs in constant time.
8. Write a program to implement a queue using two stacks such that dequeue operation runs in constant time and dequeue operation runs in linear time.
9. Write programs to implement the following data structures: (a) Single linked list (b)Double linked list.
10. Write a program to implement a stack using a linked list such that the push and pop operations of stack still take O(1)time.
11. Write a program to create a binary search tree (BST) by considering the keys in given order and perform the following operations on it. (a) Minimum key (b) Maximum key (c) Search for a given key (d) Find predecessor of a node (e) Find successor of a node (f) delete a node with given key.
12. Write a program to construct an AVL tree for the given set of keys. Also write function for deleting a key from the given AVL tree.
13. Write a program to implement hashing with (a) Separate Chaining and (b) Open addressing methods.
14. Implement the following sorting algorithms: (a) Insertion sort (b) Merge sort (c) Quick sort (d) Heap sort.
15. Write programs for implementation of graph traversals by applying: (a) BFS (b) DFS.

Elective –I

BTCOL306: Object Oriented Programming Lab

(a) Object Oriented Programming in C++

List of Experiments:

1. Programs on Operators, Arithmetic Promotion, Method Calling.
2. Programs on dealing with Arrays.
3. Programs on Classes: String and Math.
4. Programs on Inheritance and Polymorphism.
5. Programs on Garbage collection, packaging, access Modifiers, as well as static and abstract modifiers.
6. Programs on Interfaces block initializers, final Modifier, as well as static and dynamic binding.
7. Programs on file handling and stream manipulation.
8. Programs on Dynamic Polymorphism.
9. Programs on Dynamic Memory Management.
10. Programs on Exception Handling.
11. Programs on generic programming using templates.
12. Programs on STL-containers and iterators

(b) Object Oriented Programming in JAVA

List of Experiments:

1. Programs on Operators, Arithmetic Promotion, Method Calling.
2. Programs on Classes: String and Math.
3. Write a program to demonstrate following Function concepts
   i) Function overloading
   ii) Constructors of all types
   iii) Default parameters, returning by reference
4. Programs on dealing with Arrays.
5. Programs on Classes: String and Math.
6. Programs on Inheritance and Polymorphism.
7. Programs on Garbage collection, packaging, access Modifiers, as well as static and abstract modifiers.
8. Programs on Interfaces, block initializers, final Modifier, as well as static and dynamic binding.
9. Programs on Exception Handling.
10. Write a Java program that illustrates the following
    a) Creation of simple package.
    b) Accessing a package.
    c) Implementing interfaces.
11. Programs on Java script client side scripting.
12. Programs on Java script Operators, Comparisons, Statements, Loops, Events, Objects.
13. Programs on Java script User defined functions.
14. Programs on Java script Validations using object functions.
15. Programs on Java script Validations using regular expressions.
16. Programs on Java script JS document object model, Popovers, Windows.

BTCOC401: Design and Analysis of Algorithms

[Unit 1] Introduction to Algorithms **[7 Hours]**

Definition, Properties of Algorithms, Expressing Algorithm, Flowchart, Algorithm Design Techniques, Performance Analysis of Algorithms, Types of Algorithm's Analysis, Order of Growth, Asymptotic Notations, Recursion, Recurrences Relation, Substitution Method, Iterative Method, Recursion Tree, Master Theorem, Changing Variable, Heap Sort.

[Unit 2] Divide and Conquer **[7 Hours]**

Introduction, Binary Search, Merge Sort, Quick Sort, Strassen's Matrix Multiplication.

[Unit 3] Backtracking **[7 Hours]**

Backtracking Concept, N–Queens Problem, Four–Queens Problem, Eight–Queen Problem, Hamiltonian Cycle, Sum of Subsets Problem, Graph Colouring Problem, Branch and Bound: Introduction, Travelling Salesperson Problem, 15-Puzzle Problem, Comparisons between Backtracking and Branch and Bound.

[Unit 4] Greedy Algorithms [**7 Hours]**

Introduction to Greedy Technique, Greedy Method, Optimal Merge Patterns, Huffman Coding, Knapsack Problem, Activity Selection Problem, Job Sequencing with Deadline, Minimum Spanning Tree, Single-Source Shortest Path Algorithm

.

[Unit 5] Dynamic Programming **[7 Hours]**

Introduction, Characteristics of Dynamic Programming, Component of Dynamic Programming, Comparison of Divide-and-Conquer and Dynamic Programming Techniques, Longest Common Sub-sequence, matrix multiplication, shortest paths: Bellman Ford, Floyd Warshall, Application of Dynamic Programming. NP Completeness: Introduction, the Complexity Class P, the Complexity Class NP, Polynomial-Time Reduction, the Complexity Class NP-Complete.

Text Book:

1. T. Cormen, Introduction to Algorithms, PHI Publication, 2nd Edition, 2002.

Reference Books:

1. Aho, Ullman, Data Structure and Algorithms, Addison-Wesley Publication, 1st Edition,1983.
2. Michel Goodrich, Roberto Tamassia, Algorithm Design – Foundation, Analysis & Internet Examples, Wiley Publication, 2nd Edition,2006.
3. George T. Heineman, Gary Pollice, Stanley Selkow, Algorithms in a Nutshell, A Practical Guide, O'Reilly Media, 2nd Edition, 2016.
4. Ellise Horowitz, SartajSahni, S. Rajasekaran, Fundamentals of Computer Algorithms, University Press (India) Private Ltd, 2nd Edition, 2008.
5. Sara Base, Computer algorithms: Introduction to Design and Analysis, Addison-Wesley Publication, 2nd Edition, 1988

BTCOC402: Operating Systems

[Unit 1] [7 Hours]

Introduction and Operating system structures: Definition, Types of Operating system, Real-Time operating system, System Components: System Services, Systems Calls, System Programs, System structure, Virtual Machines, System Design and Implementation, System Generations.

[Unit 2] [7 Hours]

Processes and CPU Scheduling: Process Concept, Process Scheduling, Operation on process, Inter-process Communication, Cooperating processes, Threads, Multithreading model, Scheduling criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling, Scheduling Algorithms evaluation.

[Unit 3] [7 Hours]

Process Synchronization: The critical-section problem, Critical regions, Peterson‘s Solution, Synchronization Hardware, Semaphores, Classical Problems of synchronization, and Monitors Deadlocks: Systems Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling.

[Unit 4] [7 Hours]

Memory Management: Basic concept, Logical and Physical address map, Memory allocation: Continuous Memory Allocation, Fixed and variable partition, Internal and external fragmentation and compaction, Paging: Principle of operation, Page allocation – Hardware support for paging, Protection and sharing,Disadvantages of paging; Segmentation. Virtual Memory: Basics of Virtual Memory – Hardware and control structures – Locality of reference, Page fault, Working Set, Dirty page / Dirty bit – Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used(LRU).

[Unit 5] [7 Hours]

File Management: File Concept, Access methods, File types, File operation, Directory and disk structure, File System Structure, File System Implementation, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance. Mass-Storage Structure: Disk Structure, Disk attachment, Disk scheduling, Disk management, Swap Space Management.

Text Book:

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, Operating System Concepts, Wiley Publication, 8th Edition, 2008.

Reference Books:

1. Andrew S. Tanenbaum, Modern Operating System, PHI Publication, 4th Edition, 2015.
2. D. M. Dhamdhere, Systems Programming and Operating Systems, McGraw-Hill, 2nd Edition, 1996.
3. Garry Nutt, Operating Systems Concepts, Pearson Publication, 3rd Edition, 2003.
4. Harvey M. Deitel, An Introduction to Operating Systems, Addison Wesley Publication, 2nd Edition, 1990.
5. Thomas W. Doeppner, Operating System in Depth: Design and Programming, Wiley Publication, 2011.

BTHM403: Basic Human Rights

[Unit 1] [6 Hours]

The Basic Concepts: - Individual, group, civil society, state, equality, justice, Human Values, Human rights and Human Duties: - Origin, Contribution of American bill of rights, French revolution, Declaration of independence, Rights of citizen, Rights of working and exploited people.

[Unit 2] [6 Hours]

Fundamental rights and economic programme, Society, religion, culture, and their inter relationship, Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

[Unit 3] [6 Hours]

Migrant workers and human rights violations, human rights of mentally and physically challenged, State, Individual liberty, Freedom and democracy, NGOs and human rights in India: - Land, Water, Forest issues.

[Unit 4] [6 Hours]

Human rights in Indian constitution and law:- i) The constitution of India: Preamble ii) Fundamental rights iii) Directive principles of state policy vi)Fundamental duties v) Some other provisions.

[Unit 5] [6 Hours]

Universal declaration of human rights and provisions of India, Constitution and law, National human rights commission and state human rights commission.

Text Book:

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd.), 2005.

Reference books:

1. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India

BTBSC404: Probability and Statistics

[Unit 1] Probability Theory **[7 Hours]**

Definition of probability: classical, empirical and axiomatic approach of probability, Addition theorem of probability, Multiplication theorem of probability, Bayes‘theorem of inverse probability, Properties of probabilities with proofs, Examples.

[Unit 2] Random Variable and Mathematical Expectation **[7 Hours]**

Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Join and marginal probability distributions, Properties of expectation and variance with proofs. Theoretical Probability Distributions : Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of binomial, Poisson and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.

[Unit 3] Correlation **[7 Hours]**

Introduction, Types of correlation, Correlation and causation, Methods of studying correlation, Karl Pearson's correlation coefficient, Spearman‘s rank correlation, Coefficient, Properties of Karl Pearson's correlation coefficient and Spearman‘s rank correlation coefficient, Probable errors.

[Unit 4] Linear Regression Analysis **[7 Hours]**

Introduction, Linear and non-linear regression, Lines of regression, Derivation of regression lines of y on x and x on y, Angle between the regression lines, Coefficients of regression, Theorems on regression coefficient, Properties of regression coefficient.

[Unit 5] Estimation and Hypothesis **[7 Hours]**

Estimation, Large Sample Estimation of a Population Mean, Small Sample Estimation of a Population Mean, Large Sample Estimation of a Population Proportion, Sample Size Considerations, Testing Hypotheses, The Elements of Hypothesis Testing, Large Sample Tests for a Population Mean, The Observed Significance of a Test, Small Sample Tests for a Population Mean, Large Sample Tests for a Population Proportion.

Text Book:

1. S. C. Gupta, Fundamentals of Statistics, Himalaya Publishing House, 7th Revied and Enlarged Edition, 2016.

Reference Books:

1. G. V. Kumbhojkar, Probability and Random Processes, C. Jamnadas and Co., 14th Edition, 2010.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
3. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.
4. G. Haribaskaran, Probability, Queuing Theory and Reliability Engineering, Laxmi Publications, 2nd Edition, 2009.
5. Murray Spiegel, John Schiller, R. ALU Srinivasan, Probability and Statistics, Schaum's Outlines, 4th Edition, 2013.
6. Kishor S. Trivedi, Probability, Statistics with Reliability, Queuing and Computer Science Applications, Wiley India Pvt. Ltd, 2nd Edition, 2001.
7. Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, An Introduction to Probability And Statistics, Wiley

Publication, 2nd Edition, 2001.

8. Roxy Peck, Chris Olsen, Jay Devore, Introduction to Statistics and Data Analysis, Third Edition, Thomson Books/Cole.
9. Ronald Walpole; Raymond Myers; Sharon Myers; Keying Ye, Probability & statistics for engineers & scientists, 9th edition, Prentice Hall.

BTES405: Digital Logic Design & Microprocessor

[Unit1] Introduction **[7 Hours]**

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, Number Systems: binary, signed binary, octal hexadecimal number, binary arithmetic, one‘s and two‘s complements arithmetic, codes, error detecting and correcting codes.

[Unit 2] Combinational Digital Circuits **[7 Hours]**

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions, Don‘t care conditions, Multiplexer, De-Multiplexer / Decoders,Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, parity checker / generator.

[Unit 3] Sequential circuits and systems **[7 Hours]**

1-bit memory, the circuit properties of Bistable latch, the clocked SR flip flop, J-K-T and D-types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC‘s, asynchronous sequential counters, applications of counters.

[Unit 4] Fundamentals of Microprocessors **[7 Hours]**

Fundamentals of Microprocessor, Comparison of 8-bit, (8085) 16-bit (8086), and 32-bit microprocessors (80386), The 8086 Architecture: Internal Block Diagram, CPU, ALU, address, data and control bus, Working registers, SFRs, Clock and RESET circuits, Stack and Stack Pointer, Program Counter, I/O ports, Memory Structures, Data and Program Memory, Timing diagrams and Execution Cycles.

[Unit 5] 8086 Instruction Set and Programming **[7 Hours]**

Memory Interfacing, I/O Interfacing, Direct Memory Access (DMA), Interrupts in 8086, 8086 Instruction Set and Programming: Addressing modes: Introduction, Instruction syntax, Data types, Subroutines Immediate addressing, Register addressing, Direct addressing, Indirect addressing, Relative addressing, Indexed addressing, Bit inherent addressing, bit direct addressing, Instruction timings, Data transfer instructions, Arithmetic instructions, Logical instructions, Branch instructions, Subroutine instructions, Bit manipulation instruction, Assembly language programs, C language programs, Assemblers and compilers, Programming and debugging tools.

Text Book:

1. R. P. Jain, Modern Digital Electronics, McGraw Hill Education, 2009.

Reference Books:

1. M. M. Mano, Digital logic and Computer design, Pearson Education India, 2016.
2. Kumar, Fundamentals of Digital Circuits, Prentice Hall India, 2016.
3. Douglas Hall, Microprocessors and Interfacing, McGraw-Hill Publication, Revised 2nd Edition, 2006.

BTCOL406: Python Programming

One hour per week is for program demonstration and instruction which can be conducted as a classroom session or lab session.

[Unit 1] **[2 Hours]**

Informal introduction to programming, algorithms and data structures, downloading and installing Python, run a simple program on Python interpreter.

[Unit 2] **[2 Hours]**

Variables, operations, control flow – assignments, conditionals, loops, functions: optional arguments, default values, passing functions as arguments.

[Unit 3] **[2 Hours]**

Statements, Expressions, Strings: String processing. Exception handling, Basic input/output, handling files.

[Unit 4] **[2 Hours]**

Class and Object, Data Structure: List, Tuple and Sequences, Set, Dictionaries.

[Unit 5] **[4 Hours]**

Using Database and Structured Query Languages (SQL): SQLite manager, Spidering Twitter using a Database, Programming with multiple tables, JOIN to retrieve data.

*Programming assignments are mandatory.

Text Book:

1. Michael Urban and Joel Murach, Murach‘s Python Programming, Murach's Publication, 2016.

Reference Books:

1. Charles Severance, Python for Informatics: Exploring Information, University of Michigan, Version 2.7.0, 2014.
2. Dr. R. Nageswara Rao, Core Python Programming, Dreamtech Press, 1st Edition, 2016.
3. Mark Lutz, Learning Python, O'Reilly Media, 5th Edition, 2013.
4. Mark Pilgrim, Dive into Python 3, A press Publication, 2nd Edition, 2009.
5. Allen B. Downey, Think Python, O'Reilly Media, 2nd Edition, 2012.
6. Jon Kleinberg and Eva Tardos, Algorithm Design, Pearson Education, 1st Edition, 2006.

BTCOL406: Python Programming

List of Experiments:

1 Program to calculate area of triangle, rectangle, circle

2 Program to find the union of two lists.

3 Program to find the intersection of two lists.

4 Program to remove the –i‖ th occurrence of the given word in a list where words repeat.

5 Program to count the occurrences of each word in a given string sentence.

6 Program to check if a substring is present in a given string.

7 Program to map two lists into a dictionary.

8 Program to count the frequency of words appearing in a string using a dictionary.

9 Program to create a dictionary with key as first character and value as words starting with that character.

10 Program to find the length of a list using recursion.

11 compute the diameter, circumference, and volume of a sphere using class

12 Program to read a file and capitalize the first letter of every word in the file.

BTCOL406: Operating Systems Laboratory

List of Experiments:

1. Hands on Unix Commands
2. Shell programming for file handling.
3. Shell Script programming using the commands grep, awk, and sed.
4. Implementation of various CPU scheduling algorithms (FCFS, SJF, Priority).
5. Implementation of various page replacement algorithms (FIFO, Optimal, LRU).
6. Concurrent programming; use of threads and processes, system calls (fork and v-fork).
7. Study pthreads and implement the following: Write a program which shows the performance.
8. Improvement in using threads as compared with process.(Examples like Matrix Multiplication.
9. Hyper Quick Sort, Merge sort, Traveling Sales Person problem).
10. Implementation of Synchronization primitives – Semaphore, Locks and Conditional Variables.
11. Implementation of Producer-Consumer problem, Bankers algorithm.
12. Implementation of various memory allocation algorithms, (First fit, Best fit and Worst fit), Disk.
13. Scheduling algorithms (FCFS, SCAN, SSTF, C-SCAN).
14. Kernel reconfiguration, device drivers and systems administration of different operating systems. Writing utilities and OS performance tuning

BTCOS407: Seminar – II

[Unit 1]

Web Site development Essentials: Overview of Web Design Concepts, Web Project Management Fundamentals, Web Site Development Process, HTML and the Evolution of Markup languages, HTML basic tags, Web Page Layout and Elements, Create Hyperlinks, Create Tables, Create Web Forms, Image Inserting Techniques, Create Frames, GUI HTML Editors, Site Content and Metadata.

[Unit 2]
Cascading Style Sheets: Cascading Style Sheets for Web page design, Creating CSS rules, Format Text with CSS, Use of CSS Selectors, Embed Style Sheets, and Attach External Style Sheets. Using CSS with Tables: Insert and Styling Tables, Import Table Data, Style Tables with CSS, Sort Data in Table.

[Unit 3]
Introduction to JavaScript, Variables, Basic in JavaScript — Numbers and operators, Handling text — Strings in JavaScript, Useful string methods, Arrays, Troubleshooting JavaScript;
Programming fundamentals: If...Else Statements, Else...If Statements, For Loops, While Loops, Breaking Out Of Loops, Switch Statements, Functions; JavaScript Events, Selecting HTML elements using get Element ById().

[Unit 4]
PHP: Basic Syntax, Defining variable and constant, PHP Data type, Operator and Expression, Handling Html Form with PHP: Capturing Form Data, Dealing with Multi-value filed, redirecting a form after submission, PHP Session.

[Unit 5]
JQuery: Introduction to JQuery, Validation using JQuery, JQuery Forms, JQuery Examples
AJAX: Introduction to AJAX, PHP with AJAX Introduction to RDBMS: Connection with MySQL Database, Performing basic database operation (DML)(Insert, Delete, Update, Select)

Suggestive List of Experiments:

1. Design an html form for displaying information using interactive css including images, tables.
2. Create a webpage with HTML describing your department with following specification:
   a. Change the background color of the page. At the bottom create a link to take user to the top of the page.
   b. Insert an image and create a link such that clicking on image takes user to other page.
   c. Also apply font styling like italics, underline and two other fonts to words you find appropriate. Also use header tags.
3. Write a JavaScript to design a simple calculator to perform the following operations: sum, product, difference and quotient.
4. Write a JavaScript to validate the following fields of employee on html form: email, name, mobile no., address, salary.
5. Develop and demonstrate a HTML file that includes JavaScript script that uses functions for the following problems:
   a. Parameter: A string
      Output: Length of the String
   b. Parameter: A number
   Output: The number with its digits in the reverse order
6. Develop and demonstrate a HTML file that includes JavaScript for the following problems:
   a. Input: A starting and ending number
   b. Output: find all the prime numbers between starting and ending number.
7. Write a PHP program to display a digital clock which displays the current time of the server.

8. Write a PHP program to implement sign-In and Sign-out functionality.
9. Write a PHP program to keep track of the number of visitors visiting the Web page and to display this count of visitors, with proper headings.
10. Write a PHP code to implement AJAX functionality.
11. Write a PHP program to perform search operation on the student records using AJAX.
12. Write a PHP program to sort the student records which are stored in the database using ascending/descending order.

Text Book:

1. HTML 5 Black Book, Covers CSS 3, JavaScript, XML, XHTML, Ajax, PHP and jQuery, 2ed (English, Paperback, DT Editorial Services).

Reference Books:

1. Robin Nixon, Learning PHP, MySQL & JavaScript with j Query, CSS & HTML5 Paperback by Orielly Pub**.**
2. E. Robson, E. Freeman, Head First HTML & CSS, O'Reilly Media, 2nd Edition, 2012.

Guidelines for Seminar:

1. Each candidate shall deliver a seminar as per the Scheme of Teaching and Examination for a minimum 35 minutes including questions and answers.
2. Students can choose/propose any topic for web application development.
3. Students can use HTML, CSS, Java Script, AJAX, PHP or any other front-end tool for web application development.
4. Applications developed must be demonstrated on desktop/laptop as a web based application in the seminar.
5. A seminar report must be submitted at the end of semester on the base of application developed and technology used.

BTCOC501: Database Systems

[Unit 1] Introduction **[7 Hours]**

Database System Applications, Purpose of Database Systems, View of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture Data modeling using the Entity Relationship Model: ER model concepts, notation for ER diagram, Constraints, keys, E-R Diagrams, Mapping Cardinality, Concepts of Super Key, candidate key, primary key, weak entity sets, Codd‘s rules, Extended ER model, Generalization, Aggregation, , Reduction of an ER diagrams to tables.

[Unit 2] Relational Data Model, Relational Algebra and Calculus **[7 Hours]**
Structure of Relational Databases, Database Schema, Keys Relational algebra: Fundamental Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations. Calculus: Tuple relational calculus, Domain relational Calculus, calculus vs algebra, computational capabilities.

[Unit 3] Introduction to SQL **[7 Hours]**

Overview of SQL, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operators, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Modification of the Database Intermediate SQL : Join Expressions, Views, Transactions, Integrity Constraints, SQL Data Types and Schema, Authorization, Advanced SQL : Assessing SQL from Programming Language, JDBC, ODBC, Embedded SQL, Functions and Procedures, Triggers,

[Unit 4] Relational Database Design and File Organization, Indexing & Hashing **[7 Hours]**

Normalization: Features of good relational designs, Functional dependencies, Normal forms, First, Second, Third normal forms, BCNF, Functional Dependency Theory, Multivalued Dependencies, Fourth Normal Form, Database Design Process.

File Organization, Ordered Indices, B+tree Index files, B Tree Index File, Static Hashing, Dynamic Hashing,

[Unit 5] Transaction Processing **[7 Hours]**

Transaction Concept, A simple Transaction Model, Transaction Atomicity and Durability, Transaction Isolation, ACID Properties, Serializability Concurrency Control Techniques: Lock based Protocols, Deadlock handling, Multiple Granularity, Time stamp-Based Protocols, Recovery System.

Text Book:

1. Henry Korth, Abraham Silberschatz & S. Sudarshan, Database System Concepts, McGraw-Hill Publication, 6th Edition, 2011**.**

Reference Books:

1. Raghu Ramakrishnan, Johannes Gehrke, Database Management Systems, McGraw-HillPublication, 3rd Edition, 2003.
2. Joel Murach, Murach's Oracle SQL and PL/SQL for Developers, Mike Murach & Associates, 2nd Edition, 2014.
3. Wiederhold, Database Design, McGraw-Hill Publication, 2nd Edition, 1983.
4. Navathe, Fundamentals of Database System, Addison-Wesley Publication, 6th Edition, 2012.
5. Mark L. Gillenson, Fundamentals of Database Management System, Wiley Publication, 2ndEdition, 2011.
6. Serge Abiteboul, Richard Hull, Victor Vianu, ―Foundations of Databases‖, Reprint by Addison-Wesley.

BTCOC502: Theory of Computation

[Unit 1] Finite Automata and Regular Expressions **[7 Hours]**

Definition of deterministic finite automata, Non-deterministic finite automata, Moore and Mealy machines and their conversions, Regular expressions, Recursive definition, NFA with e-moves, Inter-conversion between NFA and DFA, Regular expression and FA, Pumping lemma.

[Unit 2] Context Free Grammars **[7 Hours]**

Definition, Production rules, Ambiguous grammar, Removal of ambiguity, Chomsky hierarchy, Context Free Grammar (CFG) – definition, Simplification of CFG.

[Unit 3] Context Free Languages **[7 Hours]**

Definition of context free languages, Regular grammar definition, Left linear, Right linear grammar, Inter-conversion between left linear and right linear regular grammar, Regular grammar and finite automata, CNF, GNF, Derivation graphs, Type 0 and Type 1grammars.

[Unit 4] Push down Automata **[7 Hours]**

Formal definition, Pushdown automata (PDA), Deterministic Pushdown automata (DPDA) – definition, Non-deterministic Pushdown automata (NPDA) - definition, relative powers of DPDA and NPDA.

[Unit 5] Turing Machines and Undecidability **[7 Hours]**

Definition, Computing with Turing machine, Extensions of Turing machines, Random access Turing machines, Non-deterministic Turing machines, Grammars, The Church‘s Turing hypothesis, Universal Turingmachines, The Halting problem, Unsolvable problems about Turing machines.

Text Book:

1. Hopcroft, Ullman, Motwani, *Introduction to Automata Theory, Languages, and Computation*, Addison Wesley Publication, 2nd Edition, 2001.

Reference Books:

1. Daniel I. A. Cohen, *Introduction to Computer Theory*, Wiley Publication, 1st Edition, 1986.
2. John C. Martin, *Introduction to Languages and Theory of Computation*, McGraw-Hill Publication, 4th Edition, 2010.
3. Krithivasan Kamala, *Introduction to Formal Languages, Automata Theory and Computation*, Pearson Education, 1st Edition, 2009.
4. Papadimitriou, Lewis, *Elements of the Theory of Computations*, PHI Publication, 2nd Edition, 1997.
5. E. V. Krishnamurthy, *Introductory Theory of Computer Science*, Springer-Velang New York Inc., 1st Edition, 1985.

BTCOC503: Software Engineering

[Unit 1] **[7 Hours]**

Introduction: Professional software development, Software engineering ethics, Case studies. Software processes: Software process models, Process activities, Coping with change, The rational unified process.

[Unit 2] **[7 Hours]**

Agile software development: Agile methods, Plan-driven and agile development, Extreme programming, Agile project management, Scaling agile methods. Requirements engineering: Functional and non-functional requirements, The software requirements document, Requirements specification, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

[Unit 3] **[7 Hours]**

System modeling: Context models, Interaction models, Structural models, Behavioral models, Model-driven engineering. Architectural design: Architectural design decisions, Architectural views, Architectural patterns, Application architectures.

[Unit 4] **[7 Hours]**

Design and implementation, Object-oriented design using UML, Design patterns Implementation issues, Open source development.

[Unit 5] **[7 Hours]**

Software testing, Development testing, Test-driven development, Release testing, User testing. Dependability properties, Availability and reliability, Safety Security.

Text Book:

1. Ian Sommerville, *Software Engineering*; 9th Edition, Addison-Wesley Publishing Company, USA.

Reference Books:

1. S.A. Kelkar, Software Engineering, , Prentice Hall of India, 2007.
2. Pressman, Software Engineering, Tata McGraw Hill, 6th Edition, 2006.
3. Pankaj Jalote, Software Engineering, Narosa Publishers, 3rd Edition, 2006.

NPTEL Course:

1. Software Engineering, Prof. Rajib Mall, Department of Computer Science and Engineering, IIT Kharagpur.

BTCOE504 (A): Human Computer Interaction

UNIT 1:

INTRODUCTION TO HCI, THE HUMAN: Introduction, Input–Output Channels, Human Memory, Thinking: Reasoning and Problem Solving. **The Computer:** Introduction, Text Entry Devices, Positioning, Pointing And Drawing, Display Devices, Devices For Virtual Reality And 3d Interaction, Physical Controls, **The Interaction:** Introduction, Models Of Interaction, Ergonomics, Interaction Styles, Elements Of The Wimp Interface.

UNIT 2:

Design Process: Interaction Design Basics: Introduction, The Process Of Design, Navigation Design, Screen Design And Layout. **HCI in the Software Process:** Introduction, the Software Life Cycle, Iterative Design and Prototyping, Design Rationale. **Design Rules:** Introduction, Principles to Support Usability, Golden Rules and Heuristics

UNIT 3:

Implementation Support: Introduction, Elements of Windowing Systems, Programming the Application, User Interface Management Systems. **Evaluation Techniques:** Introduction, Goals of Evaluation, Evaluation through Expert Analysis, Evaluation through User Participation. **Universal Design:** Introduction, Universal Design Principles, and Multi-Modal Interaction, **User Support:** Introduction, Requirements of User Support, Approaches to User Support, Adaptive Help Systems

UNIT 4:

Cognitive Models: Introduction, Goal and Task Hierarchies, Linguistic Models, Physical and Device Models. **Communication and Collaboration Models:** Introduction, Face-To-Face Communication, Text- Based Communication, Group Working.

UNIT 5:

Groupware: Introduction, Groupware Systems, Computer-Mediated Communication, Meeting And Decision Support Systems, Shared Frameworks For Groupware. **Ubiquitous Computing and Augmented Realities:** Introduction, Ubiquitous Computing Applications Research, Virtual and Augmented Reality. **Hypertext, Multimedia and the World Wide Web:** Introduction, Understanding Hypertext, Web Technology and Issues, Static Web Content, Dynamic Web Content.

Text Book:

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale –Human Computer Interaction‖, Pearson Education, 3rd Edition, 2003.

eference Books:

1. B. Shneiderman, Designing the User Interface, Addison-Wesley Publishing Company.
2. Jenny Preece, Helen Sharp, Yvonne Rogers, Interaction Design: Beyond Human-Computer Interaction, Wiley Publication, 4th Edition, 2015.
3. Gerard Jounghyun Kim, Human–Computer Interaction: Fundamentals and Practice, CRC Press, 2015.
4. Jenifer Tidwell, Designing Interfaces, Patterns for Effective Interaction Design, O‘Reilly Media, 2nd Edition, 2010.

NPTEL Course:

1. Human Computer Interaction, Prof. K. Ponnurangam, Dept. of Computer Science and Engineering, IIIT Delhi.

BTCOE504 (B): Numerical Methods

[Unit 1] **[7 Hours]**

Solution of Algebraic and Transcendental Equation: Bisection method, Method of false position, Newton‗s method and Newton-Raphson method.

[Unit 2] **[7 Hours]**

Solution of Linear Simultaneous Equation: Gauss elimination method, Gauss-Jordan method, Iterative method of solution- Jacobi iteration method, Gauss-Seidal iteration method, Relaxation method.

[Unit 3] **[7 Hours]**

Finite Differences: Forward difference operator, Backward difference operator, Central difference operator, New- ton‗s interpolation formulae, Newton‗s forward–backward-central interpolation formulae.

[Unit 4] **[7 Hours]**

Differentiation and Integration: Newton-Cortes formula, Trapezoidal rule, Simpson one–third rule, Simpson three- eighth rule.

[Unit 5] **[7 Hours]**

Numerical Solution of ODE: Picard‗s methods, Taylor series method, Euler‗s method, Modified Euler‗s method, Runge Kutta method.

Text Book:

1. B. S Grewal, Higher Engineering Mathematics, 40th edition, Khanna publication

Reference Books:

1. S. S. Shastri, Introduction to Numerical Methods, PHI publication.
2. V. Rajaraman, Computer Oriented Methods, 3rd edition, PHI publication.
3. Conte and De boor, Elementary Numerical Analysis, BPB publication.
4. E. Kreyszig, Advanced Engineering Mathematics, BPB publication.
5. Steven C Chapra, Numerical Methods for Engineers, 5th edition, McGraw Hill publication.

NPTEL Course:

1. Numerical Methods, Prof. Ameeya Kumar Nayak and Prof. Sanjeev Kumar, IIT Roorkee.

BTHM505 (A): Economics and Management

[Unit 1] **[7 Hours]**

Introduction, Market Equilibrium: Demand and Supply, Elasticity of Demand Forecasting, Production, Exercises on Economics, Cost-Volume-Profit Relationships, Cost Management Systems and Activity Costing System.

[Unit 2] **[7 Hours]**

Relevant Information and Decision Making, Cost Allocation, Exercises on Economics, Double-Entry Bookkeeping, Job Casting, Process Costing, The Master Budget, Flexible Budgets and Variance Analysis.

[Unit 3] **[7 Hours]**

Financial Statements, Analysis of Financial Statements, Time Value of Money, Comparison of Alternatives.

[Unit 4] **[7 Hours]**

Depreciation Accounting, Evolution of Management Thoughts, Functions of Management Directing.

[Unit 5] **[7 Hours]**

Product Development, Forecasting Revisited, Capacity Planning, Product / Services Strategies and Plant Layout, Production Planning and Control.

Text Book:

1. R. Paneerselvam, Engineering Economics, PHI publication.

Reference Books:

1. Robbins S.P. and Decenzo David A., Fundamentals of Management: Essential Concepts and Applications, Pearson Education.
2. L. M. Prasad, Principles and Practices of Management.
3. K. K. Dewett & M. H. Navalur, Modern Economic Theory, S. Chand Publications.

NPTEL Course:

1. Economics / Management / Entrepreneurship, by Prof. P. K. J. Mohapatra Department of Industrial Engineering & Management, IIT Kharagpur.

BTHM505 (B): Business Communication

[Unit 1] **[6 Hours]**
Introduction, Definitions & Concepts, Communicative Competence.

[Unit 2] **[6 Hours]**
Intercultural Communication, Nonverbal Communication, Thought and Speech, Translation as Problematic Discourse.

[Unit 3] **[6 Hours]**
Barriers to Communication, Listening, Communication Rules, Communication Style.

[Unit 4] **[6 Hours]**
Interpersonal Communication, Relational Communication, Organizational Communication. Collaboration, Communication in Groups and Teams, Persuasive Communication.

[Unit 5] **[7 Hours]**
Negotiation and Conflict Management, Leadership, Written Communication in International Business, Role of Technology in international Business Communication, Moving to Another Culture, Crisis Communication, Ethics in Business Communication.

Text Book:

1. Mary Ellen Guffey, Essentials of Business Communication, Sixth Edition, South-Western College Publishing

Reference Books:

1. Bovee, Courtland, John Thill & Mukesh Chaturvedi, Business Communication Today: Dorling kindersley, Delhi.
2. Kaul, Asha, Business Communication, Prentice-Hall of India, Delhi.
3. Monippally, Matthukutty M. Business Communication Strategies. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. Sharma, Sangeeta and Binod Mishra, Communication Skills for Engineers and Scientists, PHI Learning Pvt. Ltd., New Delhi.

NPTEL Course:

1. International Business Communication, by Aradhana Malik, IIT Kharagpur.

BTCOL506: Database Systems Laboratory

List of Experiments:

1. Defining schema for applications.
2. Creating tables, Renaming tables, Data constraints (Primary key, Foreign key, Not Null), Data insertion into a table.
3. Grouping data, aggregate functions, Oracle functions (mathematical, character functions).
4. Sub-queries, Set operations, Joins.
5. Creation of databases, writing SQL and PL/SQL queries to retrieve information from the databases.
6. Assignment on Triggers & Cursors.
7. Normal Forms: First, Second, Third and Boyce Codd Normal Forms.
8. Assignment in Design and Implementation of Database systems or packages for applications such as office automation, hotel management, hospital management.
9. Deployment of Forms, Reports Normalization, Query Processing Algorithms in the above application project.
10. Large objects – CLOB, NCLOB, BLOB and BFILE.
11. Distributed data base Management, creating web-page interfaces for database applications using servlet.

BTCOL506: Software Engineering Laboratory

List of Experiments:

1. To perform the system analysis: Requirement analysis, SRS. (Both Functional and Nonfunctional requirements. For a set of 10 sample problems, from a book on Software Engineering by Rajib Mall.)
2. To perform the function oriented diagram: DFD and Structured chart.
3. To perform the user‘s view analysis: Use case diagram.
4. To draw the structural view diagram: Class diagram, object diagram.
5. To draw the behavioral view diagram: Sequence diagram, Collaboration diagram.
6. To draw the behavioral view diagram: State-chart diagram, Activity diagram.
7. To draw the implementation view diagram: Component diagram.
8. To draw the environmental view diagram: Deployment diagram.
9. To perform various testing using the testing tool unit testing, integration testing

BTCOM507: Mini Project-1

In this subject head, it is expected that the student should complete the following tasks.

1. Identify problem statement / idea which is solving one problem preferably local problem may be in their University / College / near by vicinity.
2. Do the literature survey,
3. Design the solutions
4. Implement solution using latest technology
5. Write 20-25 pages report using latex
6. Present / demonstrate the solution in front of faculty member

BTCOC601: Compiler Design

[Unit 1] Introduction to Compiling **[7 Hours]**

Definition, analysis of the source program, the phases of a compiler, the grouping of phases, Compiler Construction tools, A simple one-pass compiler,

[Unit 2] Lexical Analysis **[7 Hours]**

The role of the Lexical analyzer, Input buffering, Specification of Tokens, A Language for Specifying Lexical Analyzers, Design of a Lexical Analyzer generator.

[Unit 3] Syntax Analysis **[7 Hours]**

The role of the Parser, Context-free grammars, Writing a Grammar, Top-Down Parsing, Bottom-Up Parsing, Operator-precedence Parsing, LR Parsers, Using Ambiguous Grammars, Parser Generators.

[Unit 4] Syntax-Directed Translation **[7 Hours]**

Definitions, Construction of Syntax Trees, Bottom-Up Evaluation of S- Attributed definitions, Top-Down Translation, Bottom-Up Evaluation of Inherited attributes. Intermediate Languages, Declarations, Assignment Statements, Boolean Expressions, Case Statements, Back patching, Procedure Calls.

[Unit 5] Code Generation **[7 Hours]**

Issues in the Design of a Code Generator, The target Machine, Run-Time Storage Management, Basic Blocks and Flow Graphs, Next-Use Information, Simple Code Generator, Register allocation and Assignment, The DAG Representation of Basic Blocks, Generating Code from DAGs, Dynamic Programming, Code- Generation Algorithm, Code-Generators.

Text Book:

1. Aho, Sethi, Ullman, Compilers Principles, Techniques and Tools, Pearson Education India, 2nd Edition, 2013

Reference Books:

1. Hopcroft, Motwani and Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Publication, 2nd Edition, 2001.
2. Dick Grune, Kees van Reeuwijk, Henri E. Bal, Ceriel J. H. Jacobs and Koen Langendoen, Modern Compiler Design, Springer, 2nd Edition, 2012.

BTCOC602: Computer Networks

[Unit 1] Introduction **[7 Hours]**

Applications of computer networks, Network hardware, Network software: Protocol Hierarchy, Design Issue, connection oriented vs. connectionless, Service Primitives, Reference models: OSI and TCP/IP, Example networks: Internet, Network standardization, Performance: Bandwidth and Latency, Delay and bandwidth product, High- Speed Network, Application Performance Needs.

[Unit 2] LAN Technologies **[7 Hours]**

X5, Frame relay, ATM, Ethernet (802.3), FDDI, Token Rings, Resilient Packet Rings, Wireless LANs: Wi-Fi (802.11), Cell Phone Technologies, Broadband Wireless: Wi-MAX (802.16), Bluetooth (802.15.1), RFID.

[Unit 3] Data Link Layer **[7 Hours]**

Data Link Layer Design Issues: Service provided to network layer Framing, Error Control, Flow Control, Error Detection and Correction: error correcting codes, error detecting codes.

[Unit 4] Network Layer and Congestion Control **[7 Hours]**

IPv4/IPv6, Routers and Routing Algorithms distance vector link state. TCP UDP and sockets, General principles, Congestion prevention policies, Load shading, Jitter control, Quality of service: Packet scheduling, Traffic shaping, integrated Services.

[Unit 5] Application Layer Protocols **[7 Hours]**

DNS, SMTP, POP, FTP, HTTP. Network Security: Authentication, Basics of public key and private key cryptography, digital signatures and certificates, firewalls.

Text Book:

1. A. Tanenbaum, Computer Networks, PHI Publication, 5th Edition, 2011.

Reference Books:

1. B. Forouzan, Data Communications and Networking, McGraw Hill Publication, 5th Edition, 2013.
2. Larry Peterson and Bruce Davie, Computer Networks: A Systems Approach, Morgan Kufman Publication, 5th Edition, 2012.
3. S. Keshav, An Engineering Approach to Computer Networking, Addison-Wesley Professional.
4. D. Comer, Computer Networks and Internet, Pearson Education, 6th Edition, 2014.
5. M. Gallo, W. Hancock, Computer Communications and Networking Technologies, Brooks/Cole Publisher, 2001.
6. Natalia Olifer, Victor Olifer, Computer Networks: Principles, Technologies and Protocols for Network Design, Wiley Publication, 2005.

BTCOC603: Machine Learning

[Unit 1] [7 Hours]

Basic definitions, types of learning, hypothesis space and inductive bias, evaluation, cross-validation, Linear regression, Decision trees, over fitting, Instance based learning, Feature reduction, Collaborative filtering based recommendation

[Unit 2] [7 Hours]

Probability and Bayes learning, Logistic Regression, Support Vector Machine, Kernel function and Kernel SVM.

[Unit 3] [7 Hours]

Perceptron, multilayer network, back propagation, introduction to deep neural network.

[Unit 4] [7 Hours]

Computational learning theory, PAC learning model, Sample complexity, VC Dimension, Ensemble learning.

[Unit 5] [7 Hours]

Clustering k-means, adaptive hierarchical clustering, Gaussian mixture model.

Text Book:

1. Tom Mitchell, Machine Learning, First Edition, McGraw Hill, 1997.

Reference Books:

1. Ethem Alpaydin, Introduction to Machine Learning, 2nd Edition,

BTCOE604 (A): Geographic Information System

[Unit 1] [6 Hours]

What is Geographic Information Systems?, Different components of GIS, Different types of vector data, Raster data models and their types TIN data model.

[Unit 2] [6 Hours]

Advantages and disadvantages associated with vector, raster and TIN Non-spatial data attributes and their type Raster data compression techniques Different raster data file formats spatial database systems and their types.

[Unit 3] [6 Hours]

Pre-processing of spatial datasets Different map projections, Spatial interpolation techniques Different types of resolutions Digital Elevation Model (DEM).

[Unit 4] [6 Hours]

Quality assessment of freely available DEMS GIS analysis-1

[Unit 5] [6 Hours]

GIS analysis-2 and applications Errors in GIS Key elements of maps.

Text Book:

1. Ian Heywood, Sarah Cornelius and Steve Carver, An Introduction to Geographical Information Systems (4th Edition) 2012.

Reference Books:

1. Chang Kang-tsung (Karl), Introduction to Geographic Information Systems, 2006
2. Tor Bernhardsen Geographic Information Systems: An Introduction, May 2002

NPTEL Course:

1. Dr. Arun K. Saraf, Introduction to Geographical Information System, IIT Roorkee.

BTCOE604 (B): Internet of Things

[Unit 1] IoT Introduction **[7 Hours]**

Genesis of IoT, IoT and Digitization, IoT Impact, Convergence of IT and IoT, IoT Challenges, IoT Network Architecture and Design, Drivers Behind New Network Architectures, Comparing IoT Architectures, A Simplified IoT Architecture, The Core IoT Functional Stack, IoT Data Management and Compute Stack.

[Unit 2] Smart Objects **[7 Hours]**

The –Things‖ in IoT, Sensors, Actuators, and Smart Objects, Sensor Networks, Connecting Smart Objects, Communications Criteria, IoT Access Technologies.

[Unit 3] IP Layer **[7 Hours]**

IP as the IoT Network Layer, The Business Case for IP, The need for Optimization, Optimizing IP for IoT, Profiles and Compliances, Application Protocols for IoT, The Transport Layer, IoT Application Transport Methods.

[Unit 4] Data and Analytics for IoT **[7 Hours]**

An Introduction to Data Analytics for IoT, Machine Learning, Big Data Analytics Tools and Technology, Edge Streaming Analytics, Network Analytics, Securing IoT, A Brief History of IoT Security, Common Challenges in IoT Security, Formal Risk Analysis Structures: OCTAVE and FAIR, The Phased Applicationof Security in an Operational Environment

[Unit 5] IoT Physical Devices and Endpoints **[7 Hours]**

Building iot with Arduino: Arduino–Interfaces-Arduino IDE–Programming, RaspberryPi: Introduction to RaspberryPi, About the RaspberryPi Board: Hardware Layout, Operating Systems on RaspberryPi, Configuring RaspberryPi, Programming RaspberryPi with Python, Wireless Temperature Monitoring System Temperature Sensor, Connecting Raspberry Pi via SSH, Accessing Temperature from sensors, Remote access to RaspberryPi, Smart and Connected Cities, An IoT Strategy for Smarter Cities, Smart City IoT Architecture, Smart City Security Architecture, Smart City Use-Case Examples.

Text Book:

1. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet Things‖, 1st Edition, Pearson Education.

Reference Books:

1. Srinivasa K G, –Internet of Things‖, CENGAGE Leaning India, 2017.
2. Vijay Madisetti and Arshdeep Bahga, –Internet of Things (A Hands-on-Approach)‖, 1st Edition, VPT, 2014.
3. Raj Kamal, –Internet of Things: Architecture and Design Principles‖, 1st Edition, McGraw Hill Education, 2017.

BTCOE604 (C): Embedded Systems

[Unit 1] **[7 Hours]**

Introduction: Embedded system overview, Design challenge, Processor technology, IC technology, Design technology, Custom single processor technology, Hardware-combinational logic, Sequential logic, Custom single purpose processor design, RT-level custom single purpose processor design, Optimizing custom single purpose processors.

[Unit 2] **[7 Hours]**

General purpose processor Software: Basic architecture, Operation, Programmers view, Development environment, Application specific instruction set processor, selecting a microprocessor, General purpose processor design. Introduction, ARM7TDMI-S processor, Block diagram, Memory mapping, Memory accelerator module.

[Unit 3] **[7 Hours]**

System control: Pin description, Register description, Crystal oscillator, External interrupt inputs, Other system controls, Memory mapping control, Phase locked loop, Power control, Reset, APB divider, Wakeup timer. GPIO: GPIO register map, Timer-TIMER / COUNTER0 and TIMER / COUNTER1 register map, Example timer operation, Architecture.

[Unit 4] **[7 Hours]**

UART: UART0/1 - UART0/1 register map, UART0/1 baud rate, UART0/1 auto-baud, UART0/1 block diagram. Serial peripheral interface: SPI data transfers, SPI pin description, SPI register map, SPI block diagram; I2C-bus interface: I2C bus configuration, I2C operating modes, I2C Bus serial interface block diagram, Summary of I2C registers.

[Unit 5] **[7 Hours]**

Introduction, Process scheduling, Examples of RTOS, Microprocessor and microcontroller based system design, typical design examples, system design and simulation using simulation software such as Proteus VSM. Digital Camera Example Introduction, Introduction to a Simple Digital Camera; User‟s Perspective, Designer‟s perspective requirements specification non functional requirements, Informal functional specification, refined functional specification.

Text Book:

1. Frank Vahid –Embedded System Design- A Unified system Hardwar/Software Introduction‖, (3rd Edition, John Wiley India) ISBN 978-81-265-0837-2.

Reference Books:

1. LPC 214x User manual (UM10139):- www.nxp.com..
2. Andrew N. Sloss, Dominic Symes and Chris Wright –ARM System Developer‟s Guide – Designing and Optimizing System Software‖, (Elsevier) ISBN: 1-55860-874-5.
3. LPC 17xx User manual (UM10360) :- www.nxp.com
4. ARM architecture reference manual : - www.arm.com
5. Steve Furber –An Engineer‟s Introduction to the LPC2100 series‖ Trevor Martin (Hitex (UK) Ltd.).–ARM System-on-Chip Architecture‖ (2nd Edition, Addison-Wesley Professional)ISBN-13: 9780201403527

BTHM605 (A): Development Engineering

[Unit 1] **[7 Hours]**

Introduction, Various Definitions of Development Engineering.

[Unit 2] **[7 Hours]**

World Poverty and Development, Poverty in the India, Sustainable Development, Culture and Global Competence, The Engineer's Role.

[Unit 3] **[7 Hours]**

Social Justice, Social Justice and Engineering, Religious Perspectives, Secular Perspectives.

[Unit 4] **[7 Hours]**

Development Strategies: Society, Technological Change, and Development, Development Economists' Perspectives, Global Health Perspective, International Education Perspective, Social Business Perspectives.

[Unit 5] **[7 Hours]**

Engineering for Sustainable Community Development: The Engineer as a Helper Participatory Community Development, Teamwork and Project Management, Community Assessment: Learning About a Community, Project Selection, Humanitarian Technology, Participatory Technology Development, Humanitarian STEM Education. ICT for Development, AI for Humanitarian purposes, Blockchain and Social Development.

Text Book:

1. Kevin M. Passino, Humanitarian Engineering: Advancing Technology for Sustainable Development.

BTHM605 (B): Employability and Skill Development

[Unit 1] Soft Skills & Communication basics: [7 Hours]

Soft skills Vs hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills, Resume, Curriculum vitae, How to develop an impressive resume, Different formats of resume Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing and delivering presentation, Technical writing.

[Unit 2] Arithmetic and Mathematical Reasoning and Analytical Reasoning and Quantitative Ability: [7 Hours]

Aspects of intelligence, Bloom taxonomy, multiple intelligence theory, Number sequence test, mental arithmetic (square and square root, LCM and HCF, speed calculation, reminder theorem).

Matching, Selection, Arrangement, Verifications (Exercises on each of these types). Verbal aptitude (Synonym, Antonym, Analogy).

[Unit 3] Grammar and Comprehension: [7 Hours]

English sentences and phrases, Analysis of complex sentences, Transformation of sentences, Paragraphwriting, Story writing, Reproduction of a story, Letter writing, précis writing, Paraphrasing and e-mail writing.

[Unit 4] Skills for interviews: [7 Hours]

Interviews- types of interviews, preparatory steps for job interviews, interview skill tips, Group discussion-importance of group discussion, types of group discussion, difference between group discussion, panel discussion and debate, personality traits evaluated in group discussions, tips for successful participation in group discussion, Listening skills- virtues of listening, fundamentals of good listening, Non-verbal communication-body movement, physical appearance, verbal sounds, closeness, time.

[Unit 5] Problem Solving Techniques: [7 Hours]

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions.

Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

Text Book:

1. R. Gajendra Singh Chauhan, Sangeeta Sharma, ―Soft Skills- An integrated approach to maximize personality‖, ISBN: 987-81-265-5639-7, First Edition 2016

Reference Books:

1. Wiley Wren and Martin, "English grammar and Composition", S. Chand publications.
2. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chand publications.
3. Philip Carter, "The Complete Book of Intelligence Test", John Willey & Sons Ltd.
4. Philip Carter, Ken Russell, "Succeed at IQ test", Kogan Page.
5. Eugene Ehrlich, Daniel Murphy, "Schaum;s Outline of English Grammar", McGraw Hills.
6. David F. Beer, David A. McMurrey, ―A Guide to Writing as an Engineer‖, ISBN: 978- 1-118-30027-5 4th Edition, 2014, Wiley.

BTHM605 (C): Consumer Behavior

[Unit 1] **[7 Hours]**

Introduction to the Study of Consumer Behavior: Defining Consumer Behavior, Scope and Application of Consumer Behavior, Why Study Consumer Behavior, Evolution of Consumer Behavior as a Field Of Study and its relationship with Marketing: Behavioral Dimension, The Interdisciplinary Nature of Consumer Behavior. Market Research and Consumer Behavior, Relevance of Market Research with Consumer Behavior, Approaches to Consumer Behavior Research, Quantitative Research, Qualitative Research.

[Unit 2] **[7 Hours]**

Market Segmentation and Positioning, Market Segmentation, Basis for Segmentation, Alternatives available for Segmentation, Positioning. The Consumer Decision Making Process: Buying Motives, Buying Roles, Consumer Decision Making Process, Levels of Consumer Decision Making, Perspectives to Consumer Decision Making, Consumer Decision Making Process.

[Unit 3] **[7 Hours]**

Models of Consumer Behavior: The Economic model, Learning model, Psychoanalytic model, The sociological model. The Howard Sheth model of Buying Behaviour, The Nicosia model, The Engel - Kollat - Blackwell Model, Engel, Blackwell and Miniard (EBM) model.

[Unit 4] **[7 Hours]**

Psychological Influences on Consumer Decision Making: Consumer's Needs & Motivation, Emotions and Mood, Consumer Involvement, Consumer Learning, Personality, Self-concept and Self-image, Consumer Perception, Risk and Imagery. Consumer Attitude: Belief, Affect, Attitude and Intention, Attitude Formation and Attitude Change, Consumer Communication. Sociological Influences on Consumer Decision Making: Consumer groups, Consumer reference groups, Family and Life cycle, Social class and mobility, lifestyle analysis, Culture; Sub-Culture, Cross Culture, Interpersonal Communication and influence, Opinion Leadership.

[Unit 5] **[7 Hours]**

Diffusion of innovation Diffusion Process, Adoption Process, Consumer Innovators, Multiplicative innovation adoption (MIA) model. Organizational Buying: Differences between Industrial Markets and Consumer Markets, Differences between Organizational and Consumer Buying, Buying Decisions in Organizational Buying Process, Types of Decision Making, Organization Buyer's Decision Making Process, and Factors influencing Organizational Buying Behaviour, Decision Makers in Organizational Buying, Webster and Wind model of Organizational buying behaviour, The Sheth model of Industrial buying, The Sheth model of Industrial buying Consumer Behavior Analysis and Marketing Strategy: Consumer Behavior and Product Strategy, Consumer Behavior and Pricing Strategy, Consumer Behavior and Distribution Channel Strategy, Consumer Behavior and Promotion Strategy.

Text Book:

1. Consumer Behavior, Schiffman, L.G. and Kanuk L.L., Prentice Hall, India.

Reference Books:

1. Consumer Behavior, Concepts and Applications, Loudon, D.L. and Bitta, A.J.D, Tata McGrawHill.
2. Consumer Behavior and Marketing Startegy, Peter, J.P. and Olson, J.C., Schiffman, L.G. and Kanuk L.L., Prentice Hall, India.

BTCOL606: Competitive Programming

[Unit 1] **[7 Hours]**

Introduction: Online Judge The Programming Challenges Robot Judge, Understanding Feedback From the Judge, Choosing Programming Languages, Reading Our Programs, Standard Input/Output, Programming Hints, Elementary Data Types.

Challenging Problems

(1) The 3n + 1 Problem (2) Minesweeper (3) The Trip, (4) LCD Display (5) Graphical Editor (6) Interpreter (7) Check the Check (8) Australian Voting.

[Unit 2] **[7 Hours]**

Elementary Data Structures: Data Structures: Elementary Data Structures, Stacks, Dictionaries, Priority Queues Sets, Object Libraries, The C++ Standard Template Library, The Java java.util Package, Program Design Example: Going to War, Hitting the Dec, String Input/Output, Winning the War, Testing and Debugging.

Challenging Problems

(1) Jolly (2) Poker Hands (3) Hartals (4) Crypt Kicker (5) Stack 'em Up (6) Erd¨os Numbers (7) Contest Scoreboard (8) Yahtzee.

[Unit 3] **[7 Hours]**

Strings: Character Codes, Representing Strings, Program Design Example: Corporate Renaming, Searchingfor Patterns, Manipulating Strings, Completing the Merger, String Library Functions.

Challenging Problems

(1) WERTYU (2) Where's Waldorf? (3) Common Permutation (4) Crypt Kicker II (5) Automated Judge Script (6) File Fragmentation (7) Doublets (8) Fmt

[Unit 4] **[7 Hours]**

Sorting: Sorting, Sorting Applications Sorting Algorithms, Program Design Example: Rating the Field, Sorting Library Functions, Rating the Field.

Challenging Problems

(1) Vito's Family (2) Stacks of Flapjacks (3) Bridge (4) Longest Nap (5) Shoemaker's Problem (6) CDVII (7) Shell Sort (8) Football.

[Unit 5] **[8 Hours]**

Arithmetic and Algebra: Machine Arithmetic, Integer Libraries, High-Precision Integers, High-Precision Arithmetic, Numerical Bases and Conversion, Real Numbers, Dealing With Real Numbers, Fractions, Decimals, Algebra, Manipulating Polynomials, Root Finding, Logarithms, Real Mathematical Libraries.

Challenging Problems

(1) Primary Arithmetic (2) Reverse and Add (3) The Archeologist's Dilemma (4) Ones (5) A Multiplication Game (6) Polynomial Coefficients (7) The Stern-Brocot Number System (8) Pairsumonious Numbers.

Combinatorics: Basic Counting Techniques, Recurrence Relations, Binomial Coefficients, Other Counting Sequences, Recursion and Induction Problems.

Challenging Problems

(1) How Many Fibs? (2) How Many Pieces of Land? (3) Counting (4) Expressions (5) Complete Tree Labeling (6) The Priest Mathematician (7) Self-describing Sequence (8) Steps

List of Practical:

At least twenty five problems solving on competitive programming platforms such as, https://uva.onlinejudge.org, http://hackerrank.com/, http://codechef.com/

Text Book:

1. Steven S. Skiena Miguel A. Revilla, Programming Challenges The Programming Contest Training Manual, Springer

Reference Books:

1. Antti Laaksonen, Competitive Programmer's Handbook.
2. Steven Halim, Competitive Programming 3: The Lower Bounds of Programming Contests.
3. Gayle Lakaman Cracking the Coding Interview.
4. The Hitchhiker's Guide to the Programming Contests.

BTCOL606: Machine Learning Laboratory

As a part of lab exercises for Machine Learning Laboratory, it is suggested that the student should get hands-on experience by solving data analysis problems available on Machine Learning competition platforms such as Hacker Earth and Kaggle. Some of the suggestive list of problem solving is given below. Knowledge of R programming or Python is required to solve these problems, students get this prerequisite in Second Year.

1	Regression Analysis and Plot interpretation.
2	Logistic Regression Analysis in R.
3	Random Forest and Parameter Tuning in R.
4	Clustering Algorithms and Evaluation in R.
5	Machine Learning Project in Python on Hourse Prices Data.

BTCOC701: Artificial Intelligence

[Unit1] Introduction [7 Hours]

What Is AI? The Foundations of Artificial Intelligence, the History of Artificial Intelligence, the State of the Art. Intelligent Agents: Agents and Environments Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.

[Unit2]Problem-solving [7 Hours]

Solving Problems by Searching, Problem-Solving Agents, Example Problems, Searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems. Adversarial Search, Games, Optimal Decisions in Games, Alpha–Beta Pruning.

[Unit 3]Knowledge & Reasoning [7 Hours]

Knowledge representation issues, Representation & mapping, Approaches to knowledge representation, Issues in knowledge representation. Using predicate logic: Representing simple fact in logic, Representing instant & ISA relationship, Computable functions & predicates, Resolution, Natural deduction. Representing knowledge using rules: Procedural verses declarative knowledge, Logic programming, Forward verses backward reasoning, Matching, Control knowledge.

[Unit 4]Probabilistic Reasoning [7 Hours]

Representing knowledge in an uncertain domain, The semantics of Bayesian networks, Dempster-Shafer theory, Fuzzy sets & fuzzy logics,

Planning: Overview, Components of a planning system, Goal stack planning, Hierarchical planning and other planning techniques.

[Unit5]Natural Language processing: [7 Hours]

Introduction, Syntactic processing, Semantic analysis, Discourse & pragmatic processing.

Learning: Forms of learning, Inductive learning, Learning decision trees, explanation based learning, Learning using relevance information, Neural net learning & genetic learning. Expert Systems: Representing and using domain knowledge, Expert system shells and knowledge acquisition.

Text Book:

1. Rich, E. and Knight K.: Artificial Intelligence, Tata McGraw- Hill

Reference Books:

1. Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition.
2. Ivan Bratko, Prolog Programming for Artificial Intelligence, Addison-Wesley.

BTCOE702 Cloud Computing

[Lecture: 3 Periods/Week **CA: 20 Marks**
End Semester Examination: 60 Marks **MSE: 20 Marks**

Prerequisites: Discrete Mathematics, Computer Networks

Course Objectives:
1. To understand the concepts of Cloud Computing.
2. To learn Taxonomy of Virtualization Techniques.
3. To learn Cloud Computing Architecture.
4. To acquire knowledge on Aneka Cloud Application Platform.
5. To learn Industry Cloud Platforms.

Course Outcomes:
At the end of this course student will:
CO1) Understand the concept of virtualization and how this has enabled the development of Cloud Computing
CO2) Know the fundamentals of cloud, cloud Architectures and types of services in cloud
CO3) Understand scaling, cloud security and disaster management
CO4) Design different Applications in cloud
CO5) Explore some important cloud computing driven commercial systems

UNIT 1
Introduction to Cloud: Cloud Computing at a Glance, the Vision of Cloud Computing, Defining a Cloud, a Closer Look, Cloud Computing Reference Model. Characteristics and Benefits, Challenges Ahead, Historical Developments. **Virtualization:** Introduction, Characteristics of Virtualized Environment, Taxonomy of Virtualization Techniques, Virtualization and Cloud computing, Pros and Cons of Virtualization, Technology Examples- VMware and Microsoft Hyper-V.
UNIT 2
Cloud Computing Architecture: Introduction, Cloud Reference Model, Architecture, Infrastructure / Hardware as a Service, Platform as a Service, Software as a Service, Types of Clouds, Public Clouds, Private Clouds, Hybrid Clouds, Community Clouds, Economics of the Cloud, Open Challenges, Cloud Interoperability and Standards, Scalability and Fault Tolerance.
UNIT 3
Defining the Clouds for Enterprise: Storage as a service, Database as a service, Process as a service, Information as a service, Integration an s a service and Testing as a service. Scaling a cloud infrastructure **-**Capacity Planning, Cloud Scale.
UNIT 4
Aneka: Cloud Application Platform Framework Overview, Anatomy of the Aneka Container, From the Ground Up: Platform Abstraction Layer, Fabric Services, Foundation Services, Application Services, Building Aneka Clouds, Infrastructure Organization, Logical Organization, Private Cloud Deployment Mode, Public Cloud Deployment Mode, Hybrid Cloud Deployment de, Cloud Programming and Management, Aneka SDK, Management Tools.
UNIT 5
Cloud Applications: Scientific Applications – Health care, Geoscience and Biology. Business and Consumer Applications- CRM and ERP, Social Networking, Media Applications and Multiplayer Online Gaming.
Cloud Platforms in Industry: Amazon Web Services- Compute Services, Storage Services, Communication Services and Additional Services. Google AppEngine-Architecture and Core Concepts, Application Life-Cycle, cost model. Microsoft Azure- Azure Core Concepts.

Learning Resource

Text Books

1. Mastering Cloud Computing by Raj Kumar Buyya, Christian Vecchiola, and S.Thamarai Selvi from TMH 2013.
2. George Reese Cloud Application Architectures, First Edition, O‟Reilly Media 2009.

References

1. Cloud Computing and SOA Convergence in Your Enterprise *A Step-by-Step Guide* by
2. David S. Linthicum from Pearson 2010.
3. Cloud Computing 2nd Edition by Dr. Kumar Saurabh from Wiley India 2012.
4. Cloud Computing – web based Applications that change the way you work and collaborate Online – Micheal Miller. Pearson Education.

NPTEL Course:

1. Cloud Computing, Prof. Soumya Kanti Ghosh, Department of Computer Science and Engineering, IIT Kharagpur

BTCOE703 (A): Bioinformatics

[Unit 1] Introduction to Bioinformatics [6 Hours]

The Brain of Biotechnology Evolutionary Biology Origin & History of Bioinformatics Origin of Bioinformatics/Biological Databases Importance of Bioinformatics Use of Bioinformatics Basics of Molecular Biology Definitions of Fields Related to Bioinformatics Applications. Biological Databases: Introduction Categories of Biological Databases The Database Industry Classification of Biological DatabasesThe Creation of Sequence Databases Bioinformatics Programs and Tools Bioinformatics Tools Application of Programmes in Bioinformatics.

[Unit 2] Genomics & Proteomics [7 Hours]

DNA, Genes and Genomes DNA Sequencing Genome Mapping Implications of Genomics for MedicalScience Proteomic Application of Proteomics to Medicine Difference between Proteomics and Genomics Protein Modeling. Sequence Alignment: Introduction Pairwise Sequence Alignment Sequence Alignment (MSA) Substitution Matrices Two Sample Applications.

[Unit 3] Phylogenetic Analysis [7 Hours]

Introduction Fundamental Elements of Phylogenetic Models Tree Interpretation Importance of Identifying Paralogs and Orthologs Phylogenetic Data Analysis Alignment Building the Data Model Determining the Substitution Model Tree-Building Methods Tree Evaluation. Microarray Technology: A Boon to Biological Sciences Introduction to Microarray Microarray Technique Potential of Microarray Analysis Microarray Products Microarray Identifying Interactions Applications of Microarrays.

[Unit 4] Bioinformatics in Drug Discovery [6 Hours]

A Brief Overview Introduction Drug Discovery Informatics and Medical Sciences Bioinformatics and Medical Sciences Bioinformatics in Computer-Aided Drug Design Bioinformatics Tools.

[Unit 5] Human Genome Project [6 Hours]

Human Genome Project: Introduction Human Genome Project Genome Sequenced in the Public (HGP) and Private Project Funding for Human Genome Sequencing DNA Sequencing Bioinformatics Analysis: Finding Functions Insights Learned from the Human DNA Sequence Future Challenges.

Text Book:

1. S. C. Rastorgi et al, Bioinformatics Concepts Skills and Applications; 2nd Edition, CBS Publishers & Distributors.

NPTEL Course:

1. Prof. M. Michael Gromiha, Algorithms and Applications.

BTCOE703 (B): Distributed Systems

[Unit1]Introduction **[7 Hours]**

Introduction to Distributed Computing System, Evolution of Distributed Computing System, Distributed Computing System models, Distributed Computing System Gaining Popularity, Distributed Operating System, Introduction to Distributed Computing Environment (DCE), Desirable Features of a Good Message- Passing System, Issues in IPC by Message-Passing, Synchronization, Buffering, Multidatagram message, Encoding and Decoding of message data, Process addressing, Failure Handling, Group Communication, Case Study: BSD UNIX IPC Mechanism.

[Unit 2] Remote Procedure Calls **[7 Hours]**

RPC model, Transparency of RPC, Implementing RPC Mechanism, Stub Generation, RPC messages, Marshaling arguments and Results, Server Management, Parameter Passing Semantics, Call Semantics, Communication Protocols for RPCs, Complicated RPCs, Client- Server Binding, Exception Handling, Security, Some Special Types of RPCs, Case studies: Sun RPC, DCE, RPC.

[Unit 3] Distributed Shared Memory **[6 Hours]**

General Architecture of DSM Systems, Design and Implementation Issues of DSM, Granularity, Structure of Shared Memory Space, Consistency Models, Replacement Strategy, Thrashing, Other Approaches to DSM, Heterogeneous DSM, Advantages of Synchronization: Clock Synchronization, Event Ordering, Mutual Exclusion, Deadlock, Election Algorithms.

[Unit 4] Resource Management And Process Management **[6 Hours]**

Desirable Features of a Good Global Scheduling Algorithm, Task assignment Approach, Load-Balancing Approach, load Sharing Approach, Process Migration, Threads.

[Unit 5] Distributed File System **[6 Hours]**

Desirable Features of a Good Distributed File System, File Models, File Accessing Models, File Sharing Semantics, File Caching Schemes, File Replication, Fault Tolerance, Atomic Transactions, Design Principles, Case Study: DCE Distributed File Service.

Text Book:

1. P. K. Sinha, Distributed Operating System, PHI Publication

Reference Books:

1. Colorouis, Distributed Systems, Addison Wesley Publication.
2. M. L. Liu, Distributed Computing: Principles and Applications, Addison-Wesley, 2004.

NPTEL Course:

1. Distributed Systems, Prof. Rajiv Mishra, IIT Patna.

BTCOE703 (C): Big Data Analytics

[Unit 1] Introduction to Big Data **[6 Hours]**

Why Big Data and Where did it come from?, Characteristics of Big, Challenges and applications of Big Data, Enabling Technologies for Big Data, Big Data Stack, Big Data distribution packages.

[Unit 2] Big Data Platforms **[7 Hours]**

Overview of Apache Spark, HDFS, YARN, MapReduce, MapReduce Programming Model with Spark, MapReduce Example: Word Count, Page Rank etc, CAP Theorem, Eventual Consistency, Consistency Trade-O-s, ACID and BASE, Zookeeper and Paxos, Cassandra, Cassandra Internals, HBase, HBase Internals.

[Unit 3] Big Data Streaming Platforms **[6 Hours]**

Big Data Streaming Platforms for Fast Data, Streaming Systems, Big Data Pipelines for Real-Time computing, Spark Streaming, Kafka, Streaming Ecosystem.

[Unit 4] Big Data Applications **[6 Hours]**

Overview of Big Data Machine Learning, Mahout, Big Data Machine learning Algorithms in Mahout-kmeans, Naive Bayes etc. Machine learning with Spark, Machine Learning Algorithms in Spark, SparkMLlib, Deep Learning for Big Data, Graph Processing: Pregel, Giraph, Spark GraphX.

[Unit 5] Database for the Modern Web **[7 Hours]**

Introduction to mongoDB key features, Core server tools, MongoDB through the JavaScript' sshell, Creating and querying through Indexes, Document-oriented, principles of schema design, Constructing queries on databases, collections and documents, MongoDB query language.

Text Book:

1. Bart Baesens –Analytics in a Big Data World: The Essential Guide to Data Science and its Applications‖, Wiley and SAS Business Series.

Reference Books:

1. Rajkumar Buyya, Rodrigo N. Calheiros, Amir M Vahid Dastjerdi, Morgan Kaufmann, –Big Data Principals and Paradiagram‖, Elsevier, ISBN: 978-0-12-805394-2
2. Kyle Banker, Peter Bakkum and Shaun Verch, –MongoDB in Action‖, 2nd Edition Dream tech Press, ISBN: 978-9351199359.
3. Anand Rajaraman, Jeffrey D. Ullman, –Mining of Massive Datasets‖, 3rd edition, Cambridge University Press
4. Sima Acharya, Subhashini Chhellappan, –BIG Data and Analytics‖, ,Willey publication, ISBN: 978-8126554782.

NPTEL COURSE:

1. Big Data Computing by Prof. Rajiv Misra, Dept. of Computer Science and Engineering, IIT Patna

BTCOE704 (A): Cryptography & Network Security

[Unit 1] [6 Hours]

Introduction and Mathematical Foundations: Introduction, Overview on Modern Cryptography, Number Theory, Probability and Information Theory. Classical Cryptosystems: Classical Cryptosystems, Crypt-analysis of Classical Cryptosystems, Shannon‘s Theory.

[Unit 2] [6 Hours]

Symmetric Key Ciphers: Symmetric Key Ciphers, Modern Block Ciphers (DES), Modern Block Cipher (AES).Crypt-analysis of Symmetric Key Ciphers: Linear Crypt-analysis, Differential Crypt-analysis, other Crypt-analytic Techniques, Overview on S-Box Design Principles, Modes of operation of Block Ciphers.

[Unit 3] [6 Hours]

Stream Ciphers and Pseudo-randomness: Stream Ciphers, Pseudo-random functions. Hash Functions and MACs: Hash functions: The Merkle Damgard Construction, Message Authentication Codes (MACs).

[Unit 4] [6 Hours]

Asymmetric Key Ciphers: Construction and Crypt-analysis: More Number Theoretic Results, The RSA Cryptosystem, Primality Testing, Factoring Algorithms, Other attacks on RSA and Semantic Security of RSA, The Discrete Logarithm Problem (DLP) and the Diffie-Hellman Key Exchange algorithm, The ElGamal Encryption Algorithm, Crypt-analysis of DLP.

[Unit -5] [6 Hours]

Digital Signatures: Signature schemes: I, Signature schemes: II. Modern Trends in Asymmetric Key Cryptography: Elliptic curve based cryptography: I, Elliptic curve based cryptography: II. Network Security: Secret Sharing Schemes, A Tutorial on Network Protocols, Kerberos, Pretty Good Privacy (PGP), Secure Socket Layer (SSL), Intruders and Viruses, Firewalls.

Text Book:

1. Douglas Stinson, *"Cryptography Theory and Practice"*, 2nd Edition, Chapman & Hall/CRC.

Reference Books:

1. B. A. Forouzan, *"Cryptography & Network Security"*, McGraw Hill Publication.
2. William Stallings, *"Cryptography and Network Security"*, Pearson Education.
3. Dr. B. B. Meshram, *TCP/IP & Network Security*, SPD Publication.
4. Wenbo Mao, *"Modern Cryptography, Theory & Practice"*, Pearson Education.
5. Hoffstein, Pipher, Silvermman, *"An Introduction to Mathematical Cryptography"*, Springer.
6. Alang.Konheim, *Computer Security and Cryptography*, Wiley Publication.
7. A. Joux, *"Algorithmic Crypt-analysis"*, CRC Press.
8. S. G. Telang, *"Number Theory"*, McGraw Hill.
9. Matt Bishop, *"Computer Security"*, Pearson Education.

BTCOE704 (B): Business Intelligence

[Unit 1] Business Intelligence Introduction [6 Hours]

Definition, History of Business intelligence, Leveraging Data and Knowledge for BI, BI Components, Business Intelligence and Business Analytics, BI Life Cycle, Business intelligence architectures, Effective and timely decisions.

[Unit 2] BI Planning for success [6 Hours]

The role of mathematical models, Enabling factors in business intelligence projects, Development of a business intelligence system, Ethics and business intelligence, Planning for Success Initiating a Program, Business/Information Technology Partnership, Business Intelligence Success Factors, Team Building, Strategic versus Tactical Planning.

[Unit 3] Decision support system [6 Hours]

Definition of system, Representation of the decision-making process, Rationality and problem solving, The decision-making process, Types of decisions, Approaches to the decision-making process, Evolution of information systems, Definition of decision support system, Development of a decision support system

[Unit 4] Data Warehousing [6 Hours]

Definition of data warehouse, Data marts, Data quality, Data warehouse architecture, ETL tools , Metadata, Schemas Used in Data Warehouses: Star, Snowflake and fact constellation , Cubes and multidimensional analysis ,Hierarchies of concepts and OLAP operations ,OLAP vs OLTP Materialization of cubes of data

[Unit 5] Data Mining and Application of BI [6 Hours]

Data mining, Definition of data mining, Models and methods for data mining, Data mining, classical statistics and OLAP, Applications of data mining, Representation of input data, Data mining process, Applications of BI:Data Warehousing Helps MultiCare Save More Lives ,Smarter Insurance: Infinity P&C Improves Customer Service and Combats Fraud with Predictive Analytics.

Text Book:

1. Efraim Turban, Ramesh Sharda, Jay Aronson, David King, Decision Support and Business Intelligence Systems, 9th Edition, Pearson Education, 2009
2 Ramesh Sharda, Dursun Delen, Efraim Turban BUSINESS INTELLIGENCE AND ANALYTICS: SYSTEMS FOR DECISION SUPPORT, 10th Edition, Pearson Education, 2009

Reference Books:

1. David Loshin, Business Intelligence – The Savy Manager's Guide Getting Onboard with Emerging IT, Morgan Kaufmann Publishers, 200BI
2 Carlo Vercellis Business Intelligence: Data Mining and Optimization for Decision Making, John Wiley & Sons Ltd

BTCOE704 (C): Blockchain Technology

[Unit 1] Introduction **[6 Hours]**

Overview of Blockchain, Public Ledgers, Bitcoin, Smart Contracts, Block in a Blockchain, Transactions, Distributed Consensus, Public vs. Private Blockchain, Understanding Crypto currency to Blockchain, Permissioned Model of Blockchain, Overview of Security aspects of Blockchain. Basic Crypto Primitives: Cryptographic Hash Function, Properties of a hash function, Hash pointer and Merkle tree, Digital Signature, Public Key Cryptography, A basic crypto currency.

[Unit 2] Bitcoin and Blockchain **[7 Hours]**

Creation of coins, Payments and double spending, Bitcoin Scripts, Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay. Working with Consensus in Bitcoin: Distributed consensus in open environments, Consensus in a Bitcoin network, Proof of Work (PoW) – Hashcash PoW, Bitcoin PoW, Attacks on PoW and the monopoly problem, Proof of Stake, Proof of Burn and Proof of Elapsed Time, The life of a Bitcoin Miner, Mining Difficulty, Mining Pool.

[Unit 3] Permissioned Blockchain **[7 Hours]**

Permissioned model and use cases, Design issues for Permissioned blockchains, Execute contracts, State machine replication, Overview of Consensus models for permissioned blockchain-Distributed consensus in closed environment, Paxos, RAFT Consensus, Byzantine general problem, Byzantine fault tolerant system, Lamport- Shostak-Pease BFT Algorithm, BFT over Asynchronous systems.

[Unit 4] Enterprise application of Blockchain **[6 Hours]**

Cross border payments, Know Your Customer (KYC), Food Security, Mortgage over Blockchain, Blockchain enabled Trade, We Trade – Trade Finance Network, Supply Chain Financing, Identity on Blockchain.

[Unit 5] Blockchain Application Development **[6 Hours]**

Hyperledger Fabric- Architecture, Identities and Policies, Membership and Access Control, Channels, Transaction Validation, Writing smart contract using Hyperledger Fabric, Writing smart contract using Ethereum, Overview of Ripple and Corda.

Text Book:

1. Melanie Swan, ―Blockchain: Blueprint for a New Economy‖, O‘Reilly, 2015.

Reference Books:

1. Josh Thompsons, ―Blockchain: The Blockchain for Beginners-Guide to Blockchain Technology and Leveraging Blockchain Programming‖.
2. Daniel Drescher, ―Blockchain Basics‖, Apress; 1st Edition, 2017.
3. Anshul Kaushik, ―Blockchain and Crypto Currencies‖, Khanna Publishing House, Delhi.
4. Imran Bashir, ―Mastering Blockchain: Distributed Ledger Technology, Decentralization and Smart Contracts Explained‖, Packt Publishing.
5. Ritesh Modi, ―Solidity Programming Essentials: A Beginner‘s Guide to Build Smart Contracts for Ethereum and Blockchain‖, Packt Publishing.
6. Salman Baset, Luc Desrosiers, Nitin Gaur, Petr Novotny, Anthony O‘Dowd, Venkatraman Ramakrishna, ―Hands-On Block Chain with Hyperledger: Building Decentralized Applications with Hyperledger Fabric and Composer‖, Import, 2018.

NPTEL Course:

1. Prof. Sandip Chakraborty, Department of Computer Science and Engineering, IIT Kharagpur and Dr. Praveen Jayachandran, Research Staff Member, IBM.

BTCOE705 (A): Virtual Reality

[Unit 1] Introduction to Virtual Reality **[6 Hours]**

Virtual Reality and Virtual Environment: Computer graphics, Real time computer graphics, Flight Simulation, Virtual environment requirement, benefits of virtual reality, Historical development of VR, Scientific Landmark 3D Computer Graphics: The Virtual world space, positioning the virtual observer, the perspective projection, human vision, stereo perspective projection, 3D clipping, Colour theory, Simple 3D modelling, Illumination models, Reflection models, Shading algorithms, Radiosity, Hidden Surface Removal, Realism- Stereographic image.

[Unit 2] Geometric Modelling **[6 Hours]**

From 2D to 3D, 3D space curves, 3D boundary representation Geometrical Transformations: Frames of reference, Modelling transformations, Instances, Picking, Flying, Scaling the VE, Collision detection Generic VR system: Virtual environment, Computer environment, VR technology, Model of interaction, VR Systems.

[Unit 3] Virtual Environment **[6 Hours]**

Animating the Virtual Environment: The dynamics of numbers, Linear and Nonlinear interpolation, the animation of objects, linear and non-linear translation, shape & object in betweening, free from deformation, particle system.

[Unit 4] Physical Simulation **[4 Hours]**

Objects falling in a gravitational field, Rotating wheels, Elastic collisions, projectiles, simple pendulum, springs, Flight dynamics of an aircraft.

[Unit 5] VR Hardware and Software **[6 Hours]**

Human factors: The eye, the ear, the somatic senses. VR Hardware: Sensor hardware, Head-coupled displays, Acoustic hardware, Integrated VR systems. VR Software: Modelling virtual world, Physical simulation, VR toolkits, Introduction to VRML.

VR Applications: Engineering, Entertainment, Science, Training. The Future: Virtual environment, modes of interaction

Text Book:

1. John Vince, –Virtual Reality Systems –, Pearson Education Asia, 2007.

Reference Books:

1. Anand R., –Augmented and Virtual Reality‖, Khanna Publishing House, Delhi.
2. Adams, ―Visualizations of Virtual Reality‖, Tata McGraw Hill, 2000.
3. Grigore C. Burdea, Philippe Coiffet, –Virtual Reality Technology‖, Wiley Inter Science, 2nd Edition, 2006.
4. William R. Sherman, Alan B. Craig, ―Understanding Virtual Reality: Interface, Application and Design‖, Morgan Kaufmann, 2008.
5. www.vresources.org
6. www.vrac.iastate.edu
7. www.w3.org/MarkUp/VRM

BTCOE705 (B): Deep Learning

[Unit 1] **[6 Hours]**

History of Deep Learning, Deep Learning Success Stories, McCulloch Pitts Neuron, Thresholding Logic, Perceptrons, Perceptron Learning Algorithm, Multilayer Perceptrons (MLPs), Representation Power of MLPs, Sigmoid Neurons, Gradient Descent, Feed forward Neural Networks.

[Unit 2] **[6 Hours]**

FeedForward Neural Networks, Backpropagation. Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp. Principal Component Analysis and its interpretations, Singular Value Decomposition.

[Unit 3] **[6 Hours]**

Auto encoders and relation to PCA, Regularization in auto encoders, Denoising auto encoders, Sparse auto encoders, Contractive auto encoders. Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying. Greedy Layer wise Pre-training, Better activation functions, Better weight initialization methods, Batch Normalization.

[Unit 4] **[6 Hours]**

Convolutional Neural Networks, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Learning Vectorial Representations of Words,

[Unit 5] **[6 Hours]**

Recurrent Neural Networks, Back propagation through time, Encoder Decoder Models, Attention Mechanism, Attention over images.

Text Book:

1. Ian Goodfellow and Yoshua Bengio and Aaron Courville, "Deep Learning", 1st Edition, MIT Press

Reference Books:

1. Raúl Rojas, Neural Networks: A Systematic Introduction, 1996.
2. Christopher Bishop, Pattern Recognition and Machine Learning, 2007.

NPTEL Courses:

1. Prof. Prof. Mitesh M. Khapra, Prof. Sudarshan Iyengar, Dept. of Computer Science and Engineering, IIT Madras & IIT Ropar, NPTEL Course on Deep Learning (Part-I).

BTCOE705 (C): Design Thinking

[Unit 1] Overview of Design Thinking Process **[6 Hours]**

Design Thinking Process: Business context of innovation for applying design thinking, two models of design thinking, phases of design thinking, correlation with other philosophies. Introduction to design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs. Design thinking, Problem solving, Understanding design thinking and its process model, Design thinking tools. Human-Centered Design (HCD) process - Empathize, Define, Ideate, Prototype and Test and Iterate or Empathize, Analyze, Solve and Test.

[Unit 2] Empathize **[5 Hours]**

Design thinking phases, How to emphasize, Role of empathy in design thinking, purpose of empathy maps, Things to be done prior to empathy mapping, creation of user personas, customer journey mapping, How might we questions.

[Unit 3] Analyze or Define **[5 Hours]**

Root cause analysis, conflict of interest, perspective analysis, big picture thinking through system operator, big picture thinking through function modeling Silent brainstorming, metaphors for ideation, CREATE and What-If tool for ideation, introduction to TRIZ, Inventive principles and their applications.

[Unit 4] Test (Prototyping and Validation) **[5 Hours]**

Prototyping, Assumptions during the design thinking process, Validation in the market, best practices of presentation.

[Unit 5] Design Innovation **[5 Hours]**

Benefits of iteration in the design thinking process, taking the idea to the market, introduction to innovation management in a company.

Text Book:

1. Bala Ramadurai, ―Karmic Design Thinking, First Edition, 2020.

Reference Books:

1. Vijay Kumar,‖ 101 Design Methods: A Structured Approach for Driving Innovation in Your Organization ―.
2. Human-Centered Design Toolkit: An Open-Source Toolkit to Inspire New Solutions in the Developing World by IDEO.
3. This is Service Design Thinking: Basics, Tools, Cases by Marc Stickdorn and Jakob Schneider.
4. Ulrich, Karl T. Design: Creation of artifacts in society, 2011.

BTCOL707 Artificial Intelligence

List of Experiments:

1. Study of PROLOG. Write the following programs using PROLOG.
2. Write a program to solve 8 queens problem.
3. Solve any problem using depth first search.
4. Solve any problem using best first search.
5. Solve 8-puzzle problem using best first search.
6. Solve Robot (traversal) problem using means End Analysis.
7. Solve traveling salesman problem.

BTCOL707 Cloud Computing

List of Experiments:

(Pl. Note: List of Experiments should be as per theory covered in the class based on Cloud Environments.

Following list can be used as a reference.)

1. Sketch out and analyze architecture of Moodle cloud portal and moodle cloud site and create different entities dynamically.
2. Create a scenario in wordpress for Social Marketing, Search engine and Sharing Tools.
3. Working in Cloud9 to demonstrate different language.
4. Working in Codenvy to demonstrate Provisioning and Scaling of a website.
5. Implement and configure Google App Engine to deploy Python Program application.
6. Installation and configuration of virtual machine with guest OS.
7. Demonstrate the use of map and reduce tasks.
8. Implementation of SOAP Web services in C#/JAVA Applications.
9. Categorize Amazon Web Service (AWS) and implement its various cloud entities using its Cloud Toolbox support.
10. Implement and use sample cloud services with the help of Microsoft Azure.
11. Design and analyze architecture of Aneka / Eucalyptus / KVM identify different entities to understand the structure of it.
12. Make and perform scenario to pause and resume the simulation in Aneka / Eucalyptus entity, and create simulation entities dynamically.
13. Organize a case in Aneka / Eucalyptus for simulation entities in run-time using a its toolkit support and manage virtual cloud.

BTCOS708: Project phase - I

BTCOF801: Project phase – II (In-house) / Internship and Project in the Industry

In this course, it is expected that students will go to industry for internship for one semester and do industry based project in that period. Student will be assigned one dept. one Industry guide to monitor progress of the student. After, completion of the Internship student will submit project report to the dept. and project examination will be conducted in consultation with the Industry guide.

In case, if student not opting / not doing Internship in the Industry, such students can do project work in the dept.

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL

Sr. No.	Name of Subject as per Curriculum	Course Code	Semester	SWAYAM/ NPTEL Course And Web Link	Name of Institute offering course	Relevance %	Duration of Course
1	Linear Algebra	BTES301	III	https://nptel.ac.in/courses/111/101/111101115/ https://nptel.ac.in/courses/111/106/111106051/	IIT, Madras	85 90	8 Weeks 12 Weeks
2	Discrete Mathematics	BTCOC302	III	https://nptel.ac.in/courses/106/106/106106094/ https://nptel.ac.in/courses/111/107/111107058/	IIT, Madras IIT, Roorkee	90 90	8 Weeks
3	Data Structures	BTCOC303	III	https://nptel.ac.in/courses/106/102/106102064/	IIT, Delhi	90	Not mentioned
4	Computer Architecture & Organization	BTCOC304	III	https://nptel.ac.in/courses/106/106/106106092/ https://nptel.ac.in/courses/106/103/106103180/ https://nptel.ac.in/courses/106/106/106106166/ https://nptel.ac.in/courses/106/105/106105163/ https://swayam.gov.in/nd1_noc20_cs64/preview	IIT, Madras IIT, Guwahati IIT, Madras ,IIT, Kharagpur IIT, Kharagpur	85 75 70 85 85	12 weeks
5	Object Oriented Programming in C++	BTCOC305	III	https://nptel.ac.in/courses/106/105/106105151/	IIT, Kharagpur	58	8 weeks
6	JAVA Programming	BTCOL306	III	https://nptel.ac.in/courses/106/105/106105191/	IIT, Kharagpur	90	12 Weeks
7	Design & Analysis of Algorithms	BTCOC401	IV	https://nptel.ac.in/courses/106/101/106101060/ https://nptel.ac.in/courses/106/105/106105164/ https://swayam.gov.in/nd1_noc20_cs71/preview	IIT, Kharagpur IIT, Madras Chennai Mathematical Institute	40	12 weeks
8	Probability & Statistics	BTBS402	IV	https://nptel.ac.in/courses/111/106/111106112/# https://nptel.ac.in/courses/111/105/111105090/	IIT, Madras IIT, Kharagpur	80 90	4 weeks 12 weeks
9	Operating Systems	BTCOC403	IV	https://nptel.ac.in/courses/106/108/106108101/ https://nptel.ac.in/courses/106/106/106106144/	IISc, Bangalore IIT, Madras	1. 85 2. 80	1. 8 Weeks 2. 8 Weeks
10	Basic Human Rights	BTHM404	IV	https://nptel.ac.in/courses/109/104/109104068/	IIT, Kanpur	75	30 Hours

11	Digital Electronics & Microprocessors	BTES405	IV	https://nptel.ac.in/courses/108/105/108105132/ https://nptel.ac.in/courses/108/103/108103157/	IIT, Kharagpur IIT, Guwahati	50	12 weeks
12	Python Programming	BTCOL406	IV	https://nptel.ac.in/courses/106/106/106106182/	IIT, Ropar	95	12 weeks
14	Database Systems	BTCOC501	V	http://nptel.ac.in/courses/106 1 06093/	IIT, Madras	95	12 Weeks
15	Theory of Computation	BTCOC502	V	https://nptel.ac.in/courses/106/104/106104028/ https://nptel.ac.in/courses/106/106/106106049/	IIT, Kharagpur IIT, Madras	92	45 Hrs 42 Hrs
16	Machine Learning	BTCOC503	V	https://nptel.ac.in/courses/106/105/106105152/	IIT, Kharagpur	100	8 Weeks
17	Human Computer Interaction	BTCOE504 (A)	V	https://nptel.ac.in/courses/106/103/106103115/#	IIT, Guwahati	70	8 Weeks
18	Numerical Methods	BTCOE504 (B)	V	https://nptel.ac.in/courses/111/107/111107105/	IIT, Roorkee	90	8 Weeks
19	Economics and Management	BTHM505 (A)	V	https://nptel.ac.in/courses/110/105/110105067/	IIT, Kharagpur	90	8 Week
20	Business Communication	BTHM505 (B)	V	https://nptel.ac.in/courses/110/105/110105052/	IIT, Kharagpur	90	8 Weeks
21	Compiler Design	BTCOC601	VI	https://nptel.ac.in/courses/106/108/106108113/ https://nptel.ac.in/courses/106/104/106104123/	IISc, Banglore IIT Kanpur	80	40 Hrs
22	Computer Networks	BTCOC602	VI	https://nptel.ac.in/courses/106/105/106105081/ https://nptel.ac.in/courses/106/105/106105080/	IIT Kharagpur	90	12 Weeks
23	Software Engineering	BTCOC603	VI	https://nptel.ac.in/courses/106/105/106105182/	IIT, Kharagpur	70	9 weeks
24	Geographic Information System	BTCOE604 (A)	VI	Introduction to Geographic Information Systems	IIT, Roorkee	90	4 weeks
25	Internet of Things	BTCOE604 (B)	VI	https://nptel.ac.in/courses/106/105/106105166/	IIT, Kharagpur	60	12 Weeks
26	Embedded Systems	BTCOE604 (C)	VI	https://nptel.ac.in/courses/106/105/106105193/	IIT, Kharagpur	80	8 Weeks
27	Development Engineering	BTCOE605 (A)	VI	https://nptel.ac.in/courses/109/103/109103023/ https://nptel.ac.in/courses/109/104/109104074/	IIT, Guwahati IIT, Kanpur	30 40	8 Weeks
28	Employability and Skills Development	BTCOE605 (B)	VI	https://nptel.ac.in/courses/109/105/109105144/	IIT, Kharagpur	75	8 Weeks
29	Consumer Behaviour	BTCOE605 (C)	VI	https://nptel.ac.in/courses/110/105/110105054/	IIT Kharagpur	90	40 Hrs

30	Artificial Intelligence	BTCOC701	VII	https://nptel.ac.in/courses/106/106/106106126/ https://nptel.ac.in/courses/106/105/106105078/	IIT, Madras IIT, Kharagpur	70	48 Hrs 41 Hrs
31	Cloud Computing	BTCOE702	VII	https://nptel.ac.in/courses/106/104/106104182/ https://nptel.ac.in/courses/106/105/106105167/	IIT, PATNA IIT, Kharagpur	30 40	8 weeks
32	Bioinformatics	BTCOE703 (A)	VII	https://nptel.ac.in/courses/102/106/102106065/	IIT, Madras	50	12 Weeks
33	Distributed Systems	BTCOE703 (B)	VII	https://nptel.ac.in/courses/106/106/106106168/	IIT, PATNA	50	8 Weeks
34	Big Data Analytics	BTCOE703 (C)	VII	https://nptel.ac.in/courses/106/104/106104189/	IIT, PATNA	50	8 Weeks
35	Cryptography and Network Security	BTCOE704 (A)	VII	https://swayam.gov.in/nd2_nou19_cs08/preview	Uttarakhand Open University, Haldwani	20	12 Weeks
36	Business Intelligence	BTCOE704 (B)	VII	https://nptel.ac.in/courses/106/104/106104220/	IIT, Kharagpur	10	12 Weeks
37	Blockchain	BTCOE704 (C)	VII	https://nptel.ac.in/courses/106/104/106104220/	IIT, KANPUR	60	8 Weeks
38	Virtual Reality	BTCOE705 (A)	VII	https://nptel.ac.in/course/106/106/106106138	IIT Madras & UIUC	30	8 Weeks
39	Deep Learning	BTCOE705 (B)	VII	https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs85/	IIT Madras & IIT Ropar	100	12 Weeks
40	Design Thinking	BTCOE705 (C)	VII	https://nptel.ac.in/courses/110/106/110106124/	IIT Madras	75	4 Weeks

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM COURSERA

Sr. No.	Name of Subject as per Curriculum	Course Code	Semester	Coursera Course	Name of Institute offering course	Relevance %	Duration of Course
1	Discrete Mathematics	BTCOC302	III	1) https://www.coursera.org/learn/discrete-mathematics/home/welcome 2) https://www.coursera.org/specializations/discrete-mathematics	1) Shanghai Jiao Tong University 2) University of California San Diego National Research University Higher School of Economics	1) 75 2) 90	8 Weeks
2	Data Structures	BTCOC303	III	1) Data Structures 2) Data Structures & Algorithms	1) UC SanDiego 2) UC SanDiego	1) 90 2) 80	1) 6 Weeks 2) 6 Weeks
3	Computer Architecture & Organization	BTCOC304	III	Computer Architecture	Princeton University, US	25	4 Weeks
4	Object Oriented Programming in C++	BTCOC305	III	C++ For C Programmers, Part A	University of California, Santa Cruz	27	5 Weeks
5	Digital Electronics & Microprocessors	BTES403	IV	1) Digital Systems: From Logic Gates to Processors	1) Universitat Autonoma de Barcelona 2) Princetone University	20	4 Weeks
6	Design & Analysis of Algorithms	BTCOC401	IV	Algorithms Specialization	Stanford University	40	16 Weeks
7	Probability & Statistics	BTBS402	IV	Probability Theory, Statistics and Exploratory Data Analysis	National Research University Higher School of Economics	80	6 Weeks
8	Operating Systems	BTCOC403	IV	Operating Systems and You: Becoming a Power User	Google	20	6 Weeks
9	Database Systems	BTCOC501	V	Relational database systems	Universidad Nacional Autónoma de México	30	4 Weeks
10	Theory of Computation	BTCOC502	V	Computer Science: Algorithms, Theory, and Machines	Princeton University	25	4 Weeks
11	Machine Learning	BTCOC503	V	Machine Learning with Python	IBM	50	6 Weeks
12	Human Computer Interaction	BTCOE504 (A)	V	Interaction Design Specialization	UCSanDiego	30	13 Weeks
13	Economics and Management	BTHM505 (A)	V	Managerial Economics and Business Analysis Specialization	University of Illinois	30	4 Weeks

14	Business Communication	BTHM505 (B)	V	Communication theory: bridging academia and practice	National Research University Higher School of Economics	35	9 Weeks
15	Compiler Design	BTCOC601	VI	Nil	Nil	Nil	Nil
16	Computer Networks	BTCOC602	VI	The Bits and Bytes of Computer Networking	Google	50	4 Weeks
17	Software Engineering	BTCOC603	VI	<u>Software Development Processes and Methodologies</u> https://www.coursera.org/learn/software-Processes	University of Minnesota	25	4 Weeks
18	Geographic Information System	BTCOE604 (A)	VI	1. GIS, mapping, and spacial analysis Specialization	University of Toronto	40	6 months
19	Internet of Things	BTCOE604 (B)	VI	Internet of Things Specialization	UC San Diego	40	6 Months
20	Development Engineering	BTCOE605 (A)	VI	Revolutionary Ideas: Utility, Justice, Equality, Freedom	Rutgers the State University of New Jersey	30	5 Weeks
21	Consumer Behaviour	BTCOE605 (C)	VI	Digital Marketing Specialization	Illinois	70	6 Months
22	Artificial Intelligence	BTCOC701	VII	Introduction to Artificial Intelligence (AI)	IBM	40	4 Weeks
23	Cloud Computing	BTCOE702	VII	Cloud Computing Applications, Part 1: Cloud Systems and Infrastructure	University of Illinois at Urbana-Champaign	70	4 Weeks
24	Bioinformatics	BTCOE703 (A)	VII	Bioinformatics Capstone: Big Data in Biology	University of California San Diego	20	3 Weeks
25	Distributed System	BTCOE703 (B)	VII	Distributed Programming in Java	Rice University	30	4 Weeks
26	Cryptography and Network Security	BTCOE704 (A)	VII	Information Security: Context and Introduction	Royal Holloway, University of London	40	4 Weeks
27	Business Intelligence	BTCOE704 (B)	VII	Business Intelligence Concepts, Tools, and Applications	University of Colorado System	30	5 Weeks

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM
Edx

Sr. No.	Name of Subject as per Curriculum	Course Code	Semester	Edx Course	Name of Institute offering Course	Relevance %	Duration of Course
1	Discrete Mathematics	BTCOC302	III	https://www.edx.org/course/advanced-algorithmics-and- graph-theory-with-python	IMT Atlantique, a french technological university	50	6 Weeks
2	Data Structures	BTCOC303	III	1) Foundations of Data Structures 2) Algorithms and Data Structures	1) IIT Bombay 2) UCSanDiego	1) 90 2) 70	1) 6 Weeks 2) 4 Weeks
3	Computer Architecture & Organization	BTCOC304	III	1. Computer Organization 2. Computer Architecture	1. MITx 2. MITx	1. 20 2. 20	10 Weeks
4	Object Oriented Programming in C++	BTCOC305	III	Object-oriented Programming	IIT BombayX	53	4 Weeks
5	Design & Analysis of Algorithms	BTCOC401	IV	Algorithm Design and Analysis	University of Pennsylvania	40	4 Weeks
6	Probability & Statistics	BTBS402	IV	Introduction to Probability	Harvard University	50	8 Weeks
7	Operating Systems	BTCOC403	IV	Computer Hardware and Operating Systems	New York University	40	6 Weeks
8	Digital Electronics & Microprocessors	BTES405	IV	Computer System Design: Advanced Concepts of Modern Microprocessors	1) Edx Edge	10	6 Weeks
9	Database Systems	BTCOC501	V	Databases: SQL	Stanford Online	50	8 Weeks
10	Theory of Computations	BTCOC502	V	Automata Theory	Stanford University	60	7 Weeks
11	Machine Learning	BTCOC503	V	Machine Learning with Python: A Practical Introduction	IBM	50	5 Weeks
12	Human Computer Interaction	BTCOE504 (A)	V	Human-Computer Interaction	Georgia Tech	30	12 Weeks
13	Economics and Management	BTHM505 (A)	V	Introduction to Managerial Economics	IIM Bangalore	30	6 Weeks
14	Business Communication	BTHM505 (B)	V	Effective Business Communication	IIM Bangalore	40	6 Weeks
15	Compiler Design	BTCOC601	VI	Compilers	Stanford University	45	10 Weeks

16	Computer Networks	BTCOC602	VI	Introduction to Networking	New York University	40	7 Weeks
17	Software Engineering	BTCOC603	VI	Software Engineering Essentials https://www.edx.org/course/software-engineering-essentials	TUMx	40	8 Weeks
18	Geographic Information System	BTCOE604 (A)	VI	No Program available	NA	NA	NA
19	Internet of Things	BTCOE604 (B)	VI	Getting Started with the Internet of Things (IoT)	Microsoft	30	4 Weeks
20	Development Engineering	BTCOE605 (A)	VI	Human Rights, Human Wrongs: Challenging Poverty, Vulnerability and Social Exclusion	SDGAcademyX, Middlesex University	40	11 Weeks
21	Consumer Behaviour	BTCOE605 (B)	VI	Consumer Behaviour	IITMB	50	4 Weeks
22	Artificial Intelligence	BTCOC701	VII	CS50's Introduction to Artificial Intelligence with Python	Harvard University	35	7 Weeks
23	Bioinformatics	BTCOE703 (A)	VII	Bioinformatics	University of Maryland	40	24 Weeks
24	Distributed Systems	BTCOE703 (B)	VII	Reliable Distributed Algorithms - Part 1	KTHx	30	5 Weeks
25	Cloud Computing	BTCOE703 (C)	VII	Cloud Computing Management	University of Maryland	20	8 Weeks
26	Cryptography and Network Security	BTCOE704 (A)	VII	Cyber security	Rochester Institute of Technology	50	40 Weeks
27	Business Intelligence	BTCOE704 (B)	VII	Business Intelligence for IoT Solutions	Microsoft	20	4 Weeks
28	Block Chain	BTCOE704 (C)	VII	1. Block chain Technology 2. Block chain Fundamentals	Berkeley University Of California	60	14 Weeks
29	Virtual Reality	BTCOE705 (A)	VII	How Virtual Reality Works	Ucsan Diego	10	6 Weeks
30	Deep Learning	BTCOE705 (B)	VII	Deep Learning Fundamentals with Keras	IBM	15	5 Weeks

Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
(under Maharashtra Act No. XXIX of 2014)
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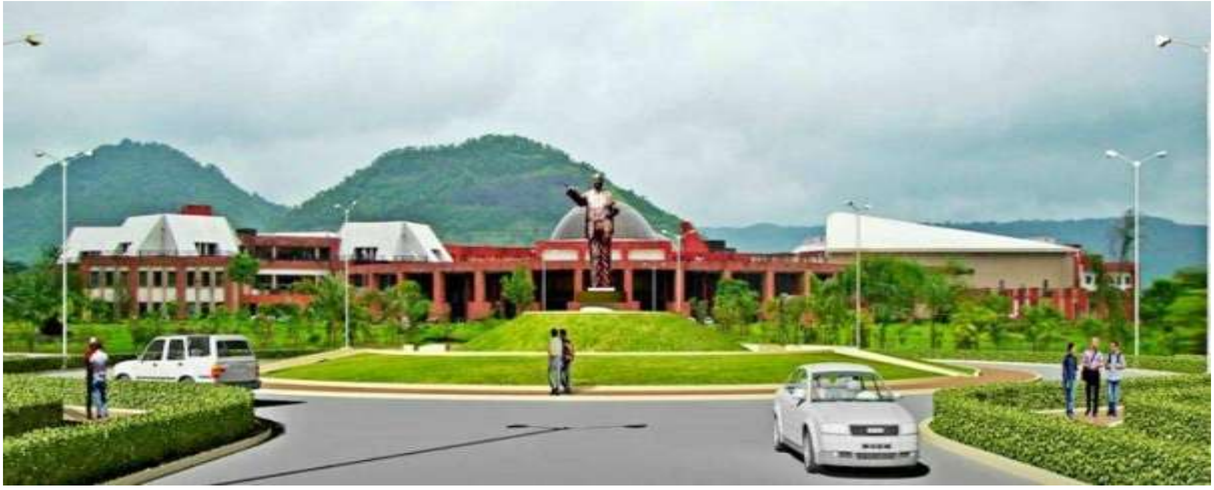
PROPOSED CURRICULUM

UNDER GRADUATE PROGRAMME

B.TECH

ELECTRONICS AND TELECOMMUNICATION ENGINEERING

WITH EFFECT FROM THE ACADEMIC YEAR 2020-2021.



Rules and Regulations

1. The normal duration of the course leading to B.Tech degree will be EIGHT semesters.
2. The normal duration of the course leading to M.Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well.For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.
4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra -curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

REGISTRATION:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PG Programme:

A full time student of a particular UG/PG programme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PG programme as stipulated in the specific Regulations pertaining to that UG/PG programme.

2. Mandatory Pre-Registration for higher semesters:
   In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.
3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.

2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.
3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the following conditions:

(a) Satisfied all the Academic Requirements to continue with the programme of Studies without termination
(b) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;
(c) Paid all required advance payments of the Institute and hostel for the current semester;
(d) Not been debarred from registering on any specific ground by the Institute.

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below will be implementeds from academic year 2019-20,starting from I year B.Tech.

Perentage of marks	Letter grade	Grade point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. Class is awdared based on CGPA of all eigth semster of B.Tech Program.

CGPA for pass is minimum 5.0	
CGPAupto<5.50	Pass class
CGPA $\geq$ 5.50 &<6.00	SecondClass
CGPA $\geq$ 6.00 &<7.50	First Class
CGPA $\geq$ 7.50	Distinction
[Percentage of Marks =CGPA*10.0]	

3. A total of 100 Marks for each theory course are distributed as follows:

	MidSemester Exam (MSE) Marks	20
	ContinuousAssesment Marks	20
	End SemesterExamination(ESE)Marks	60

4.A total of 100 Marks for each practical course are distributed as follows:

1.	Continuous Assesment Marks	60
2.	End Semester Examination (ESE)Marks	40

It is mandatory for every student of B.Tech to score a minimum of 40 marks out of 100, <u>with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.</u>

This will be implemented from the first year of B.Tech starting from Academic Year 2019-20

5. Description of Grades:

EX Grade: An 'EX' grade stands for outstanding achievement.
EE Grade: The 'EE' grade stands for minimum passing grade.
The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.
If any of the student remain Absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.
FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance .The students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

(A) Semester Grade Point Average (SGPA) The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{[\sum_{i=1}^{n} c_i g_i]}{[\sum_{i=1}^{n} c_i]}$$

Where
'n' is the number of subjects for the semester,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his performance as per the above table.
-SGPA will be rounded off to the second place of decimal and recorded as such.

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (upto two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{[\sum_{i=1}^{m} c_i g_i]}{[\sum_{i=1}^{m} c_i]}$$

Where

'm' is the total number of subjects from the first semester onwards up to and including the semester S,

'ci' is the number of credits allotted to a particular subject, and

'gi' is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

-CGPA will be rounded off to the second place of decimal and recorded as such.

Award of Degree of Honours

Major Degree

The concept of Major and Minors at B.Tech level is introduced , to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

A. <u>Eligibility Criteria for Majors</u>

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for majors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded B.Tech (Honours) Degree.

B. <u>Eligibility Criteria for Minors</u>

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for minors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded with B.Tech Degree in ------- Engineering with Minor in ------ --Engineering.

(For e.g.: B. Tech in Civil Engineering with Minor in Computer Engineering)

For applying for Honours and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS:

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.

If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.

The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.

In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.

3. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.
4. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

TRANSFER OF CREDITS

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a) 20 % of the total credit will be considered for respective calculations.

b) Credits transferred will be considered for overall credits requirements of the programme.

c) Credits transfer can be considered only for the course at same level i.e UG, PG etc.

d) A student must provide all details (original or attested authentic copies)such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e) A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

g) In exceptional cases, the students may opt for higher credits than the prescribed.

Bachelor of Technology in Electronics and Telecommunication Engineering

Basic Science Course (BSC)

BTBS101	Engineering Mathematics - I	(3-1-0)4
BTBS102	Engineering Physics	(3-1-0)4
BTBS107L	Engineering Physics Lab	(0-0-2)1
BTBS201	Engineering Mathematics - II	(3-1-0)4
BTBS202	Engineering Chemistry	(3-1-0)4
BTBS207L	Engineering Chemistry Lab	(0-0-2)1
BTBS301	Engineering Mathematics - III	(3-1-0)4
BTBS404	Probability Theory and Random Processes	(3-0-0)3

Engineering Science Course (ESC)

BTES103	Engineering Graphics	(2-0-0)2
BTES105	Energy and Environment Engineering	(2-0-0)2
BTES106	Basic Civil and Mechanical Engineering	(2-0-0) Audit
BTES108L	Engineering Graphics Lab	(0-0-4)2
BTES203	Engineering Mechanics	(2-1-0)3
BTES204	Computer Programming	(3-0-0)3
BTES205	Workshop Practice	(0-0-4)2
BTES206	Basic Electrical and Electronics Engineering	(2-0-0) Audit
BTES208L	Engineering Mechanics Lab	(0-0-2)1
BTES304	Electrical Machines and Instruments	(3-1-0)4

Humanities and Social Science including Management Courses (HSSMC)

BTHM104	Communication Skills	(2-0-0)2
BTHM109L	Communication Skills Lab	(0-0-2)1
BTHM403	Basic Human Rights	(3-0-0)3
BTHM605	Employability and Skill Development	(3-0-0)3
BTHM705	Engineering Economics and Financial Mathematics	(3-0-0)3
BTHM706	Foreign Language Studies	Audit

Professional Core Course (PCC)

BTETC302	Electronic Devices & Circuits	(3-1-0)4
BTETC303	Digital Electronics	(3-1-0)4
BTETL305	Electronic Devices & Circuits Lab	(0-0-2)1
BTETL306	Digital Electronics Lab	(0-0-2)1
BTETC401	Network Theory	(3-1-0)4
BTETC402	Signals and Systems	(3-1-0)4
BTETL406	Network Theory Lab & Signals and Systems Lab	(0-0-4)2
BTETC501	Electromagnetic Field Theory	(3-1-0)4
BTETC502	Digital Signal Processing	(3-1-0)4
BTETC503	Analog Communication	(3-1-0)4
BTETL506	Digital Signal Processing Lab & Analog Communication Lab	(0-0-4)2
BTETC601	Antennas and Wave Propagation	(3-1-0)4

BTETC602	Digital Communication	(3-1-0)4
BTETL606	Digital Communication Lab and Professional Elective Course 3 Lab	(0-0-4)2
BTETC701	Microwave Engineering	(3-1-0)4
BTETL707	Microwave Engineering Lab	(0-0-2)1

Professional Elective Course (PEC)

BTETPE405	(A) Numerical Methods and Computer Programming (B) Data Compression & Encryption (C) Computer Organization and Architecture (D) Introduction to MEMS (E) Python Programming	(3-1-0)4
BTETPE504	(A)Analog Circuits (B) Embedded System Design (C) Digital System Design (D) Automotive Electronics (E) Mixed Signal Design (F) Power Electronics	(3-1-0)4
BTETPE603	(A) Microprocessors and Microcontrollers (B) CMOS Design (C) Nano Electronics (D) Advanced Digital Signal Processing (E) Information Theory and Coding (F) VLSI Signal Processing (G) VLSI Design &Technology	(3-1-0)4
BTETPE702	(A) Digital Image Processing (B) RF Circuit Design (C) Satellite Communication (D) Fiber Optic Communication (E) Bio-medical Signal Processing (F) Principles of Modern Radar Engineering	(3-1-0)4

Open Elective Course (OEC)

BTETOE505	(A) Control System Engineering (B) Artificial Intelligence and Machine learning (C) Optimization Techniques (D) Project Management and Operation Research (E) Augmented, Virtual and Mixed Reality (F) Open Source Technologies	(3-1-0)4
BTETOE604	(A) IoT and Industry4.0 (B) Deep Learning (C) Computer Network (D) Industrial Drives and Control (E) Robotics Design (F) Patents and IPR (G) Acoustic Engineering	(3-1-0)4

BTETOE703	(A) Wireless Sensor Networks	(3-1-0)4
	(B) Block Chain Technology	
	(C) Cyber Security	
	(D) Mobile Computing	
	(E) Mobile Communication and Networks	
	(F) EMI and EMC	
BTETOE704	(A) Soft Computing	(3-1-0)4
	(B) Big Data Analytics	
	(C) Data Structure & Algorithms Using Java Programming	
	(D) Entrepreneurship Development	
	(E) Software Defined Radio	
	(F) E Waste Management	

Seminar/Mini Project/ Internship

BTES209S	Seminar	(0-0-2)1
BTES211P	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in at one time). (Internship – 1)	Audit
BTETS307	Seminar I	(0-0-4)2
BTETS407	Seminar II	(0-0-4)2
BTETP408	(Internship – 2)	Audit
BTETM507	Mini Project – 1	(0-0-4)2
BTETM607	Mini Project – 2	(0-0-4)2
BTETP608	(Internship–3)	Audit
BTETM708	Mini Project– 3	(0-0-4)2

Project (MP)

BTETP801	Project work /Internship	(0-0-24)12

Minor Courses (MC)

BTETC302	Electronic Devices& Circuits	(3-1-0)4
BTETC303	Digital Electronics	(3-1-0)4
BTETC402	Signals and Systems	(3-1-0)4
BTETPE603	(A) Microprocessors and Microcontrollers	(3-1-0)4
BTETC503	Analog Communication	(3-1-0)4

Suggested Plan of Study:

Number of Courses	Semester							
	I	II	III	IV	V	VI	VII	VIII
1	BTBS101	BTBS201	BTBS301	BTETC401	BTETC501	BTETC601	BTETC701	BTETP801 (Project/Internship)
2	BTBS102	BTBS202	BTETC302	BTETC402	BTETC502	BTETC602	BTETPE702 **(Elective)**	--
3	BTES103	BTES203	BTETC303	BTHM403	BTETC503	BTETPE603 **(Elective)**	BTETOE703 **(Elective)**	--
4	BTHM104	BTES204	BTES304	BTBS404	BTETPE504 **(Elective)**	BTETOE604 **(Elective)**	BTETOE704 **(Elective)**	--
5	BTES105	BTES205	BTETL305	BTETPE405 **(Elective)**	BTETOE505 **(Elective)**	BTHM605	BTHM705	--
6	BTES106	BTES206	BTETL306	BTETL406	BTETL507	BTETL606	BTHM706	--
7	BTBS107L	BTBS207L	BTETS307	BTETS407	BTETM508	BTETM607	BTETL707	--
8	BTES108L	BTES208L	BTES211P (Internship - 1 Evaluation)	BTETP408 (Internship – 2)	BTETP408 (Internship – 2 Evaluation)	BTETP608 (Internship – 3)	BTETM708	--
9	BTHM109L	BTES209S	--	--	--	--	BTETP608 (Internship – 3 Evaluation)	--
10	--	BTES211P (Internship - 1)	--	--	--	--	--	--

Degree Requirements:

Category of courses	Minimum credits to be earned
Basic Science Course (BSC)	**25**
Engineering Science Course (ESC)	**19**
Humanities and Social Science including Management Courses (HSSMC)	**12**
Professional Core Course (PCC)	**48**
Professional Elective Course (PEC)	**17**
Open Elective Course (OEC)	**16**
Seminar/Mini Project/ Internship/Major Project	**23**
Total	**160**

B. Tech in Electronics & Telecommunication Engineering

Program Educational Objectives and Outcomes

A. Program Educational Objectives (PEOs)

Graduates will able to–

1. To equip graduates with a strong foundation in engineering sciences and Electronics & Telecommunication Engineering fundamentals to become effective collaborators, researchers and real-time problem solver with technical competencies.
2. Perceive the limitation and impact of engineering solutions in social, legal, environmental, economical and multidisciplinary contexts.
3. Excel in Industry/technical profession, higher studies, and entrepreneurship exhibiting global competitiveness.

B. Program Outcomes

Engineering Graduate will be able to –

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

C. Program Specific Outcomes (PSOs)

1. Apply basic knowledge related to Electronic Circuits, Embedded & wireless communication Systems and Signal Processing to solve engineering/ societal problems in the field of Electronics and Telecommunication Engineering.
2. Recognize and adapt to technical developments and to engage in lifelong learning and develop consciousness for professional, social, legal and ethical responsibilities.
3. Excellent adaptability to the changing industrial and real world requirements.

DR. BABASAHEB AMBEDKAR TECHNOLOGICAL UNIVERSITY,

B. Tech in Electronics & Telecommunication Engineering
Curriculum for Second Year

Semester III										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
BSC	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
PCC 1	BTETC302	Electronic Devices & Circuits	3	1	-	20	20	60	100	4
PCC 2	BTETC303	Digital Electronics	3	1	-	20	20	60	100	4
ESC	BTES304	Electrical Machines and Instruments	3	1	-	20	20	60	100	4
LC	BTETL305	Electronic Devices & Circuits Lab	-	-	2	60	-	40	100	1
LC	BTETL306	Digital Electronics Lab	-	-	2	60	-	40	100	1
Seminar	BTETS307	Seminar I	-	-	4	60	-	40	100	2
Internship	BTES211P	Internship – 1 Evaluation	-	-	-	-	-	-	-	Audit
		Total	**12**	**4**	**8**	**260**	**80**	**360**	**700**	**20**

Semester IV										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 3	BTETC401	Network Theory	3	1	-	20	20	60	100	4
PCC 4	BTETC402	Signals and Systems	3	1	-	20	20	60	100	4
HSSMC	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
BSC	BTBS404	Probability Theory and Random Processes	3	-	-	20	20	60	100	3
PEC 1	BTETPE405	(A) Numerical Methods and Computer Programming (B) Data Compression & Encryption (C) Computer Organization and Architecture (D) Introduction to MEMS (E) Python Programming	3	1	-	20	20	60	100	4
LC	BTETL406	Network Theory Lab & Signals and Systems Lab	-	-	4	60	-	40	100	2
Seminar	BTETS407	Seminar II	-	-	4	60	-	40	100	2
Internship	BTETP408 (Internship – 2)	Field Training /Internship/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at onetime).	-	-	-	-	-	-	-	Audit (evaluation will be in V Sem.)
		Total	**15**	**3**	**8**	**220**	**100**	**380**	**700**	**22**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

B. Tech in Electronics & Telecommunication Engineering
Curriculum for Third Year

Semester V										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 5	BTETC501	Electromagnetic Field Theory	3	1	-	20	20	60	100	4
PCC 6	BTETC502	Digital Signal Processing	3	1	-	20	20	60	100	4
PCC 7	BTETC503	Analog Communication	3	1	-	20	20	60	100	4
PEC 2	BTETPE504	Group A	3	1	-	20	20	60	100	4
OEC 1	BTETOE505	Group B	3	1	-	20	20	60	100	4
LC	BTETL506	Digital Signal Processing Lab & Analog Communication Lab	-	-	4	60	-	40	100	2
Project	BTETM507	Mini Project – 1	-	-	4	60	-	40	100	2
Internship	BTETP408	Internship – 2 Evaluation	-	-	-	-	-	-	-	Audit
		Total	**15**	**5**	**8**	**220**	**100**	**380**	**700**	**24**

Semester VI										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 8	BTETC601	Antennas and Wave Propagation	3	1	-	20	20	60	100	4
PCC 9	BTETC602	Digital Communication	3	1	-	20	20	60	100	4
PEC 3	BTETPE603	Group A	3	1	-	20	20	60	100	4
OEC 2	BTETOE604	Group B	3	1	-	20	20	60	100	4
HSSMC	BTHM605	Employability and Skill Development	3	-	-	20	20	60	100	3
LC	BTETL606	Digital Communication Lab & Professional Elective Course 3 Lab	-	-	4	60	-	40	100	2
Project	BTETM607	Mini Project – 2	-	-	4	60	-	40	100	2
Internship	BTETP608 (Internship – 3)	Field Training / Internship/Industrial Training (minimum of 4 weeks which can be completed partially in third semester and fourth semester or in at one time).	-	-	-	-	-	-	-	Audit (evaluation will be in VII Sem.)
		Total	**15**	**4**	**8**	**220**	**100**	**380**	**700**	**23**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Semester V

BTETPE504 Program Elective 2 (Group A)	BTETOE505 Open Elective 1 (Group B)
(A) Analog Circuits	(A) Control System Engineering
(B) Embedded System Design	(B) Artificial Intelligence and Machine learning
(C) Digital System Design	(C) Optimization Techniques
(D) Automotive Electronics	(D) Project Management and Operation Research
(E) Mixed Signal Design	(E) Augmented, Virtual and Mixed Reality
(F) Power Electronics	(F) Open Source Technologies

Semester VI

BTETPE603 Program Elective 3 (Group A)	BTETOE604 Open Elective 2 (Group B)
(A) Microprocessors and Microcontrollers	(A) IoT and Industry 4.0
(B) CMOS Design	(B) Deep Learning
(C) Nano Electronics	(C) Computer Network
(D) Advanced Digital Signal Processing	(D) Industrial Drives and Control
(E) Information Theory and Coding	(E) Robotics Design
(F) VLSI Signal Processing	(F) Patents and IPR
(G) VLSI Design & Technology	(G) Acoustic Engineering

B. Tech in Electronics & Telecommunication Engineering
Curriculum for Final Year

Semester VII										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC 10	BTETC701	Microwave Engineering	3	1	-	20	20	60	100	4
PEC 4	BTETPE702	Group A	3	1	-	20	20	60	100	4
OEC 3	BTETOE703	Group B	3	1	-	20	20	60	100	4
OEC 4	BTETOE704	Group C	3	1	-	20	20	60	100	4
HSSMC	BTHM705	Engineering Economics and Financial Mathematics	3	-	-	20	20	60	100	3
HSSMC	BTHM706	Foreign Language Studies	-	-	-	-	-	-	-	Audit
LC	BTETL707	Microwave Engineering Lab	-	-	2	60	-	40	100	1
Project	BTETM708	Mini Project – 3	-	-	4	60	-	40	100	2
Internship	BTETP608	Internship – 3 Evaluation	-	-	-	-	-	-	-	Audit
		Total	**15**	**4**	**6**	**220**	**100**	**380**	**700**	**22**

Semester VIII										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
Project/ Internship	BTETP801	Project work/ Internship	-	-	24	60	-	40	100	12
		Total	**-**	**-**	**24**	**60**	**-**	**40**	**100**	**12**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

BTETPE702 Program Elective 4 (Group A)	**BTETOE703 Open Elective 3 (Group B)**	**BTETOE704 Open Elective 4 (Group C)**
(A) Digital Image Processing	(A) Wireless Sensor Networks	(A) Soft Computing
(B) RF Circuit Design	(B) Block Chain Technology	(B) Big Data Analytics
(C) Satellite Communication	(C) Cyber Security	(C) Data Structure & Algorithms Using Java Programming
(D) Fiber Optic Communication	(D) Mobile Computing	(D) Entrepreneurship Development
(E) Bio-medical Signal Processing	(E) Mobile Communication and Networks	(E) Software Defined Radio
(F) Principles of Modern Radar Engineering	(F) EMI and EMC	(F) E Waste Management

Total Credits: 160

SEMESTER III

BTBS301 Engineering Mathematics-III **4 Credits**

Second Year B. Tech Classes (Common to all Branches)

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Vector differentiation and integration required in Electro-magnetics and Wave theory.
4. Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Course Outcomes:

On completion of the course, students will be able to:

- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
- Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
- Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.
- Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.
- Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Unit 1: Laplace Transform **09 Hours**

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform **09 Hours**

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients.

Unit 3:Fourier Transform **09 Hours**

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Parseval‟s identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications **09 Hours**

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange‟s linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation (), and one dimensional wave equation

Unit 5: Functions of Complex Variables **09 Hours**

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functionsinCartesianform;Cauchy‟sintegraltheorem;Cauchy‟sintegralformula;Residues; Cauchy"s residue theorem (All theorems without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
2. A Text Book of Engineering Mathematics by PeterO"Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., NewDelhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill , NewYork.

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.

   The minimum number of assignments should be eight covering all topics.

BTETC302 Electronic Devices and Circuits — 4 Credits

Prerequisites: Basic knowledge of Semiconductor Physics.

Course Objectives:

1. To introduce Static characteristics of ideal two terminal and three terminal devices.
2. To introduce semiconductor devices BJT, JFET and MOSFET, their characteristics, operations, circuits and applications.
3. To analyze and interpret BJT, FET and MOSFET circuits for small signal at low and high frequencies.
4. To simulate electronics circuits using computer simulation software and verify desired results.

Course Outcomes:

On completion of the course, students will be able to:

1. Comply and verify parameters after exciting devices by any stated method.
2. Implement circuit and test the performance.

3. Analyze BJT, JFET and MOSFET for various applications.
4. Analyze Feedback amplifiers and oscillators..

UNIT – 1 Bipolar Junction Transistor: 07 Hours

BJT: construction, working, characteristics, Transistor as switch, Transistor configurations, current gain equation, stability factor.

BJT Biasing and basic amplifier configurations: Need for biasing BJT, Transistor biasing methods, Transistor as amplifier , Analysis of Single Stage Amplifier, RC coupled Amplifiers, Effects of bypass and coupling capacitors, Frequency response of CE amplifier, Emitter follower, Cascaded Amplifier, Need for multistage amplifiers and suitability of CE, CC and CB configurations in multistage amplifiers.

UNIT – 2 Junction Field Effect Transistor and MOSFET 07 Hours

JFET: JFET and its characteristics, Pinch off voltage, Drain saturation current, JFET amplifiers, CS,CD,CG amplifiers ,their analysis using small signal JFET model ,Biasing the FET, The FET as VVR.

MOSFET: Overview of DMOSFET, EMOSFET, Power MOSFET, n MOSFET, p - MOSFET and CMOS devices, Handling precautions of CMOS devices, MOSFET as an Amplifier and Switch, Biasing in MOSFET, Small signal operation and models, Single stage MOS amplifier, MOSFET capacitances, CMOS Inverter, Comparison of FET with MOSFET and BJT w.r.t. to device and Circuit parameter.

UNIT – 3 Power amplifiers: 07 Hours

Introduction, classification of power amplifiers -A, B, AB, C and D, transformer coupled class A amplifier, Class B push pull and complementary symmetry amplifier, efficiency, calculation of power output, power dissipation, cross over distortion and its elimination methods, need of heat sink and its design.

UNIT – 4 Feedback amplifiers: 07 Hours

Principle of Negative feedback in electronic circuits, Voltage series, Voltage shunt, Current series, Current shunt types of Negative feedback, Typical transistor circuits effects of Negative feedback on Input and Output impedance, Voltage and Current gains, Bandwidth, Noise and Distortion

UNIT – 5 Oscillators & Voltage Regulator Circuits **07 Hours**

Principle of Positive feedback, Concept of Stability in electronics circuits, Barkhausen criteria for oscillation, RC, Clapp, Wien Bridge, Colpitt, Hartley, Tuned LC, UJT, Relaxation Oscillators.

Transistor application: Discrete transistor voltage Regulation, series voltage regulator, shunt voltage regulator.

IC Voltage Regulators: Three terminal voltage regulator, Variable voltage regulator

TEXT/REFERENCE BOOKS:

1. D. A. Neamen, Semiconductor Physics and Devices (IRWIN), Times Mirror High Education Group, Chicago)1997.
2. E.S. Yang, Microelectronic Devices, McGraw Hill, Singapore, 1988.
3. Brijesh Iyer, S. L. Nalbalwar, R. Dudhe, "Electronics Devices & Circuits", Synergy Knowledge ware Mumbai, 2017.ISBN:9789383352616
4. B.G. Streetman, Solid State Electronic Devices, Prentice Hall of India, New Delhi,1995.
5. J. Millman and A. Grabel, Microelectronics, McGraw Hill, International,1987.
6. A.S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, 1991.
7. R.T. Howe and C.G. Sodini, Microelectronics: An integrated Approach, Prentice Hall International,1997.

BTETC303 Digital Electronics 4 Credits

Course Objectives:

1. To acquaint the students with the fundamental principles of two-valued logic and various devices used to implement logical operations on variables.
2. To lay the foundation for further studies in areas such as communication, VHDL, computer.

Course Outcomes:

On completion of the course, students will be able to:

1. Use the basic logic gates and various reduction techniques of digital logic circuit in detail.
2. Design combinational and sequential circuits.

3. Design and implement hardware circuit to test performance and application.
4. Understand the architecture and use of VHDL for basic operations and Simulate using simulation software.

UNIT – 1 Combinational Logic Design: 07 Hours

Standard representations for logic functions, k map representation of logic functions (SOP and POS forms), minimization of logical functions for min-terms and max-terms (upto 4 variables), don't care conditions, Design Examples: Arithmetic Circuits, BCD - to - 7 segment decoder, Code converters. Adders and their use as subtractor, look ahead carry, ALU, Digital Comparator, Parity generators/checkers, Design of Multiplexers and De-multiplexers, Decoders.

UNIT – 2 Sequential Logic Design: 07 Hours

1 Bit Memory Cell, Clocked SR, JK, MS J-K flip flop, D and T flip-flops. Use of preset and clear terminals, Excitation Table for flip flops and Conversion of flip flops. Application of Flip- flops: Registers, Shift registers, Counters (ring counters, twisted ring counters), Sequence Generators, ripple counters, up/down counters, synchronous counters, definitions of lock out, Clock Skew, and Clock jitter.

UNIT – 3 State Machines: 07 Hours

Basic design steps- State diagram, State table, State reduction, State assignment, Mealy and Moore machines representation, Implementation, finite state machine implementation, Sequence detector.

UNIT – 4 Digital Logic Families: 07 Hours

Classification of logic families, Characteristics of digital ICs-Speed of operation, power dissipation, figure of merit, fan in, fan out, current and voltage parameters, noise immunity, operating temperatures and power supply requirements. TTL logic, Operation of TTL NAND gate, active pull up, wired AND, open collector output, unconnected inputs. Tri-State logic. CMOS logic – CMOS inverter, NAND, NOR gates, unconnected inputs, wired logic, open drain output. Interfacing CMOS and TTL, Comparison table of Characteristics of TTL, CMOS, ECL, RTL, I^2L and DCTL

UNIT – 5 Programmable Logic Devices, Semiconductor Memories and Introduction to

VHDL: **07Hours**

Programmable logic devices: Detail architecture, Study of PROM, PAL, PLA, Designing combinational circuits using PLDs. General Architecture of FPGA and CPLD Semiconductor memories: memory organization and operation, expanding memory size, Classification and characteristics of memories, RAM, ROM, EPROM, EEPROM, NVRAM, SRAM, DRAM. Introduction to VHDL: Behavioral – data flow, and algorithmic and structural description, lexical elements, data objects types, attributes, operators; VHDL coding examples, combinational circuit design examples in VHDL and simulation.

TEXT/REFERENCE BOOKS:

1. R.P. Jain, ―Modern digital electronics‖, 3rd edition, 12threprint Tata McGraw Hill Publication,2007.
2. M. Morris Mano, ―Digital Logic and Computer Design‖ 4th edition, Prentice Hall of India,2013.
3. Anand Kumar, ―Fundamentals of digital circuits‖ 1st edition, Prentice Hall of India, 2001.
4. Pedroni V.A., "Digital Circuit Design with VHDL", Prentice Hall India, 2nd 2001 Edition.

BTES304 Electrical Machines and Instruments 4 Credits

Course Objectives:

1. Model and Analyze the performance of different types of DC machines
2. Learn the applications of DC generators
3. Analyze the performance of different types of DC motors
4. Analyze the performance of different types of Sensors and Transducers
5. Familiarize with the applications of DC machines
6. To prepare students to perform the analysis of any electromechanical system.
7. To empower students to understand the working of electrical equipment used in everyday life.

Course Outcomes:

On completion of the course, students will be able to:

1. The ability to formulate and then analyze the working of any electrical machine using mathematical model under loaded and unloaded conditions.

2. The skill to analyze the response of any electrical machine.
3. The ability to troubleshoot the operation of an electrical machine.
4. The ability to select a suitable measuring instrument for a given application.
5. The ability to estimate and correct deviations in measurements due to the influence of the instrument and due to the accuracy of the instrument.

UNIT – 1 DC Machines: **07 Hours**

DC machines construction, working principle (motor & generator), EMF equation of DC Machine (motor and generator), Types and its characteristics of DC machines (motor and generator), back emf, starters of dc machine, Speed control of DC motor Breaking of DC motor, applications of DC machines (motor and generator).

UNIT – 2 Induction Motor and Synchronous Motor: **07 Hours**

Induction Motor: Construction, working principle, types, torque equation, torque slip characteristics, power stages, losses and efficiency, starters speed control, breaking, applications.

Synchronous motor: Construction, working principle, starting methods, effect of load, hunting, V-curve, synchronous condenser, applications.

UNIT – 3 Special Purpose Machines: **07 Hours**

Construction, working and application of steeper motor, variable reluctance motor, servo motor, FHP motor, hysteresis, repulsion, linear IM.

UNIT – 4 Sensors and Transducers: **07 Hours**

Classification selection of transducers strain gauges, LVDT, Temperature transducers, piezoelectric, photosensitive transducers, Hall Effect transducers, proximity devices Digital transducers need of signal conditioning and types, interfacing techniques of transducers with microprocessor and controller.

UNIT – 5 Industrial Measurement and Industrial Applications: **07 Hours**

Measurement of vibration, electrical telemetry thickness, humidity, thermal conductivity and gas analysis emission computerized tomography, smoke and fire detection, burglar alarm, object counter level measurement, on /off timers, RTC, sound level meter, tachometer, VAW meter, Recorder X- Y plotters and its applications, optical oscillograph.

TEXT/REFERENCE BOOKS:

1. A course in Electrical and Electronic Measurement and Instrumentation" by A. K. Sawhney (Publisher name: Dhanpat Rai&Co.)
2. Electronics Instrumentation by H.S. Kalsi (Publisher McGrawHill)
3. Electrical Machines by Ashfaqu Husain, Dhanpatrai andpublication
4. Instrumentation Devices System edition C. S. Rajan, G. R.sharma
5. AbhijitChakrabarti&SudiptaDebnath, “Electrical Machines”, Tata McGraw-hill Publication.
6. William H Hayt, Jack E Kimmerly and Steven M. Durbin, “Engineering Circuit Analysis”, Tata McGrawHill.
7. A.E. Fitzgerald, Charles Kingsley & Jr. Stephen D. Umans, “Electrical Machinery”, Tata McGraw-hill Publication 6thEdition.
8. I.J Nagarath & D.P Kothari, “Electrical Machines”, Tata McGraw-hill Publication 4^{th} Edition.
9. T. J. E. Miller, “Brushless permanent-magnet and reluctance motor drives”, Oxford University Press(1989).
10. Ned Mohan, “Electric Machines and Drives”: A first course,Wiley.
11. B. L. Theraja, “Electrical technology” volume 2, S.Chand.

SEMESTER IV

BTETC401 Network Theory **4Credits**

Course Objectives:

1. To learn about the basic laws of electric circuits as well as the key fundamentals of the communication channels, namely transmission lines.
2. To understand the need of simplification techniques of complicated circuits
3. To learn about the comprehensive insight into the principle techniques available for characterizing circuits, networks and their implementation in practice.
4. To learn about the use of mathematics, need of different transforms and usefulness of differential equations for analysis of networks.
5. To train the students for handling analog filter design through theory of NA along with practical, this is basic requirement of signal processing field.

Course Outcomes:

On completion of the course, students will be able to:

1. Apply knowledge of mathematics to solve numerical based on network simplification and it will be used to analyze thesame.
2. Design passive filters and attenuators theoretically and practically. To apply knowledge for design of active filters as well as digital filters and even extend this to advance adaptive filters.
3. Identify issues related to transmission of signals, analyze different RLC networks.
4. Find technology recognition for the benefit of the society.

UNIT – 1 Network Theorems: **07 Hours**

Basic nodal and mesh analysis, linearity, superposition and source transformation, Thevinin"s, Norton"s and maximum power transfer theorem and useful circuit analysis techniques, network topology, introduction to SPICE in circuit analysis.

UNIT – 2 Transient Analysis and Frequency Domain Analysis: **07 Hours**

Transient Analysis: Source free RL and RC circuits, unit step forcing function, source free parallel and series RLC circuit, complete response of the RLC circuit, lossless LC circuit. Frequency Domain Analysis: The phasor concept, sinusoidal steady state analysis; AC circuit power analysis.

UNIT – 3 Laplace transform and its circuit applications: 07 Hours

Laplace transform, initial and final value theorem, circuit analysis in s domain, frequency response.

UNIT – 4 Two Port Networks: 07 Hours

Two Port Networks: Z, Y, h and ABCD parameters, analysis of interconnected (magnetically coupled) two port, three terminal networks.

UNIT – 5 State Variable Analysis and RL & RC Network Synthesis: 07 Hours

State Variable Analysis: State variables and normal-form equations, matrix-based solution of the circuit equations. RL & RC Network Synthesis: Synthesis of one-port networks, transfer function synthesis, basics of filter design.

TEXT/REFERENCE BOOKS:

1. Hayt, Kemmerley and Durbin, “Engineering Circuit Analysis”, 8th 2012 Ed., Tata McGraw-Hill
2. DeCarlo, R.A. and Lin, P.M., “Linear Circuit Analysis: Time Domain, Phasor and Laplace Transform Approaches”, Oxford University Press.2003.
3. M.E. Van Valkenburg, “Network Analysis”, 3rd ed., Pearson2006.
4. M.E. Van Valkenburg, “Network Synthesis,” PHI2007.
5. Kuo, F.F., “Network Analysis and Synthesis”, 2nd Ed., Wiley India.2008.
6. D Roy Choudary, “Network and Systems” 1st edition, New Age International,1988
7. Boylestead, “Introductory Circuit Analysis”, 4th edition, Charles & Merrill,1982.
8. Royal Signal Handbook on Line Communication.

BTETC402 Signals and Systems 4 Credits

Course Objectives:

1. To understand the mathematical description of continuous and discrete time signals and systems.
2. To classify signals into different categories.
3. To analyze Linear Time Invariant (LTI) systems in time and transform domains.
4. To build basics for understanding of courses such as signal processing, control system and communication.

Course Outcomes:

On completion of the course, students will be able to:

1. Understand mathematical description and representation of continuous and discrete time signals and systems.
2. Develop input output relationship for linear shift invariant system and understand the convolution operator for continuous and discrete time system.
3. Understand and resolve the signals in frequency domain using Fourier series and Fourier transforms.
4. Understand the limitations of Fourier transform and need for Laplace transform and develop the ability to analyze the system in s-domain.

UNIT – 1 Introduction to Signals and Systems: 07 Hours

Introduction and Classification of signals: Definition of signal and systems, Continuous time and discrete time signal, Classification of signals as even, odd, periodic and non-periodic, deterministic and non-deterministic, energy and power, elementary signals used for testing: exponential, sine, impulse, step and its properties, ramp, rectangular, triangular, signum, sinc Operations on signals: Amplitude scaling, addition, multiplication, differentiation, integration (Accumulator for DT), time scaling, time shifting and time folding, Sampling Theorem and reconstruction of sampled signal, Concept of aliasing, examples on under sampled and over sampled signals.

Systems: Definition, Classification: linear and non-linear, time variant and invariant, causal and non-causal, static and dynamic, stable and unstable, invertible.

UNIT – 2 Time domain representation of LTI System: 07 Hours

System modeling: Input-output relation, definition of impulse response, convolution sum, convolution integral, computation of convolution integral using graphical method, Computation of convolution sum. Properties of convolution, properties of the system based on impulse response, step response in terms of impulse response.

UNIT – 3 Fourier Series: 07 Hours

Fourier series (FS) representation of periodic Continuous Time (CT) signals, Dirichlet condition for existence of Fourier series, FS representation of CT signals using exponential Fourier series, Fourier spectrum representation, properties of Fourier series, Gibbs phenomenon, Discrete Time Fourier Series and its properties.

UNIT – 4 Fourier Transform: 07 Hours

Fourier Transform (FT) representation of aperiodic CT signals, Dirichlet condition for existence of Fourier transform, evaluation of magnitude and phase response, FT of standard CT signals, FT of standard periodic CT signals, Introduction to Fourier Transform of DT signals, Properties of CTFT and DTFT, Fourier Transform of periodic signals. Concept of sampling and reconstruction in frequency domain, sampling of band-pass signals.

UNIT – 5 Laplace and Z-Transform: 07 Hours

Definition of Laplace Transform (LT), Limitations of Fourier transform and need of Laplace transform, ROC and its properties, properties of Laplace transform, Laplace transform evaluation using properties, Inverse Laplace transform based on partial fraction expansion, Application of Laplace transforms to the LTI system analysis.

Introduction to Z-transform, and its properties, Inverse Z-transform, different methods of inverse Z-transform, Z-transform for discrete time system LTI analysis.

TEXT/REFERENCE BOOKS:

1. Alan V. *Oppenheim*. Alan S. Willsky and S. Hamid Nawab, “Signals and Systems”,PHI
2. Dr. S. L. Nalbalwar, A.M. Kulkarni and S.P. Sheth, “Signals and Systems”, 2nd Edition, Synergy Knowledgeware,2017
3. Simon Haykins and Barry Van Veen, “Signals and Systems”, 2nd Edition, WileyIndia.
4. ShailaApte, “Signals and Systems-principles and applications”, Cambridge University press,2016.

5. Mrinal Mandal and Amir Asif, Continuous and Discrete Time Signals and Systems, Cambridge University Press,2007.
6. Peyton Peebles, “Probability, Random Variable, Random Processes”, 4th Edition, Tata McGraw Hill.
7. A. NagoorKanni “Signals and Systems”, 2nd edition, McGrawHill.
8. NPTEL video lectures on Signals andSystems.
9. Roberts, M.J., “Fundamentals of Signals & Systems”, Tata McGraw Hill.2007.
10. Ziemer, R.E., Tranter, W.H. and Fannin, D.R., “Signals and Systems: Continuous and Discrete”, 4th 2001 Ed., Pearson Education.

BTHM403 Basic Human Rights 3 Credits

Course Objectives:

1. To train the young minds facing the challenges of the pluralistic society and the rising conflicts and tensions in the name of particularistic loyalties to caste, religion, region and culture.
2. To give knowledge of the major "signposts" in the historical development of human rights, the range of contemporary declarations, conventions, and covenants.
3. To enable them to understand the basic concepts of human rights (including also discrimination, equality, etc.), the relationship between individual, group, and national rights.
4. To develop sympathy in their minds for those who are denied rights.
5. To make the students aware of their rights as well as duties to the nation

Course Outcomes:

- Students will be able to understand the history of human rights.
- Students will learn to respect others caste, religion, region and culture.
- Students will be aware of their rights as Indian citizen.
- Students will be able to understand the importance of groups and communities in the society.
- Students will be able to realize the philosophical and cultural basis and historical perspectives of human rights.

UNIT – 1

The Basic Concepts: - Individual, group, civil society, state, equality, justice. Human Values, Human rights and Human Duties: - Origin, Contribution of American bill of rights, French revolution. Declaration of independence, Rights of citizen, Rights of working and exploited people

UNIT – 2

Fundamental rights and economic programme. Society, religion, culture, and their inter relationship. Impact of social structure on human behavior, Social Structure and Social Problems: - Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

UNIT – 3

Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy. NGOs and human rights in India: - Land, Water, Forest issues.

UNIT – 4

Human rights in Indian constitution and law:-

i) The constitution of India: Preamble ii) Fundamental rights. iii) Directive principles of state policy. iv) Fundamental duties. v) Some other provisions.

UNIT – 5

Universal declaration of human rights and provisions of India. Constitution and law. National human rights commission and state human rights commission.

Reference books:

Shastry, T. S. N., *India and Human rights: Reflections*, Concept Publishing Company India (P Ltd.), 2005

Nirmal, C.J., *Human Rights in India: Historical, Social and Political Perspectives(Law in India)*, Oxford India

BTBS404 Probability Theory and Random Processes 3Credits

Course Objectives:

1. To develop basic of probability and random variables.
2. The primary objective of this course is to provide mathematical background and sufficient experience so that the student can read, write, and understand sentences in the language of probability theory, as well as solve probabilistic problems in engineering and applied science.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand representation of random signals
2. Investigate characteristics of random processes
3. Make use of theorems related to random signals
4. To understand propagation of random signals in LTI systems.

UNIT – 1 Introduction to Probability: 07 Hours

Definitions, scope and history; limitation of classical and relative-frequency-based definitions, Sets, fields, sample space and events; axiomatic definition of probability, Combinatorics: Probability on finite sample spaces, Joint and conditional probabilities, independence, total probability; Bayes" rule and applications

UNIT – 2 Random variables: 07 Hours

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability density functions (pdf) and properties, Jointly distributed random variables, conditional and joint density and distribution functions, Function of one random variable, pdf of the function of one random variable; Function of two random variables; Sum of two independent random variables, Expectation: mean, variance and moments of a random variable, conditional expectation; covariance and correlation; independent,

UNIT – 3 Random vector and distributions: 07 Hours

Random vector: mean vector, covariance matrix and properties, Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; MultivariateGaussiandistribution,Vector-spacerepresentationofrandomvariables,linear independence, inner product, Schwarz Inequality, Moment-generating functions, Bounds and approximations: Tchebysheff inequality and Chernoff Bound

UNIT – 4 Sequence of random variables **07 Hours**

Almost sure convergence and strong law of large numbers; convergence in mean square sense with examples from parameter estimation; convergence in probability with examples; convergence in distribution, Central limit theorem and its significance.

UNIT – 5 Random process: **07 Hours**

Random process: Probabilistic structure of a random process; mean, autocorrelation and auto - covariance functions, Stationarity: strict - sense stationary (SSS) and wide- sense stationary (WSS) processes, Autocorrelation function of a real WSS process and its properties, cross- correlation function, Ergodicity and its importance, Power spectral density, properties of power spectral density, cross- power spectral density and properties; auto- correlation function and power spectral density of a WSS random sequence, examples with white - noise as input; Examples of random processes: white noise process and white noise sequence; Gaussian process; Poisson process, Markov Process.

TEXT/REFERENCE BOOKS:

1. T. Veerrajan, “Probability, Statistics and Random Processes”, Third Edition, McGraw Hill.
2. Probability and Random Processes by Geoffrey Grimmett, David Stirzaker
3. Probability, random processes, and estimation theory for engineers by Henry Stark, John William Woods.
4. H. Stark and J. Woods, ``Probability and Random Processes with Applications to Signal Processing," Third Edition, Pearson Education
5. A. Papoulis and S. Unnikrishnan Pillai, “Probability, Random Variables and Stochastic Processes," Fourth Edition, McGrawHill.
6. K. L. Chung, Introduction to Probability Theory with Stochastic Processes, Springer International
7. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability, UBSPublishers.
8. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Stochastic Processes, UBS Publishers
9. S. Ross, Introduction to Stochastic Models, Harcourt Asia, AcademicPress.

BTETPE405A Numerical Methods and Computer Programming 4Credits

Course Objectives:

1. To prepare students for successful career in industries, for Post Graduate programmes and to work in research institutes.
2. To understand different numerical techniques used for solving algebraic and transcendental equations.
3. To understand numerical methods to solve a system of linear equations.
4. To understand numerical integration and differentiation techniques.
5. To understand various difference operators and interpolation techniques.
6. To understand object-oriented programming fundamentals and features.
7. To mold students professionally by course contents and sufficient problem solving and programming exercises and to acquaint them with different types of numerical techniques and programming concepts.

Course Outcomes:

On completion of the course, students will be able to:

1. Able to solve algebraic and transcendental equations by using numerical techniques and will be able to compare different numerical techniques used for this purpose and also will be able to choose a proper one as per the requirement of the problem.
2. Able to solve a system of linear equations with any number of variables using different direct and iterative numerical techniques.
3. Understand the concept of interpolation, finite difference operators and their relations, and can apply different interpolation techniques on equi-spaced or non equi-spaced data values.
4. Prepare them to write computer programs for the numerical computational techniques.
5. Understand application of the NMCP course in many engineering core subjects like signal processing, digital communication, numerical techniques in electromagnetics etc.
6. Understand procedure-oriented and object-oriented programming concepts.
7. Capable of writing C and C++ programs efficiently.

UNIT – 1 Introduction to Computational Methods and Errors: 07 Hours

Computational Methods: General principles of computational techniques, Introduction, common ideas and concepts of computational methods, various computational techniques.

Errors: Types and sources of errors, Concept in error estimation, Error propagation, Error due to floating point, Representation of errors, Elementary uses of series in calculation of errors.

UNIT – 2 Solution of Transcendental / Polynomial Equations and System of Linear Equation: 07Hours

Solution of Transcendental / Polynomial Equations: Finding root of polynomial equations deploying computational methods such as Bisection, Regula-falsi, Newton-Raphson, Seccant, Successive approximation. System of linear equation: Solving linear equations deploying computational methods such as Gauss elimination, Gauss Jordan, Partial pivoting, Matrix triangularisation (LU decomposition), Cholesky, Gauss Seidel and Jacobi methods.

UNIT – 3 Interpolation and Polynomial Approximation: 07 Hours

Least square approximation, Orthogonal polynomials Chebyshev polynomials, Finite difference operator and their relations, Forward, backward, central and divided difference, Newton's forward divided difference, Backward difference interpolation, Sterling interpolation, Lagrange"sinterpolation polynomials, Spline interpolation, Least square approximation.

UNIT – 4 Numerical Integration and Differentiation: 07 Hours

Numerical Integration: Methods based on interpolation such as Trapezoidal rule, Simsons 1/3 and 3/8 rules. Numerical differentiation: Euler's method, Modified Euler's method, Taylor's series, RungeKutta $2^{nd}$and 4^{th} order, Stability analysis of above methods.

UNIT – 5 Object Oriented Programming: 07 Hours

Software Evaluation, Object oriented programming paradigm, Basic concepts of object oriented programming, Benefits of OOP, Object oriented languages, Applications of OOP Beginning with C++: Structure of C++ program, Creating the source file, Compiling & linking, Basic data types, User defined data types, Symbolic constants, Declaration of variables, Dynamic initialization of variables, Reference variables, Operators in C++, Scope resolution operator, Type cast operator. Functions in C++: Function prototyping, Inline functions, Function overloading, Friend and virtual functions. Classes and Objects: Specifying a class, Defining member functions, C++ program with class, Arrays within a class, Memory allocation for objects, Constructors, Multiple constructor in class, Dynamic initialization of objects, Dynamic constructor, Destructors.

TEXT/REFERENCE BOOKS:

1. S. S. Sastry, "Introductory Methods of Numerical Analysis", PHI, 1990, 3rd edition.
2. V. Rajaraman, "Computer Oriented Numerical Methods, PHI, New Delhi", 2000, 3rd Edition.
3. E. V. Krishnamurthy, and Sen S. K., "Numerical Algorithm: Computations in Science and Engg", Affiliated East West, New Delhi,1996.
4. D. Ravichandran, "Programming with C++",TMH
5. E. Balagurusamy, "Object-Oriented Programming with C++", TMH, New Delhi, 2001,2nd Edition
6. YeshwantKanetkar, "Let us C++, BPB Pub.", Delhi, 2002,4th Edition.
7. StroupstrupBjarne, "C++ Programming Language", Addison Wesley, 1997, 3rdEdition.
8. Horton, "Beginning C++: The Complete Language", Shroff Pub., Navi Mumbai,1998.

BTETPE405B Data Compression & Encryption 4 Credits

Course Objectives:

1. The concept of security, types of attack experienced.
2. Encryption and authentication for deal with attacks, what is data compression, need and techniques of data compression.

Course Outcomes:

At the end of this course

1. The student will have the knowledge of Plaintext, cipher text, RSA and other cryptographic algorithm.
2. The student will have the knowledge of Key Distribution, Communication Model, Various models for data compression.

UNIT – 1 Data Compression and Encryption: 07 Hours

Need for data compression, Lossy /lossless compression, symmetrical compression and compression ratio, run length encoding for text and image compression, relative encoding and its applications in facsimile data compression and telemetry, scalar and quantization.

UNIT – 2 Statistical Methods and Dictionary Methods: 07 Hours

Statistical Methods: Statistical modeling of information source, coding redundancy, variable size codes, prefix codes, Shannon- Fano coding, Huffman coding, adaptive Huffman coding, arithmetic coding and adaptive arithmetic coding, text compression using PPMmethod.

Dictionary Methods: String compression, sliding window compression, LZ77, LZ78 and LZW algorithms and applications in text compression, zip and Gzip, ARC and Redundancy code.

UNIT – 3 Image Compression: 07 Hours

Lossless techniques of image compression, gray codes, two-dimensional image transform, Discrete cosine transform and its application in lossy image compression, quantization, Zig-Zag coding sequences, JPEG and JPEG-LS compression standards, pulse code modulation and differential pulse code modulation methods of image compression, video compression and MPEG industry standard.

UNIT – 4 Audio Compression: 07 Hours

Digital audio, lossy sound compression, M-law and A-law companding, DPCM and ADPCM audio compression, MPEG audio standard, frequency domain coding, format of compressed data.

UNIT – 5 Conventional Encryption: 07 Hours

Security of information, security attacks, classical techniques, caeser Cipher, block cipher principles, data encryption standard, key generation for DES, block cipher principle, design and modes of operation, S-box design, triple DES with two three keys, introduction to international data encryption algorithm, key distribution.

TEXT/REFERENCE BOOKS:

1. Data compression- David Solomon Springer Verlagpublication.
2. Cryptography and network security- William Stallings Pearson Education Asia Publication.
3. Introduction to data compression-Khalid Sayood Morgan kaufmannpublication.
4. The data compression book- Mark Nelson BPBpublication.
5. Applied cryptography-Bruce schnecer, John Wiley and sons Inc.,publications.

BTETPE405C Computer Organization and Architecture 4 Credits

Prerequisites: Digital Electronic Circuits.

Course Objectives:

1. To introduce basic concepts of computer organization and to illustrate the computer organization concepts by Assembly Language programming.
2. To understand operating systems and how they work with the computer and students will understand the relationship between hardware and software specifically how machine organization impacts the efficiency of applications written in a high-level language.
3. Students will be able to make use of the binary number system to translate values between the binary and decimal number systems, to perform basic arithmetic operations and to construct machine code instructions and students will be able to design and implement solutions for basic programs using assembly language.
4. Students will be able to design logical expressions and corresponding integrated logic circuits for a variety of problems including the basic components of a CPU such as adders, multiplexers, the ALU, a register file, and memory cells and to explain the fetch-execute cycle performed by the CPU and how the various components of the data path are used in this process.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. learn how computers work
2. know basic principles of computers working
3. analyze the performance of computers
4. know how computers are designed and built.

UNIT – 1 Overview of computer organization: 07 Hours

Overview of computer organization – components and system buses; Concepts of assembly and machine language programs. Machine language program execution – instruction cycles, machine cycles and bus cycles. Overview of memory and I/O addressing; CPU organization – components and subsystems, register banks, internal bus structure, information flow;

UNIT – 2 Instruction set: 07 Hours

Instruction set – characteristics and functions, types of operation and operands. Addressing modes – various ways of addressing memory and input-output devices and their timing characteristics;

UNIT – 3 CISC and RISC architectures: 07 Hours

CISC and RISC architectures – examples; ALU – flags, logical operations, fixed point number representations and arithmetic, floating point number representations and arithmetic, exceptions. Control Unit – how it operates, hardwired control unit, concepts of micro programs and micro programmed control unit;

UNIT –4 Memory: 07 Hours

Memory hierarchy – main memory – types and interfacing; Cache memory – its organizations and operations, levels of caches; Memory management module – paging and segmentation, virtual memory; Disk memory, RAIDs. Back-up memory.

UNIT – 5 Interrupts and interrupt structures and DMA controller: 07 Hours

Interrupts and interrupt structures – interrupt cycles, handling multiple simultaneous interrupts, programmable interrupt controllers; I/O interfacing and modes of I/O data transfer. Direct memory access – DMA controller; Instruction level parallelism – instruction pipelining, pipeline hazards; Concepts of multiprocessor systems; Examples will be drawn from real life RISC and CISC processors.

TEXT/REFERENCE BOOKS:

1. Carl Hamacher, ZvonkoVranesic and SafwatZaky, “Computer Organization,” McGraw Hill, 2011.
2. D A Patterson and J L Hennessy, “Computer Architecture – A Quantitative Approach,” Morgan Kaufmann,2011.
3. W Stallings, “Computer Organization and Architecture – Designing for Performance,” Pearson,2013.
4. J. P. Hayes, “Computer Architecture and Organization,” McGraw-Hill,1998.
5. D A Patterson and J L Hennessy, “Computer Organization and Design – The Hardware/Software Interface,” ARM Edition, Morgan Kaufmann,2012.
6. S. Tannenbaum, “Structured Computer Organization,” EEE Ed., Prentice Hall,2013.

7. Mano, M.M., “Computer System Architecture” 3rd Ed., Prentice-Hall of 2004India.

BTETPE405D Introduction to MEMS 4 Credits

Course Objectives:

1. The objective of this course is to make students to gain basic knowledge on overview of MEMS (Micro electro Mechanical System) and various fabrication techniques.
2. This enables them to design, analysis, fabrication and testing the MEMS based components and to introduce the students various opportunities in the emerging field of MEMS.
3. This will enable student to study applications of micro-sensors and micro-actuators, various MEMS fabrication technologies, MEMS-specific design issues and constraints, Dynamics and modeling of microsystems, getting access to fabrication and testing in academia and industry.

Course Outcomes:

At the end of the course the students will be able to

1. Appreciate the underlying working principles of MEMS and NEMS devices.
2. Design and model MEM devices.

UNIT – 1 Introduction to MEMS: 07 Hours

Introduction, History, Concepts of MEMS: Principles, application and design, Scaling Properties/Issues, Micromachining Processes: Substrates, lithography, wet/dry etching processes, deposition processes, film stress, exotic processes. Mechanical Transducers: transduction methods, accelerometers, gyroscopes, pressure sensors, MEMS microphones, mechanical structures, actuators.

UNIT – 2 Control and Materials of MEMS: 07 Hours

Controls of MEMS: Analog control of MEMS, Sliding mode control of MEMS, Digital control of MEMS, Materials for MEMS: Substrate and wafers, Active substrate material, silicon, Silicon compound, Silicon pezoresisters, Gallium arsenide, Quartz, piezoelectric crystals,Polymers.

UNIT – 3 Review of Basic MEMS fabrication modules: 07 Hours

MEMS fabrication modules, Oxidation, Deposition Techniques, Lithography (LIGA), and Etching.

UNIT –4 Micromachining: 07 Hours

Micromachining, Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding

UNIT – 5 Mechanics of solids in MEMS/NEMS: 07 Hours

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes‟s law, Poisson effect,Linear Thermal Expansion, Bending, Energy methods. Overview of Finite Element Method, Modeling of Coupled Electro-mechanical Systems.

TEXT/REFERENCE BOOKS:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalkrishnan K. N. Bhat, V. K. Aatre, Micro and Smart Systems, Wiley India,2012.
2. S. E.Lyshevski, Nano-and Micro-Electromechanical systems: Fundamentals of Nano-and Micro-engineering (Vol. 8). CRC press, (2005).
3. S. D. Senturia, Microsystem Design, Kluwer Academic Publishers,2001.
4. M. Madou, Fundamentals of Microfabrication, CRC Press,1997.
5. G. Kovacs, Micromachined Transducers Sourcebook, McGraw-Hill, Boston,1998.
6. M.H. Bao, Micromechanical Transducers: Pressure sensors, accelerometers,and Gyroscopes, Elsevier, New York,2000.

BTETPE405EPython Programming 4 Credits

Course Objectives:

1. Provide an understanding of the role computation can play in solving problems.
2. Help students, including those who do not plan to major in Computer Science and Electrical Engineering, feel confident of their ability to write small programs that allow them to accomplish useful goals.
3. Position students so that they can compete for research projects and excel in subjects with programming components.

Course Outcomes:

1. Experience with an interpreted Language.
2. To build software for real needs
3. Prior Introduction to testing software

UNIT –1Introduction: 07 Hours

History of Python, Need of Python Programming, Applications Basics of Python Programming Using the REPL(Shell), Running Python Scripts, Variables, Assignment, Keywords, Input-Output, Indentation.

UNIT – 2 Types, Operators and Expressions: 07 Hours

Types – Integers, Strings, Booleans; Operators- Arithmetic Operators, Comparison (Relational) Operators, Assignment Operators, Logical Operators, Bitwise Operators, Membership Operators, Identity Operators, Expressions and order of evaluations Control Flow- if, if-elif-else, for, while break, continue, pass.

Data Structures Lists – Operations, Slicing, Methods; Tuples, Sets, Dictionaries, Sequences, Comprehensions

UNIT – 3 Default Arguments: 07 Hours

Default Arguments, Variable-length arguments, Anonymous Functions, Fruitful Functions (Function Returning Values), Scope of the Variables in a Function- Global and Local Variables. Modules: Creating modules, import statement, from. Import statement, name spacing, Python packages, Introduction to PIP, Installing Packages via PIP, Using Python Packages.

UNIT – 4 Object-Oriented Programming OOP in Python: 07 Hours

Classes, „self-variable", Methods, Constructor Method, Inheritance, Overriding Methods, Data hiding, Error, and Exceptions: Difference between an error and Exception, Handling Exception, try except for block, Raising Exceptions, User Defined Exceptions.

UNIT – 5 Brief Tour of the Standard Library: 07 Hours

Operating System Interface – String Pattern Matching, Mathematics, Internet Access, Dates and Times, Data Compression, Multithreading, GUI Programming, Turtle Graphics Testing:

Why testing is required? Basic concepts of testing, Unit testing in Python, Writing Test cases, Running Tests.

TEXT/REFERENCE BOOKS:

1. Python Programming: A Modern Approach, Vamsi Kurama, Pearson
2. Learning Python, Mark Lutz, Orielly
3. Think Python, Allen Downey, Green Tea Press
4. Core Python Programming, W. Chun, Pearson
5. Introduction to Python, Kenneth A. Lambert, Cengage

SEMESTER V

BTETC501 Electromagnetic Field Theory 4 Credits

Course Objectives:

1. Learners can be able to explore their knowledge in the area of EM Waves and its analysis.
2. To learn basic coordinate system, significance of divergence, gradient, curl and its applications to EM Waves.
3. To understand the boundary conditions for different materials/surfaces.
4. To get insight on finding solution for non-regular geometrical bodies using Finite Element Method, Method of Moments, Finite Difference Time Domain.
5. To get the basics of microwave, transmission lines and antenna parameters.
6. Students get acquainted with different physical laws and theorems and provide basic platform for upcoming communication technologies.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Understand characteristics and wave propagation on high frequency transmission lines
2. Carryout impedance transformation on TL
3. Use sections of transmission line sections for realizing circuit elements
4. Characterize uniform plane wave
5. Calculate reflection and transmission of waves at media interface
6. Analyze wave propagation on metallic waveguides in modal form Understand principle of radiation and radiation characteristics of an antenn

UNIT – 1 Mathematical Fundamentals and Static Electric Fields: 07 Hours

Introduction, Vector Analysis, Coordinate systems and Transformations, Line, surface and volume integrals, Divergence Theorem, Stoke's theorem, Columb's Law, Electric Field, Electric flux density, Gauss's Law with Application, Electrostatic Potential and Equipotential Surfaces, Boundary conditions for Electrostatic fields, Capacitance and Capacitors, Electrostatic Energy and Energy Density..

UNIT – 2 Steady Electric Currents and Static Magnetic Fields: 07 Hours

Current Density and Ohm's Law, Electromotive force and Kirchhoff's Voltage Law, ContinuityEquationandKirchhoff‟sCurrentLaw,PowerDissipationandJoule'sLaw,Biot-Savart Law and its Application, Ampere's Circuital Law and its Application, Magnetic Flux Density, Magnetic Scalar and Vector Potentials, Boundary Condition Magnetic Fields, Inductance and Inductor, Energy stored in Magnetic Field.

UNIT – 3 Time Varying Field &Maxwell's Equations: 07 Hours

Introduction, Faraday's Law of electromagnetic Induction, Maxwell's Equation, Boundary Conditions for Electromagnetic fields, Time Harmonic Fields

UNIT – 4Transmission Lines: 07 Hours

Equations of Voltage and Current on TX line, Propagation constant and characteristic impedance, and reflection coefficient and VSWR, Impedance Transformation on Loss-less and Low loss Transmission line, Power transfer on TX line, Smith Chart, Admittance Smith Chart, Applications of transmission lines: Impedance Matching, use transmission line sections as circuit elements.

UNIT – 5 Electromagnetic Waves: 07 Hours

Maxwell Equations in phasor form, Wave Equation, Uniform Plane wave in Homogeneous, free space, dielectric, conducting medium. Polarization: Linear, circular & Elliptical polarization, unpolarized wave. Reflection of plane waves, Normal incidence, oblique incidence, Electromagnetic Power and Poynting theorem and vector.

TEXT/REFERENCE BOOKS:

1. R.K. Shevgaonkar, Electromagnetic Waves, Tata McGraw Hill India,2005
2. E.C. Jordan & K.G. Balmain, Electromagnetic waves & Radiating Systems, Prentice Hall, India
3. Narayana Rao, N: Engineering Electromagnetics, 3rd ed., Prentice Hall,1997.
4. David Cheng, “Electromagnetics”, PrenticeHall.
5. Sadiku, "Elements of Electromagnetics",Oxford.
6. Krauss, "Electromagnetics", McGraw Hill, New York, 4th edition.
7. W. H. Hayt, "Engineering Electromagnetics", McGraw Hill, New Delhi,1999.
8. Edminister, Schaum series, "Electromagnetics", McGraw Hill, New York, 1993, 2nd edition.
9. Sarvate, "Electromagnetism", WileyEastern.

BTETC502 Digital Signal Processing 4 Credits

Course Objectives:

1. To introduce students with transforms for analysis of discrete time signals and systems.
2. To understand the digital signal processing, sampling and aliasing.
3. To use and understand implementation of digital filters.
4. To understand concept of sampling rate conversion and DSP processor architecture.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand use of different transforms and analyze the discrete time signals and systems.
2. Realize the use of LTI filters for filtering different real-world signals.
3. Capable of calibrating and resolving different frequencies existing in any signal.
4. Design and implement multistage sampling rate converter.
5. Design of different types of digital filters for various applications.

UNIT – 1 DSP Preliminaries: 07 Hours

Discrete time signals: Sequences; representation of signals on orthogonal basis; Sampling and reconstruction of signals, Basic elements of DSP and its requirements, advantages of Digital over Analog signal processing.

UNIT – 2 Discrete Fourier Transform: 07 Hours

DTFT, Definition, Frequency domain sampling, DFT, Properties of DFT, circular convolution, linear convolution, Computation of linear convolution using circular convolution, FFT, decimation in time and decimation in frequency using Radix-2 FFT algorithm

UNIT – 3 Z transform: 07 Hours

Need for transform, relation between Laplace transform and Z transform, between Fourier transform and Z transform, Properties of ROC and properties of Z transform, Relation between pole locations and time domain behavior, causality and stability considerations for LTI systems, Inverse Z transform, Power series method, partial fraction expansion method, Solution of difference equations.

UNIT – 4 IIR Filter Design: 07 Hours

Concept of analog filter design (required for digital filter design), Design of IIR filters from analog filters, IIR filter design by impulse invariance method, Bilinear transformation method. Characteristics of Butterworth filters, Chebyshev filters, Butterworth filter design, IIR filter realization using direct form, cascade form and parallel form, Lowpass, High pass, Bandpass and Bandstop filters design using spectral transformation (Design of all filters using Low pass filter)

UNIT – 5 FIR Filter Design and introduction to MDSP: 07 Hours

Ideal filter requirements, Gibbs phenomenon, windowing techniques, characteristics and comparison of different window functions, Design of linear phase FIR filter using windows and frequency sampling method. FIR filters realization using direct form, cascade form and lattice form. Introduction to Multirate signal processing: Concept of Multirate DSP, Introduction to Up sampler, Down sampler and two channel filter banks, Application of Multirate signal processing in communication, Music processing, Image processing and Radar signal processing.

TEXT/REFERENCE BOOKS:

1. S. K. Mitra, Digital Signal Processing: A computer-based approach,TMH
2. A.V. Oppenheim and Schafer, Discrete Time Signal Processing, Prentice Hall,1989.
3. John G. Proakis and D.G. Manolakis, Digital Signal Processing: Principles, Algorithms and Applications, Prentice Hall,1997.
4. L. R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall,1992.
5. J. R. Johnson, Introduction to Digital Signal Processing, Prentice Hall,1992.
6. D. J. DeFatta, J. G. Lucas and W. S. Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

BTETC503 Analog Communication — 4 Credits

Course Objectives:

1. To introduce the concepts of analog communication systems.
2. To equip students with various issues related to analog communication such as modulation, demodulation, transmitters and receivers and noise performance.
3. To understand the concepts of modulation and demodulation techniques of angle modulation (frequency and phase)

Course Outcomes:

On completion of the course, students will be able to:

1. Understand and identify the fundamental concepts and various components of analog communication systems.
2. Understand the concepts of modulation and demodulationtechniques.
3. Design circuits to generate modulated and demodulated wave.
4. Equip students with various issues related to analog communication such as modulation, demodulation, transmitters and receivers and noiseperformance.

5. Understand the concepts of modulation and demodulation techniques of angle modulation (frequency and phase).
6. Explain signal to noise ratio, noise figure and noise temperature for single and cascaded stages in a communication system.
7. Develop the ability to compare and contrast the strengths and weaknesses of various communication systems.

UNIT – 1 Introduction to Communication System **07 Hours**

Block schematic of communication system, Simplex and duplex systems, Modes of communication: Broadcast and point to point communication, Necessity of modulation, Classification of modulation, sampling theorem and pulse analog modulation, multiplexing: TDM, FDM.

UNIT – 2 Amplitude Modulation **07 Hours**

Introduction, Mathematical analysis and expression for AM, Modulation index, Frequency spectrum and bandwidth of AM, Power calculations, Generation of AM using nonlinear property, Low and high level modulation, Balance Modulator.

Types of AM: DSB-FC, DSB-SC, SSB-SC, ISB and VSB, their generation methods and comparison.

UNIT – 3 Angle Modulation **07 Hours**

Introduction, Mathematical analysis of FM and PM, Modulation index for FM and PM, Frequency spectrum and bandwidth of FM, Narrow band and wide band FM, Direct and indirect methods of FM generation, Pre emphasis and de-emphasis, Comparison of AM, FM and PM.

UNIT – 4 Radio Receivers and Demodulators **07 Hours**

Introduction, Performances characteristic of receivers: Sensitivity, Selectivity, Fidelity, Image frequency and IFRR, Tracking and Double spotting, TRF, Super heterodyne receivers, RF amplifier, Local oscillator and mixer, IF amplifier, AGC.

UNIT – 5 AM and FM Detectors and noise **07 Hours**

AM Detectors: Envelop detector and practical diode detector.

FM Detectors: Slope detector, phase discriminator and ratio detector.

Noise: Introduction, Sources of noise, Classification of noise, Noise calculations (thermal noise), SNR, Noise figure, Noise Factor, Noise Temperature.

TEXT/REFERENCE BOOKS:

1. Kennedy, "Electronics Communications Systems", McGraw-Hill New Delhi-1997, 4^{th} Edition.
2. Anokh Singh, "Principles of communication engineering"S.Chand
3. Roddy&Coolen, "Electronic communication"PHI
4. Taub & Schilling "Principles of communication systems" Tata Mc GrawHill
5. Beasley & Miller, "Modern Electronic Communication", Prentice-Hall India-2006, 8^{th} Edition.
6. Wayne Tomasi, "Electronic Communication Systems", Pearson Education-2005, 5^{th} Edition.
7. R. G. Gupta, "Audio & Video Systems" Tata McGraw-Hill NewDelhi-2008.

BTETPE504A Analog Circuits 4 Credits

Course Objectives:

1. To understand characteristics of IC and Op-Amp and identify the internal structure.
2. To introduce various manufacturing techniques.
3. To study various op-amp parameters and their significance for Op-Amp.
4. To learn frequency response, transient response and frequency compensation techniques for Op-Amp.
5. To analyze and identify linear and nonlinear applications of Op-Amp.

Course Outcomes:

On completion of the course, students will be able to:

1. Understand the characteristics of IC and Op-Amp and identify the internal structure.
2. Understand and identify various manufacturing techniques.
3. Derive and determine various performances-based parameters and their significance forOp-Amp.
4. Verify parameters after exciting IC by any stated method.
5. Analyze and identify the closed loop stability considerations and I/O limitations.

6. Analyze and identify linear and nonlinear applications of Op-Amp.
7. Understand and verify results (levels of V & I) with hardware implementation.
8. Implement hardwired circuit to test performance and application for what it is being designed.

UNIT – 1 Introduction to operational Amplifiers: 07 Hours

Introduction to operational amplifiers: The difference amplifier and the ideal operational amplifier models, concept of negative feedback and virtual short; Analysis of simple operational amplifier circuits; Frequency response of amplifiers, Bode plots.

Feedback: Feedback topologies and analysis for discrete transistor amplifiers; stability of feedback circuits using Barkhausen criteria.

UNIT – 2 Linear applications of operational amplifiers: 07 Hours

Linear applications of operational amplifiers: Inverting and non-inverting amplifier configurations, voltage follower, summing, averaging scaling amplifier, difference amplifier, integrator, differentiator, instrumentation amplifiers, and Active filters.

UNIT – 3 Non-linear applications of operational amplifiers: 07 Hours

Non-linear applications of operational amplifiers: Comparators, clippers and clampers; Linearization amplifiers; Precision rectifiers; Logarithmic amplifiers, multifunction circuits and true rms convertors.

UNIT –4 Oscillators: 07 Hours

Waveform Generation: sinusoidal feedback oscillators; Relaxation oscillators, square-triangle oscillators

UNIT – 5 Analog and Digital interface circuits: 07 Hours

Analog and Digital interface circuits: Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash type, Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc., V-F, I-V and V-I converter.

TEXT/REFERENCE BOOKS:

1. J. V. Wait, L. P. Huelsman and GA Korn, Introduction to Operational Amplifier theory and applications, 2nd edition, McGraw Hill, New York,1992.

2. J. Millman and A. Grabel, Microelectronics, 2nd edition, McGraw Hill,1988.
3. P.Horowitz and W. Hill, The Art of Electronics, 2nd edition, Cambridge University Press,1989.
4. A. S. Sedra and K.C. Smith, Microelectronic Circuits, Saunder's College Publishing, EditionIV.
5. Paul R. Gray & Robert G. Meyer, Analysis and Design of Analog Integrated Circuits, Wiley, 3 rdEdition.
6. Ramakant A. Gaikwad, “Op Amps and Linear Integrated Circuits”, Pearson Education 2000.
7. Salivahanan and Kanchana Bhaskaran, “Linear Integrated Circuits”, Tata McGraw Hill, India2008.
8. George Clayton and Steve Winder, “Operational Amplifiers”, 5th EditionNewnes.
9. Sergio Franco, “Design with Operational Amplifiers and Analog Integrated Circuits”, Tata McGrawHill.
10. Bali, “Linear Integrated Circuits”, McGraw Hill 2008.Gray, Hurst, Lewise, Meyer, “Analysis & Design of Analog Integrated Circuits”, Wiley Publications on Education.

BTETPE504B Embedded System Design 4 Credits

Prerequisites: Good understanding of the concepts of basic electronics such as circuits, logic gates, Number systems, fundamentals of C programming

Course Objectives:

1. To understand Embedded Design Specification.
2. Understand the ARM Design Philosophy
3. Understand the ARM architecture and the pipeline structure
4. Understand the instruction sets of ARM Processor

Course Outcomes:

1. The student will study ARM Processor based Embedded System design
2. The student will be able to do programming in Embedded programming in C,C++
3. The student will understand Linux operating system and device driver
4. The student will demonstrate the knowledge of Real Time Operating System

UNIT – 1 INTRODUCTION TO EMBEDDED SYSTEMS 07 Hours

Introduction to Embedded Systems, Architecture of Embedded System, Design Methodology, Design Metrics, General Purpose Processor, System On chip.

Embedded system design and development: Embedded system design, Life-Cycle Models, Problem solving, The design process, Requirement identification, Formulation of requirements specification. Development tools.

System design specifications: System specifications versus system requirements, Partitioning and decomposing a system, Functional design, Architectural design, Functional model versus architectural model, Prototyping, Other considerations, Archiving the project

UNIT – 2 ARM PROCESSOR FUNDAMENTALS AND INSTRUCTION SET 07 Hours

Registers, Current Program Status Registers(CPSR), Pipeline, exceptions, Interrupts and the vector table, Data Processing Instruction, Branch Instruction, Load-Store Instructions, Software Interrupts instructions, Program Status Register Instructions, Loading Constants, Thumb register usage, ARM-Thumb Interworking, other branch instructions, Data Processing instructions, Stack instructions, Single -register load -store instruction, multiple -register load- store instruction, software interrupt instructions

UNIT – 3 EMBEDDED LINUX 07 Hours

Embedded Linux: System architecture, BIOS versus boot-loader, Booting the kernel, Kernel initialization, Space initialization, Boot loaders, Storage considerations

Linux kernel construction: Kernel build system, Obtaining a custom Linux kernel, File systems, Device drivers, Kernel configuration.

UNIT – 4 COMMUNICATION PROTOCOLS 07 Hours

Use of communication protocols in embedded systems, Serial communication basics, synchronous/asynchronous interfaces, UART Protocol, I2C protocol, SPI protocol, USB Protocol, SPI protocol, CAN Protocol, 1 Wire protocol

UNIT – 5 REAL TIME OPERATING SYSTEMS 07 Hours

RTOS fundamentals, Multitasking in small embedded systems, Memory management, Task management, Queue management, software timer management, interrupt management, resource management, event, Task notification

TEXT BOOKS:

1. Steve Furber, “ARM System-on-Chip Architecture”, Second Edition, Pearson EducationPublication
2. James K. Peckol, “Embedded Systems: A Contemporary Design Tool”, WILEY Student EditionPublication
3. Andrew N. Sloss, “ARM system developer's guide”, Morgan Kaufmannelsevier.com
4. Tammy Noergaard, “Embedded Systems Architecture”, ElsevierPublication
5. Christopher Hallinan, “Embedded Linux Primer: A Practical Real-World Approach”, Second Edition, Pearson EducationPublication
6. “Real -Time System Design and analysis -Tools for the practioner ” By Phillip A Laplante (WileyPublication)

REFERENCE BOOKS:

1. Mastering the Free RTOS Real time Kernel A hands on tutoral guide by Richard Barry
2. The Free RTOS Reference manual API functions and configuration options

BTETPE504C Digital System Design 4 Credits

Course Objectives:

1. The concept and theory of digital Electronics are needed in almost all electronics and telecommunication engineering fields and in many other engineering and scientific disciplines as well.
2. The main objective of this course is to lay the foundation for further studies in areas such as communication, VLSI, computer, microprocessor etc. One of the most important reasons for the unprecedented growth of digital electronics is the advent of integrated circuit.
3. This course will explore the basic concepts of digital electronics.

Course outcomes:

At the end of this course students will demonstrate the ability to

1. Design and analyze combinational logic circuits

2. Design & analyze modular combinational circuits with MUX/DEMUX, Decoder, Encoder
3. Design & analyze synchronous sequential logic circuits
4. Use HDL & appropriate EDA tools for digital logic design and simulation.

UNIT – 1 Introduction to VHDL: 07 Hours

Introduction to VHDL, design units, data objects, signal drivers, inertial and transport delays, delta delay, and VHDL data types, concurrent and sequential statements.

UNIT –2 Subprograms: 07 Hours

Subprograms – Functions, Procedures, attributes, generio, generate, package, IEEE standard logic library, file I/O, test bench, component declaration, instantiation, configuration.

UNIT – 3 Combinational logic circuit design and VHDL implementation: 07 Hours

Combinational logic circuit design and VHDL implementation of following circuits – first adder, Subtractor, decoder, encoder, multiplexer, ALU, barrel shifter, multiplier, divider.

UNIT – 4 Synchronous sequential circuits design: 07 Hours

Synchronous sequential circuits design – finite state machines, Mealy and Moore, state assignments, design and VHDL implementation of FSMs, Linear feedback shift register (Pseudorandom and CRC).

UNIT – 5 Asynchronous sequential circuit designs: 07 Hours

Asynchronous sequential circuit design – primitive flow table, concept of race, critical race and hazards, design issues like meta stability, synchronizers, clock skew and timing considerations, Introduction to place & route process, Introduction to ROM, PLA, PAL, Architecture of CPLD (Xilinx / Altera)

TEXT/REFERENCE BOOKS:

1. R.P. Jain, “Modern digital Electronics”, Tata McGraw Hill, 4th edition,2009.
2. Douglas Perry, “VHDL”, Tata McGraw Hill, 4th edition,2002.
3. W.H. Gothmann, “Digital Electronics- An introduction to theory and practice”, PHI,2nd edition, 2006.

4. D.V. Hall, " Digital Circuits and Systems" , Tata McGraw Hill,1989
5. Charles Roth, "Digital System Design using VHDL", Tata McGraw Hill 2nd edition 2012.
6. Bhasker J, "VHDL Primer" Prentice-Hall of India Pvt. Ltd 3rdEdition.

BTETPE504D Automotive Electronics 4 Credits

Course Objectives:

1. To understand the concepts of Automotive Electronics and it"s evolution and trends automotive systems & subsystems overview.
2. To understand sensors and sensor monitoring mechanisms aligned to automotive systems, different signal conditioning techniques, interfacing techniques and actuator mechanisms.
3. To understand, design and model various automotive control systems using Model based development technique.
4. To understand role of Microcontrollers in ECU design and choice of appropriate Hardware and Software.
5. To describe various communication systems, wired and wireless protocols used in vehicle
6. To understand Safety standards, advances in towards autonomous vehicles.
7. To understand vehicle on board and off board diagnostics.

Course Outcomes:

At the end of the course, students will be able to:

1. Acquire an overview of automotive components, subsystems, and basics of Electronic Engine Control in todays automotive industry.
2. Use available automotive sensors and actuators while interfacing with microcontrollers / microprocessors during automotive system design.
3. Understand the networking of various modules in automotive systems, communication protocols and diagnostics of the subsystems.
4. Design and implement the electronics that attribute the reliability, safety, and smartness to the automobiles, providing add-on comforts and get fair idea on future Automotive Electronic Systems.

UNIT – 1 Automotive Fundamentals Overview: 07 Hours

Evolution of Automotive Electronics, Automobile Physical Configuration, Survey of Major Automotive Systems, The Engine – Engine Block, Cylinder Head, Four Stroke Cycle, Engine Control, Ignition System - Spark plug, High voltage circuit and distribution, Spark pulse generation, Ignition Timing, Diesel Engine, Drive Train - Transmission, Drive Shaft, Differential, Suspension, Brakes, Steering System , Starter Battery –Operating principle

UNIT – 2 The Basics of Electronic Engine Control: 07 Hours

Motivation for Electronic Engine Control – Exhaust Emissions, Fuel Economy, Concept of an Electronic Engine control system, Definition of General terms, Definition of Engine performance terms, Engine mapping, Effect of Air/Fuel ratio, spark timing and EGR on performance, Control Strategy, Electronic Fuel control system, Analysis of intake manifold pressure, Electronic Ignition.

UNIT – 3 Automotive Sensors and Actuators: 07 Hours

Airflow rate sensor, Strain Gauge MAP sensor, Engine Crankshaft Angular Position Sensor, Magnetic Reluctance Position Sensor, Hall effect Position Sensor, Shielded Field Sensor, Optical Crankshaft Position Sensor, Throttle Angle Sensor (TAS), Engine Coolant Temperature (ECT) Sensor, Exhaust Gas Oxygen (O2/EGO) Lambda Sensors, Piezoelectric Knock Sensor, Solenoid, Fuel Injector, EGR Actuator, Ignition System

UNIT – 4 Digital Engine Control Systems: 07 Hours

Digital Engine control features, Control modes for fuel Control (Seven Modes), EGR Control, Electronic Ignition Control - Closed loop Ignition timing, Spark Advance Correction Scheme, Integrated Engine Control System - Secondary Air Management, Evaporative Emissions Canister Purge, Automatic System Adjustment, SystemDiagnostics

UNIT – 5 Vehicle Motion Control: 07 Hours

Typical Cruise Control System, Digital Cruise Control System, Digital Speed Sensor, Throttle Actuator, Digital Cruise Control configuration, Cruise Control Electronics (Digital only), Antilock Brake System(ABS)

TEXT/REFERENCE BOOKS:

1. William B. Ribbens, ―Understanding Automotive Electronics‖, 6th Edition, Elsevier Publishing.
2. Robert Bosch Gmbh (Ed.) Bosch Automotive Electrics and Automotive Electronics Systems and Components, Networking and Hybrid Drive, 5th edition, John Wiley& Sons Inc.,2007.

BTETPE504E Mixed Signal Design 4 Credits

Course Objectives:

1. To introduce how to handle the practical situations where mixed signal analysis is required.
2. To analyze and handle the inter-conversions between signals.
3. To introduce the students how to design systems involving mixed signals.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the practical situations where mixed signal analysis is required.
2. Analyze and handle the inter-conversions between signals.
3. Design systems involving mixed signals.

UNIT – 1 Analog and discrete-time signal processing: 07 Hours

Analog and discrete-time signal processing, introduction to sampling theory; Analog continuous-time filters: passive and active filters. Basics of analog discrete-time filters and Z-transform.

UNIT – 2 Switched-capacitor filters: 07 Hours

Switched-capacitor filters- Non idealities in switched-capacitor filters, Switched-capacitor filter architectures, Switched-capacitor filter applications.

UNIT – 3 Basics of data converters: 07 Hours

Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

UNIT – 4 Mixed-signal data transmission: 07 Hours

Mixed-signal layout, Interconnects and data transmission, Voltage-mode signaling and data transmission, Current-mode signaling and data transmission.

UNIT –5 PLLs: 07 Hours

Introduction to frequency synthesizers and synchronization, Basics of PLL, Analog PLLs, Digital PLLs, DLLs.

TEXT/REFERENCE BOOKS:

1. R. Jacob Baker, CMOS mixed-signal circuit design, Wiley India, IEEE press, reprint 2008.
2. Behzad Razavi, Design of analog CMOS integrated circuits, McGraw-Hill,2003.
3. R. Jacob Baker, CMOS circuit design, layout and simulation, revised second edition, IEEE press, and2008.
4. Rudy V. de Plassche, CMOS Integrated ADCs and DACs, Springer, Indian edition,2005.
5. Arthur B. Williams, Electronic Filter Design Handbook, McGraw-Hill,1981.
6. R. Schauman, Design of analog filters by, Prentice-Hall 1990 (or neweradditions).
7. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford University Press, First Indian edition,2008.

BTETPE504F Power Electronics 4Credits

Course Objectives:

1. To introduce students to different power devices to study their construction, characteristics and turning on circuits.
2. To give an exposure to students of working & analysis of controlled rectifiers for different loads, inverters, DC choppers, AC voltage controllers and resonant converters.
3. To study the different motor drives, various power electronics applications like UPS, SMPS, etc. and some protection circuits.

Course Outcomes:

At the end of this course students will demonstrate the ability to

1. Build and test circuits using power devices such asSCR
2. Analyze and design-controlled rectifier, DC to DC converters, DC to ACinverters.

3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

UNIT – 1 Characteristics of Semiconductor Power Devices: 07 Hours

Thyristor, power MOSFET and IGBT- Treatment should consist of structure, Characteristics, operation, ratings, protections and thermal considerations. Brief introduction to power devices viz. TRIAC, MOS controlled thyristor (MCT), Power Integrated Circuit (PIC) (Smart Power), Triggering/Driver, commutation and snubber circuits for thyristor, power MOSFETs and IGBTs (discrete and IC based). Concept of fast recovery and schottky diodes as freewheeling and feedback diode.

UNIT – 2 Controlled Rectifiers: 07 Hours

Single phase: Study of semi and full bridge converters for R, RL, RLE and level loads. Analysis of load voltage and input current- Derivations of load form factor and ripple factor, Effect of source impedance, input current Fourier series analysis of input current to derive input supply power factor, displacement factor and harmonic factor.

UNIT –3 Choppers: 07 Hours

Quadrant operations of Type A, Type B, Type C, Type D and type E choppers, Control techniques for choppers – TRC and CLC, Detailed analysis of Type A chopper. Step up chopper. Multiphase Chopper.

UNIT – 4Single-phaseinverters: 07 Hours

Principle of operation of full bridge square wave, quasi-square wave, PWM inverters and comparison of their performance. Driver circuits for above inverters and mathematical analysis of output (Fourier series) voltage and harmonic control at output of inverter (Fourier analysis of output voltage). Filters at the output of inverters, Single phase current source inverter.

UNIT – 5 Switching Power Supplies and Applications: 07 Hours

Analysis of fly back, forward converters for SMPS, Resonant converters - need, concept of soft switching, switching trajectory and SOAR, load resonant converter - series loaded half bridge DC-DC converter.

Applications: Power line disturbances, EMI/EMC, power conditioners. Block diagram and configuration of UPS, salient features of UPS, selection of battery and charger ratings, sizing of UPS, Separately excited DC motor drive. P M Stepper Motor Drive.

TEXT/REFERENCE BOOKS:

1. Muhammad H. Rashid, "Power electronics" Prentice Hall ofIndia.
2. Ned Mohan, Robbins, "Power electronics", edition III, John Wiley andsons.
3. P.C. Sen., "Modern Power Electronics", edition II, Chand&Co.
4. V. R. Moorthi, "Power Electronics", Oxford UniversityPress.
5. Cyril W., Lander," Power Electronics", edition III, McGraw Hill.
6. G K Dubey, S R Doradla,:Thyristorised Power Controllers", New Age International Publishers. SCR manual from GE,USA.

BTETOE505A Control System Engineering 4 Credits

Course Objectives:

1. To introduce the elements of control system and their modeling using various Techniques.
2. To introduce methods for analyzing the time response, the frequency response and the stability of systems.
3. To introduce the concept of root locus, Bode plots, Nyquist plots.
4. To introduce the state variable analysis method.
5. To introduce concepts of PID controllers and digital and control systems.
6. To introduce concepts programmable logic controller.

Course Outcomes:

At the end of this course, students will demonstrate the ability to

1. Understand the modeling of linear-time-invariant systems using transfer function and state-space representations.
2. Understand the concept of stability and its assessment for linear-time invariant systems.
3. Design simple feedback controllers.

UNIT – 1 Introduction to control problem: 07 Hours

Industrial Control examples, Mathematical models of physical systems, Control hardware and their models, Transfer function models of linear time-invariant systems.

Feedback Control: Open-Loop and Closed-loop systems. Benefits of Feedback, Block diagram reduction techniques, Signal flow graph analysis.

UNIT – 2 Time Response Analysis and Stability Analysis: 07 Hours

Standard test signals, Time response of first and second order systems for standard test inputs. Application of initial and final value theorem, Design specifications for second-order systems based on the time-response.

Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique. Construction of Root-loci, Dominant Poles, Application of Root Locus Diagram.

UNIT – 3 Frequency-response analysis: 07 Hours

Relationship between time and frequency response, Polar plots, Bode plots. Nyquist stability criterion, Relative stability using Nyquist criterion – gain and phase margin. Closed-loop frequency response.

UNIT – 4 Introduction to Controller Design: 07 Hours

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems, Application of Proportional, Integral and Derivative Controllers, Designing of Lag and Lead Compensator using Root Locus and BodePlot.

UNIT – 5 State variable Analysis: 07 Hours

Concepts of state variables, State space model. Diagonalization of State Matrix, Solution of state equations, Eigen values and Stability Analysis, Concept of controllability and observability, Pole-placement by state feedback, Discrete-time systems, Difference Equations, State-space models of linear discrete-time systems. Stability of linear discrete-time systems.

TEXT/REFERENCE BOOKS:

1. N. J. Nagrath and M. Gopal, “Control System Engineering”, New Age International Publishers, 5th Edition,2009.
2. Benjamin C. Kuo, “Automatic control systems”, Prentice Hall of India, 7thEdition,1995.

3. M. Gopal, “Control System – Principles and Design”, Tata McGraw Hill, 4th Edition, 2012.
4. Schaum‟sOutlineSeries,“FeedbackandControlSystems”TataMcGraw-Hill,2007.
5. John J. D‟Azzo& Constantine H. Houpis, “Linear Control System Analysis andDesign”, Tata McGraw-Hill, Inc.,1995.
6. Richard C. Dorf and Robert H. Bishop, “Modern Control Systems”, Addison – Wesley, 1999.

BTETOE505B Artificial Intelligence and Machine Learning 4 Credits

Course Objectives:

1. Apply AI techniques to solve the given problems.
2. Implement trivial AI techniques on relatively largesystem
3. Explain uncertainty and Problem-solving techniques.
4. Compare various learning techniques.

Course Outcomes:

This course will enable students to

1. Identify the AI basedproblems.
2. Apply techniques to solve the AIproblems.
3. Define learning and explain various logicinferences.
4. Discuss different learning techniques.

UNIT –1Introduction: 07 Hours

What Is AI? Thinking humanly: The cognitive modeling approach. Thinking rationally: The “laws of thought” approach, Acting rationally: The rational agent approach. The Foundations of Artificial Intelligence, Mathematics, Economics, Neuroscience, Computer engineering, The History of Artificial Intelligence. AI becomes an industry (1980-- present). Agents and Environments, Good Behaviour: The Concept of Rationality. The Nature of Environments. The Structure of Agents.

UNIT – 2SearchTechniques: 07 Hours

Problem-Solving Agents, Well-defined problems and solutions, Formulating problems, Real-world problems. Uninformed Search Strategies, Breadth-first search, Uniform-cost search, Depth-first search, Depth-limited search, Iterative deepening depth-first search, Bidirectional search, Informed (Heuristic) Search Strategies, Greedy best-first search, A* search: Minimizing the total estimated solution cost, Heuristic Functions. The effect of heuristic accuracy on performance. Beyon Classical Search, Local Search Algorithms and Optimization Problems, Local Search in Continuous Spaces.

UNIT – 3 Game Playing: **07 Hours**

Games, Optimal Decisions in Games, The minimax algorithm, Optimal decisions in multiplayer games, Alpha Beta Pruning, Move ordering, Imperfect Real-Time Decisions, Cutting off search, Forward pruning, Stochastic Games, Evaluation functions for games of chance, Partially Observable Games, Krieg spiel: Partially observable chess, Card games, State-of-the-Art Game Programs, Alternative Approaches.

UNIT – 4 Logic and inference: **07 Hours**

Defining Constraint Satisfaction Problems, Constraint Propagation: Inference in CSPs, **Backtracking** Search for CSPs, Local Search for CSPs, The Structure of Problems, Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic: A Very Simple Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic. Forward Chaining, Backward Chaining, Definition of Classical Planning. Algorithms for Planning as State-Space Search, PlanningGraphs.

UNIT –5 Learning: **07 Hours**

Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and Choosing the Best Hypothesis, Model selection: Complexity versus goodness of fit, From error rates to loss, Regularization, The Theory of Learning, Regression and Classification with Linear Models, Artificial Neural Networks, Nonparametric Models, Ensemble Learning, Online Learning, Practical Machine Learning, A Logical Formulation of Learning. Knowledge in Learning. Explanation-Based Learning, Learning Using Relevance Information. Inductive Logic Programming. Statistical Learning. Learning with Complete Data. Learning with Hidden Variables: The EM Algorithm.

TEXT/REFERENCE BOOKS:

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach. IIIEdition
2. E. Rich, K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGrawHill.
3. Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems, Prentice Hal of India.
4. G. Luger, "Artificial Intelligence: Structures and Strategies for complex problem Solving", Fourth Edition, Pearson Education,2002.
5. N.P. Padhy "Artificial Intelligence and Intelligent Systems" , Oxford UniversityPress-2015.

BTETOE505C Optimization Techniques 4 Credits

Course Objectives:

1. Introduction to optimization techniques using both linear and non-linearprogramming
2. The focus of the course is on convex optimization though some techniques will be covered for non-convex function optimization.

Course Outcomes:

After completion of this course students will be able to

1. Cast engineering minima/maxima problems into optimization framework.
2. Learn efficient computational procedures to solve optimization problems.

UNIT – 1 Introduction and Basic Concepts: 07 Hours

Historical Development; Engineering applications of Optimization; Art of Modeling, Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems, Classification of optimization problems, Optimization techniques – classical and advanced techniques.

UNIT – 2 Optimization using Calculus: 07 Hours

Stationary points; Functions of single and two variables; Global Optimum, Convexity and concavity of functions of one and two variables, Optimization of function of one variable and multiple variables; Gradient vectors; Examples, Optimization of function of multiple variables subject to equality constraints; Lagrangian function, Optimization of function of multiple variables subject to equality constraints; Hessian matrix formulation; Eigen values, Kuhn-Tucker Conditions; Examples.

UNIT – 3 Linear Programming: **07 Hours**

Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations, Graphical method for two variable optimization problem; Examples, Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems, Revised simplex method; Duality in LP; Primal-dual relations; Dual Simplex method; Sensitivity or post optimality analysis, Other algorithms for solving LP problems – Karmarkar‟s projective scaling method.

UNIT – 4 Dynamic Programming: **07 Hours**

Sequential optimization; Representation of multistage decision process; Types of multistage decision problems; Concept of sub optimization and the principle of optimality, Recursive equations – Forward and backward recursions; Computational procedure in dynamic programming (DP), Discrete versus continuous dynamic programming; Multiple state variables; curse of dimensionality in DP.

UNIT – 5 Integer Programming and Advanced Topics in Optimization: **07 Hours**

Integer linear programming; Concept of cutting plane method, Mixed integer programming; Solution algorithms; Examples.

Advanced Topics in Optimization: Piecewise linear approximation of a nonlinear function, Multi objective optimization – Weighted and constrained methods; Multi level optimization, Direct and indirect search methods, Evolutionary algorithms for optimization and search.

TEXT/REFERENCE BOOKS:

1. S.S. Rao, "Engineering Optimization: Theory and Practice", New Age International, New Delhi,2000.
2. G. Hadley, "Linear programming", Narosa Publishing House, New Delhi,1990.
3. H.A. Taha, "Operations Research: An Introduction", 5th Edition, Macmillan, New York, 1992.
4. K. Deb, "Optimization for Engineering Design-Algorithms and Examples", Prentice-Hall of India Pvt. Ltd., New Delhi,1995.

5. K. Srinivasa Raju and D. Nagesh Kumar, "Multicriterion Analysis in Engineering and Management", PHI Learning Pvt. Ltd., New Delhi, India, ISBN 978-81-203-3976-7, pp.288, 2010.

BTETOE505D Project Management and Operation Research 4 Credits

Course Objectives:

- To help students understand Evolution of Management Thought, Concepts, basic functions and recent trends managerial concepts and practices for better business decisions.
- To introduce students to framework those are useful for diagnosing problems involving human behavior.
- To enable the students apply mathematical, computational and communication skills needed for the practical utility of Operations Research.
- To teach students about networking, inventory, queuing, decision and replacement models.
- To introduce students to research methods and current trends in Operations Research.

Course Outcomes: Student will be able to

- Apply operations research techniques like L.P.P, scheduling and sequencing in industrial optimization problems.
- Solve transportation problems using various OR methods.
- Illustrate the use of OR tools in a wide range of applications in industries.
- Analyze various OR models like Inventory, Queuing, Replacement, Simulation, Decision etc and apply them for optimization.
- Gain knowledge on current topics and advanced techniques of Operations Research for industrial solutions.

UNIT– 1 **07 Hours**

Introduction: Operations Research: Development, history, definitions, objectives, characteristics, limitations, phases and applications. Optimization models and their classifications

Linear Models: Formation of an L.P model- graphical solution – simplex algorithm – artificial variables technique– Big M method, two phase method, Duality in LPP. .

UNIT– 2 **07 Hours**

Replacement Models:

Replacement of items that deteriorates with time, Value of money changing with time and not changing with time, Optimum replacement policy , Individual and group replacement.

Introduction: Solution methods, Variations of the assignment problem, Traveling salesman problem

UNIT– 3 **07 Hours**

Transportation Problems: Introduction, Methods for finding initial solution, Test of optimality, Maximization and Minimization Transportation problems, Transshipment problems, Degeneracy.

Queuing Theory: Queuing models – queuing systems and structures – notation –parameter – single server and multiserver models – Poisson input – exponential service – constant rate service – infinite population.

Game Theory: Introduction, Two-person zero-sum game, Minimum and Maximum principle, Saddle point, Methods for solving game problems with pure and mixed strategies

UNIT– 4 **07 Hours**

Sequencing Models: Scheduling and sequencing. Assumptions in sequencing models, Processing 'n' jobs on 'm' machines. Processing of two jobs on machines with each having different processing order.

Inventory Models: Types of Inventory- EOQ –ERL- Deterministic inventory problems, Price breaks, stochastic inventory problems, Selective inventory control techniques..

UNIT– 5 **07 Hours**

Network Models: Introduction to PERT/CPM & its importance in project management. Concept & construction of network diagrams. Critical path & project duration, floats, network crashing, optimum project duration & cost, PERT activity, time estimate, probability of completion of a project on or before specified time.

TEXT/REFERENCE BOOKS:

1. Wayne. L. Winston, Operations research applications and algorithms, Thomson learning,4th edition 2007.
2. 2. Taha H.A, "Operation Research", Pearson Education sixth edition, 2003
3. 3. S. D. Sharma, "Introduction to Operations Research", Discovery Publishing House, New Delhi
4. 4. P. K. Gupta, D. S. Hira, "Operations Research", S Chand and Co. Ltd., ISBN 81-219-0281-9.

BTETOE505E Augmented, Virtual and Mixed Reality 4 Credits

Course Objectives:
An ability to use current techniques, skills, and tools necessary for computing practice with an understanding of the limitations

Course Outcomes:

After completion of this course students will be able to

1. To develop 3D virtual environments.
2. To develop 3D interaction techniques and immersive virtual reality applications.

UNIT – 1 Introduction & Geometry of Virtual Worlds: 07 Hours

Course mechanics, Goals and VR definitions, Historical perspective, Birds-eye view Geometric modeling, transforming models, Matrix algebra and 2D rotations, 3D rotations and yaw, pitch, and roll, 3D rotations and yaw, pitch, and roll, Axis-angle representations, Quaternions, Converting and multiplying rotations, Homogeneous transforms, The chain of viewing transforms, Eye transforms, Canonical view transform, View port transform

UNIT – 2 Light and Optics: 07 Hours

Three interpretations of light, Refraction, Simple lenses, Diopters, Imaging properties of lenses, Lens aberrations, Optical system of eyes

UNIT – 3 Visual Physiology &Visual Perception: 07 Hours

Photoreceptors, Sufficient resolution for VR, light intensity, Eye movements, Eye movements, Eye movement issues for VR, Neuroscience of vision, Depth perception, Depth perception, Motion perception, Frame rates and displays, Frame rates anddisplays

UNIT – 4 Tracking Systems &Visual Rendering: 07 Hours

Overview, Orientation tracking, Tilt drift correction, Yaw drift correction, Tracking with a camera, Perspective n-point problem, Filtering, Lighthouse approach, Visual Rendering-overview, Shading models, Rasterization, Pixel shading, VR-specific problems, Distortion shading, Post-rendering imagewarp

UNIT – 5 Audio & Interfaces and Augmented Reality: 07 Hours

Physics and physiology, auditory perception, Auditory localization, Rendering, Spatialization and display, combining other senses, Interfaces, Locomotion, Manipulation, System control, Social interaction, Evaluation of VR Systems.

Augmented Reality: System Structure of Augmented Reality; Key Technology in AR; General solution for calculating geometric & illumination consistency in the augmented environment.

TEXT/REFERENCE BOOKS:

1. http://msl.cs.uiuc.edu/vr/
2. George Mather, Foundations of Sensation and Perception: Psychology Press; 2 edition, 2009.
3. Peter Shirley, Michael Ashikhmin, and Steve Marschner, Fundamentals of Computer Graphics, A K Peters/CRC Press; 3 edition,2009.

BTETOE505F Open Source Technologies 4 Credits

Course Objectives:

1. Understand the difference between open source software and commercial software.
2. Familiarity with Linux operating system.
3. Understanding and development of web applications using open source web technologies

Course Outcomes:

Student will be able to

1. Define the development model of Open source software, and tell about the open-source licensing
2. Understand the difference between open source software and commercial software.

3. To get acquainted with Linux OS by understanding configuration and troubleshooting of Linux Operating System.
4. Identify, install and implementation of open source technologies.

UNIT– 1 Fundamentals of Open Source Technology **07 Hours**

History of Open Source Software, Introduction – Need and Advantage of Open-Source Software, Open Source Movement- Open Source Licensing Certification, Comparing OSS with other Software-OSS Licenses.

UNIT– 2 Introduction to Open source operating system - Linux OS **07 Hours**

Introduction & types of OS, Interfaces of OS: CLI, GUI, Brief history of Linux, Architecture of Linux, Features of Linux, Difference between Linux and other OS, Linux Distributions, Boot process & run levels, Major application areas of Linux..

UNIT– 3 Linux Basics Usage **07 Hours**

User & password management & Logging into the system, GNOME and KDE desktop environment, Basic desktop operations, Text editors: vi and gedit, File system, File system architecture, File types, File attributes, File naming conventions, Shell as interpreter, Types of shell, Command line, Command syntax, Running commands and getting help, Basic commands, File-directory handling commands, Locating Files, File access permissions

UNIT– 4 Open Source Operating System (SHELL PROGRAMMING): **07 Hours**

Bash Shell Scripting, Executing Script, Working with Variables and Input, Using Control Structures, Handling signals, creating functions, working sed and gawk, working with web using shell script: Downloading web page, Converting Web page content to a text file, parsing data, working cURL.

UNIT– 5 Open Source Database And Application: **07 Hours**

MySQL: Configuring MySQL Server, working with MySQL Databases, MySQL Tables, SQL Commands – INSERT, SELECT, UPDATE, REPLACE, DELETE. Date and Time functions in MySQL. **PHP – MySQL Application Development:** Connecting to MySQL with PHP, Inserting data with PHP, Retrieving data with PHP.

TEXT/REFERENCE BOOKS:

1. Linux the complete reference' by Richard Mathews, McGraw Hill Publication. Sixth Edition, 2008
2. Linux with Operating System Concepts' by Richard Fox, CRC Press Publication. Second Edition , 2006
3. PHP6 and MySQL Bible by Steve Suehring and Joyce Park Wiley-India, New Delhi 2009.

SEMESTER VI

BTETC601 Antennas and Wave Propagation 4Credits

Course Objectives:

1. To understand the applications of electromagnetic engineering.
2. To formulate and solve the Helmholtz wave equation and solve it for Uniform Plane Wave.
3. To analyze and understand the Uniform plane wave propagation in variousmedia.
4. To solve the electric field and magnetic fields for a given wireantenna.

Course Outcomes:

After successfully completing the course students will be able to

1. Formulate the wave equation and solve it for uniform plane wave.
2. Analyze the given wire antenna and its radiation characteristics.
3. Identify the suitable antenna for a given communication system.

UNIT – 1WavePropagation: 07 Hours

Fundamental equations for free space propagation, Friis Transmission equation, Attenuation over reflecting surface, Effect of earth‟s curvature. Ground, sky & space wave propagations. Structure of atmosphere. Characteristics of ionized regions. Effects of earth‟s magneticfield. Virtual height, MUF, Skip distance. Ionospheric abnormalities. Multi-hop propagation. Space link geometry. Characteristics of Wireless Channel: Fading, Multipath delay spread, Coherence Bandwidth, and CoherenceTime.

UNIT – 2 Antenna Fundamentals andWireAntennas: 07 Hours

Introduction, Types of Antenna, Radiation Mechanism, Antenna Terminology: Radiation pattern, radiation power density, radiation intensity, directivity, gain, antenna efficiency, half power beam width, bandwidth, antenna polarization, input impedance, antenna radiation efficiency, effective length, effective area, reciprocity. Radiation Integrals: Vector potentials A, J, F, M, Electric and magnetic fields electric and magnetic current sources, solution of inhomogeneous vector potential wave equation, far field radiation.

Wire Antennas: Analysis of Linear and Loop antennas: Infinitesimal dipole, small dipole, and finite length dipole half wave length dipole, small circular loop antenna. Complete Analytical treatment of all these elements.

UNIT – 3 Antenna Arrays: **07 Hours**

Antenna Arrays: Two element array, pattern multiplication N-element linear array, uniform amplitude and spacing, broad side and end-fire array, N-element array: Uniform spacing, non-uniform amplitude, array factor, binomial and DolphTchebyshev array. Planar Array, Circular Array, Log Periodic Antenna, YagiUda Antenna Array.

UNIT – 4 Concepts of Smart Antennas: **07 Hours**

Introduction, Smart Antenna Analogy, Cellular Radio System Evolution, benefits and drawbacks of smart antennas, fixed weight beam forming basics, Antenna beamforming

UNIT – 5 Antennas and Applications: **07 Hours**

Structural details, dimensions, radiation pattern, specifications, features and applications of following Antennas: Hertz & Marconi antennas, V- Antenna, Rhombic antenna. TW antennas. Loop antenna, Whip antenna, Biconical, Helical, Horn, Slot, Microstrip, Turnstile, Super turnstile & Lens antennas. Antennas with parabolic reflectors.

TEXT/REFERENCE BOOKS:

1. C. A. Balanis, “Antenna Theory - Analysis and Design", JohnWiley.
2. Mathew N O Sadiku, “Elements of Electromagnetics” 3rd edition, Oxford University Press.
3. John D Kraus, Ronald J Marhefka, Ahmad S Khan, Antennas for All Applications, 3rd Edition, the McGraw Hill Companies.
4. K. D. Prasad, “Antenna & Wave Propagation”, SatyaPrakashan, NewDelhi.
5. John D Kraus, “Antenna& Wave Propagation”, 4th Edition, McGraw Hill,2010.
6. Vijay K Garg, Wireless Communications and Networking, Morgan Kaufmann Publishers, An Imprint of Elsevier, 2008.

BTETC602 Digital Communication 4 Credits

Course Objectives:

1. To understand the building blocks of digital communication system.
2. To prepare mathematical background for communication signal analysis.
3. To understand and analyze the signal flow in a digital communication system.
4. To analyze error performance of a digital communication system in presence of noise and other interferences.
5. To understand concept of spread spectrum communication system.

Course Outcomes:

1. Analyze the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
2. Perform the time and frequency domain analysis of the signals in a digital communication system.
3. Select the blocks in a design of digital communication system.
4. Analyze Performance of spread spectrum communication system.

UNIT – 1 Digital Transmission of Analog Signal: 07 Hours

Introduction to Digital Communication System: Why Digital?, Block Diagram and transformations, Basic Digital Communication Nomenclature. Digital Versus Analog Performance Criteria, Sampling Process, PCM Generation and Reconstruction, Quantization Noise, Non-uniform Quantization and Companding, PCM with noise: Decoding noise, Error threshold, Delta Modulation, Adaptive Delta Modulation, Delta Sigma Modulation, Differential Pulse Code Modulation, LPC speechsynthesis.

UNIT – 2 Baseband Digital Transmissions: 07 Hours

Digital Multiplexing: Multiplexers and hierarchies, Data Multiplexers. Data formats and their spectra, synchronization: Bit Synchronization, Scramblers, Frame Synchronization. Inter-symbol interference, Equalization.

UNIT – 3 Random Processes: 07 Hours

Introduction, Mathematical definition of a random process, Stationary processes, Mean, Correlation & Covariance function, Ergodic processes, Transmission of a random process through a LTI filter, Power spectral density, Gaussian process, noise, Narrow band noise, Representation of narrowband noise in terms of in phase & quadrature components.

UNIT – 4 Baseband Receivers: 07 Hours

Detection Theory: MAP, LRT, Minimum Error Test, Error Probability, Signal space representation: Geometric representation of signal, Conversion of continuous AWGN channel to vector channel, Likelihood functions, Coherent Detection of binary signals in presence of noise, Optimum Filter, Matched Filter, Probability of Error of Matched Filter, Correlation receiver.

UNIT – 5 Passband Digital Transmission & Spread Spectrum Techniques: 07 Hours

Pass band transmission model, Signal space diagram, Generation and detection, Error Probability derivation and Power spectra of coherent BPSK, BFSK and QPSK. Geometric representation, Generation and detection of - M-ary PSK, M-ary QAM and their error probability, Generation and detection of -Minimum Shift Keying, Gaussian MSK, Non-coherent BFSK, DPSK and DE PSK ,Introduction to OFDM.

Spread Spectrum Techniques: Introduction, Pseudo noise sequences, A notion of spread spectrum, Direct sequence spread spectrum with coherent BPSK, Signal space dimensionality & processing gain, Probability of error, Concept of jamming, Frequency hop spread spectrum, Wireless Telephone Systems, Personal Communication System.

TEXT/REFERENCE BOOKS:

1. Simon Haykin, “Digital Communication Systems”, John Wiley & Sons, Fourth Edition.
2. A.B Carlson, P B Crully, J C Rutledge, “Communication Systems”, Fourth Edition, McGraw Hill Publication.
3. Ha Nguyen, Ed Shwedyk, “A First Course in Digital Communication”, Cambridge University Press.
4. B P Lathi, Zhi Ding “Modern Analog and Digital Communication System”, Oxford University Press, Fourth Edition.
5. Bernard Sklar, Prabitra Kumar Ray, “Digital Communications Fundamentals and Applications” Second Edition, Pearson Education.
6. Taub, Schilling, “Principles of Communication System”, Fourth Edition, McGrawHill.
7. P Ramkrishna Rao, Digital Communication, Mc Graw Hill Publication.

BTETPE603A Microprocessors and Microcontrollers 4 Credits

Course Objectives:

1. Objective of this course is to introduce to the students the fundamentals of microprocessor and Microcontrollers.
2. After learning Microprocessors and Microcontrollers course, students will get advantage to pursue higher studies in Embedded Systems or employment in core industries.
3. The students can design and develop processor which can be used in Robotics, Automobiles, Space and many research areas.
4. The students will get acquainted with recent trends in microprocessor like pipelining, cache memory etc.
5. To understand the applications of Microprocessors and Microcontrollers.
6. To learn interfacing of real-world input and output devices.
7. The learner can microcontroller design-based systems and thus can become successful entrepreneur and meet needs of Indian and multinational industries.

Course Outcomes:

1. Students get ability to conduct experiments based on interfacing of devices to or interfacing to real world applications.
2. Students get ability to interface mechanical system to function in multidisciplinary system like in robotics, Automobiles.
3. Students can identify and formulate control and monitoring systems using microprocessors.
4. Learn use of hardware and software tools.
5. Develop interfacing to real world devices.
6. Graduates will be able to design real time controllers using microcontroller-based system.
7. Learn importance of microcontroller in designing embedded application.

UNIT– 1 07Hours

CISC and RISC Processor Architectures. Harvard and Von Neumann memory architectures. Introduction to 8085 Microprocessor based System: Architecture, Pin Description. Addressing modes. Instruction set and assembler directives. Timing Diagram.

UNIT– 2 **07 Hours**

Introduction to 8085 Assembly language programming. Programming examples using Data Transfer, Arithmetic, Logical, Branching and control instructions. Stacks and subroutine related programs. Serial data transfer. Interrupts.

UNIT– 3 **07 Hours**

Introduction to 8051 Microcontroller based System: Architecture, Pin Description, Internal Memory Organization. Addressing modes. Instruction set and assembler directives. Assembly Language Programming examples. I/O port structure and programming. Embedded C Programming with I/O port programming examples.

UNIT– 4 **07Hours**

Introduction to 8051 Timers. Timer programming in assembly and C. Introduction to 8051 serial communication. Serial Programming in assembly and C. Introduction to 8051 interrupts. Interrupt Programming in assembly andC.

UNIT– 5 **07Hours**

Interfacing of 8255, 8254, 8259 with 8085 microprocessor. External memory interfacing with 8085 microprocessor and 8051 microcontroller. Interfacing of LED, 7 Segment display, LCD, Keypad, ADC, DAC, DC Motor, Stepper Motor, Temperature sensors, Motion detectors, Relay, Buzzer, Opto-isolators with 8051microcontroller.

TEXT/REFERENCE BOOKS:

1. Douglas V. Hall, Microprocessors & Interfacing, McGraw Hill International Edition, 1992.
2. Microprocessor-Architecture, programming and application with 8085, gaonkar, penram international.
3. M. A. Mazidi, The 8085 microcontroller & embedded system, using assembly and C, 2nd edi, pearsonedu.
4. Jonathan W Valvano, Embedded Microcomputer Systems: Real Time Interfacing, Cengage Learning, Jan2011.
5. David Calcutt, 8051 microcontrollers: Applications based introduction,Elsevier.
6. Udayashankara V., MallikarjunaSwamy, 8051 microcontroller,TMH.
7. K. J. Ayala, 8051 microcontroller, Cenage (Thomson).

BTETPE603B CMOS Design **4 Credits**

Course Objectives:

1. Model the behavior of a MOS Transistor
2. Design combinational and sequential circuits using CMOS gates.
3. Analyze SRAM cell and memory arrays.
4. To develop an understanding of design different CMOS circuits using various logic families along with their circuit layout.
5. To introduce the student how to use tools for VLSI IC design.

Course Outcomes:

At the end of the course the students will be able to

1. Design different CMOS circuits using various logic families along with their circuit layout.
2. Identify the sources of power dissipation in a CMOS circuit.
3. Analyze SRAM cell and memory arrays
4. Use tools for VLSI IC design.

UNIT– 1 **07 Hours**

MOS Transistors, CMOS Logic, CMOS Fabrication and Layout, Design Partitioning, Fabrication, Packaging, and Testing, MOS transistor Theory, Long Channel I-V Characteristics, C-V Characteristics, Non-Ideal I-V Effects, DC Transfer Characteristics

UNIT– 2 **07 Hours**

CMOS Processing Technology, CMOS Technologies, Layout Design Rules, CMOS Process Enhancements, Technology-Related CAD Issues, Manufacturing Issues, Circuit Simulation, A SPICE Tutorial, Device Models, Device Characterization, Circuit Characterization, Interconnect Simulation. Combinational Circuit Design, Circuit Families, Silicon-On-Insulator Circuit Design, Sub Threshold Circuit Design. Sequential Circuit Design, Circuit Design of Latches and Flip-Flops, Static Sequencing Element Methodology, Sequencing Dynamic Circuits, Synchronizers, Wave Pipelining

UNIT– 3 **07 Hours**

Power, Sources of Power Dissipation, Dynamic Power, Static Power, Energy-Delay Optimization, Low Power Architectures, Robustness, Variability, Reliability, Scaling, Statistical Analysis of Variability, Variation-Tolerant Design. Delay, Transient Response, RC

Delay Model, Linear Delay Model, Logical Effort of Paths, Timing Analysis Delay Models, Datapath Subsystems, Addition/Subtraction, One/Zero Detectors, Comparators, Counters, Boolean Logical Operations, Coding, Shifters, Multiplication

UNIT– 4 **07 Hours**

Array Subsystems, SRAM, DRAM, Read-Only Memory, Serial Access Memories, Content Addressable Memory, Programmable Logic Arrays, Robust Memory Design, Special-Purpose Subsystems.

UNIT– 5 **07 Hours**

Packaging and Cooling, Power Distribution, Clocks, PLLs and DLLs, I/O, High-Speed Links, Random Circuits, Design Methodology and Tools, Testing, Debugging, and Verification.

TEXT/REFERENCE BOOKS:

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4th Edition, Pearson Education India,2011.
2. C. Mead and L. Conway, Introduction to VLSI Systems, Addison Wesley,1979.
3. J. Rabaey, Digital Integrated Circuits: A Design Perspective, Prentice Hall India,1997.
4. P. Douglas, VHDL: programming by example, McGraw Hill,2013.
5. L. Glaser and D. Dobberpuhl, The Design and Analysis of VLSI Circuits, Addison Wesley,1985.

BTETPE603C Nano Electronics 4 Credits

Course Objectives:

1. To convey the basic concepts of Nano electronics to engineering students with no background in quantum mechanics and statistical mechanics.
2. Main objective of this is to provide the basic platform and deep information of different Nano electronics devices like MOSFET, FINFET, Nano metrology tools used to design the recently developing VLSI applications.
3. This subject gives idea about the role and importance of the Nano electronic devices system in engineering world to develop the research ideas inVLSI.
4. Recent technology proceeds with MOSFET with 64nm technology, the need Nano electronic Devices and Material subject to achieve transistor size which is less than current technology.

5. The content of this course gives platform to the Nano electronics world and innovative ideas to ensure the knowledge of real time applications which helps students to stand them in Indian and multinational industries.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand various aspects of nano-technology and the processes involved in making nano components and material.
2. Leverage advantages of the nano-materials and appropriate use in solving practical problems.
3. Understand various aspects of nano-technology and the processes involved in making nano components and material.
4. Leverage advantages of the nano-materials and appropriate use in solving practical problems.

UNIT – 1 Overview Nano Technology and Basics of Quantum Mechanics: 07 Hours

Introduction to nanotechnology, Nano devices, Nano materials, Nano characterization, Definition of Technology node, Basic CMOS Process flow, meso structures.

Basics of Quantum Mechanics: Schrodinger equation, Density of States, Particle in a box Concepts, Degeneracy, Band Theory of Solids, Kronig-Penny Model. Brillouin Zones

UNIT – 2 MOS Scaling theory: 07 Hours

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.)

UNIT – 3 Nano electronics Semiconductor devices: 07 Hours

Resonant Tunneling Diode, Coulomb dots, Quantum blockade, Single electron transistors, Carbon nanotube electronics, Band structure and transport, devices, applications, 2D semiconductors and electronic devices, Graphene, atomistic simulation

UNIT – 4 Properties of Nano devices: 07 Hours

Vertical transistors, Fin FET and Surround gate FET. Metal source/drain junctions – Properties of schottky functions on Silicon, Germanium and compound semiconductors -

Work functionpinning.

UNIT – 5 Characterization techniques for Nano materials: 07 Hours

FTIR, XRD, AFM, SEM, TEM, EDAX Applications and interpretation of results, Emerging nano material, nano tubes, Nano rods and other Nano structures, LB technique, Soft lithography Microwave assisted synthesis,Self-assembly.

TEXT/REFERENCE BOOKS:

1. G.W. Hanson, Fundamentals of Nanoelectronics, Pearson, 2009.
2. W. Ranier, Nanoelectronics and Information Technology (Advanced ElectronicMaterial and Novel Devices), Wiley-VCH,2003.
3. K.E. Drexler, Nanosystems, Wiley,1992.
4. J.H. Davies, The Physics of Low-Dimensional Semiconductors, Cambridge University Press,1998.

BTETPE603D Advanced Digital Signal Processing 4 Credits

Course Objectives:

1. This Multirate Signal Processing course covers advanced techniques for the design of digital filters, which are essential components in almost every digital signal processing system, as well as cyclostationary signals, so important to the understanding of modulation systems.
2. The course then moves on to treat multi-rate systems and presents multi-rate processing of both deterministic and random signals, culminating in a full case study exercise.
3. To analyze multi-rate systems and the effects of interpolation and decimation on deterministic signals.
4. To analyze the effects of interpolation and decimation on random signals.
5. To design interpolation and decimation filters to a given specification.

Course Outcomes:

After successfully completing the course students will have:

1. Ability to understand the concepts of sampling rate conversions, Decimation and Interpolation as part of Signal Processing techniques.

2. Able to explain how the multirate implementation of ADC and DAC converters works.
3. Able to describe basic sampling rate conversion algorithms.
4. Able to draw and describe different kinds of interpolator and decimator.
5. Able to analyze how the interpolated FIR filter works.
6. Able to do sampling rate conversion.

UNIT – 1 Fundamentals of Multirate Systems: 07 Hours

Introduction, Basic multirate operations, Interconnection of building blocks, Polyphase representation, Mulstage implementation, Some application of multirate systems,Special filter and filter banks.

UNIT – 2 Maximally Decimaled Filter Banks: 07 Hours

Introduction, Errors created in the QMF bank, A simple alias free QMF system, Power symmetric QMF banks, M-channel filter banks, Polyphase representation, Perfect reconstruction system, alias free filter banks, Tree structured filter banks, Trans multiplexer.

UNIT – 3 Paranitary Perfect Reconstruction Filter Banks: 07 Hours

Introduction, Lossless transfer matrices, Filter banks properties induced by paraunitariness, Two channel FIR paraunitary QMF banks, Two channel para unitary QMF lattice, M - channel FIR paraunitary filter banks, Transform coding and LOT.

UNIT – 4 Linear Phase and Cosine Modulated Filter Banks: 07 Hours

Introduction, Some necessary conditions, Lattice structure for linear phase FIR PR banks, formalsynthesisoflinearphaseFIRPRQMFLattice.PseudoQMFbanks,Designofthe Pseudo QMF bank, Efficient poly phase structure, Cosine modulated perfect reconstruction system.

UNIT – 5 The Wavelet Transform and its Relation to Multirate Filter Banks: 07 Hours

Introduction, Background and outline, Short time Fourier transform, The Wavelet transform, DT orthogonal Wavelets, Continuous time orthonormal Wavelet basis.

Multidimensional, Multivariable and Lossless Systems: Introduction, Multidimensional signals, Sampling a multidimensional Signals, Multirate fundamentals. Review of discrete time multi-input multi-output LTI System, Para UNITary and lossless system.

TEXT/REFERENCE BOOKS:

1. P. P. Vaidyanathan , PTR Prentice Hall, Englewood Cliffs , New Jersey, Multirate System and FilterBanks.
2. N. J. Fliege , John Wiley & Sons, Multirate Digital SignalProcessing.
3. RaghuveerRao, AjitBopardikar, Pearson Education Asia, Wavelet Transforms Introduction to Theory andApplication.
4. C. Sidney Burrus ,R.A.Gopianath , Pretice Hall, Introduction to wavelet and wavelet Transform.

BTETPE603E Information Theory and Coding 4Credits

Course Objectives:

1. To provide in-depth understanding of principles and applications of information theory.
2. To provide in-depth understanding of how information is measured in terms of probability and entropy and how these are used to calculate the capacity of a communication channel.
3. To provide in-depth understanding of different coding techniques for error detection and correction.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the concept of information and entropy.
2. Understand Shannon‟s theorem for coding.
3. Calculation of channel capacity.
4. Apply coding techniques.

UNIT – 1 Theory of Probability and Random Processes: 07 Hours

Concept of probability, random variables, random process, power spectral density of a random process, probability models, statistical averages, central limit theorem, correlation, linear mean square estimation.

UNIT – 2 Noise in Communication Systems: 07 Hours

Behavior of analog and digital communication systems in the presence of noise, Sources of noise, Noise representation, Noise filtering, Noise bandwidth, Performance of analog and digital communication systems in the presence of noise.

UNIT – 3InformationTheory: **07 Hours**

Measure of information, Joint entropy and conditional entropy, Relative entropy and mutual information, Markov sources, Source encoding, Shannon-Fano coding and Huffman coding, Shannon's first and second fundamental theorems, Channel capacity theorem.

UNIT – 4 Error Correcting Codes and Markov sources: **07 Hours**

Galois fields, Vector spaces and matrices, Block codes, Cyclic codes, Burst-error detecting and correcting codes, Multiple error correcting codes, Convolutional codes, ARQ

Markov sources: Shannon's noisy coding theorem and converse for discrete channels; Calculation of channel capacity and bounds for discrete channels; Application to continuous channels

UNIT – 5 Speech Coding: **07 Hours**

Characteristics of speech signal, Quantization techniques, Frequency domain coding, Vocoders, Linear predictive coders, Codecs for mobile communication, GSM codec, USDC codec, Performance evaluation of speech coders

TEXT/REFERENCE BOOKS:

1. B. P. Lathi; Modern Digital and Analog Communication Systems; OxfordPublication.
2. Das, Mullick, Chaterjee; Principles of Digital Communication; New AgeInternational.
3. Taub, Schilling, Principles of CommunicationEngineering(2nd Edition), TMH.
4. Thomas M. Cover, Joy A. Thomas, Elements of Information Theory, Wiley Interscience.
5. R.P.Singh, S.D. Sapre; Communication systems: Analog and Digital;TMH.
6. Theodore S. Rappaport; Wireless Communication: Principles and Practice (2ndEdition), Pearson India.
7. N. Abramson, Information and Coding, McGraw Hill,1963.
8. M. Mansurpur, Introduction to Information Theory, McGraw Hill, 1987.

BTETPE603F VLSI Signal Processing 4 Credits

Course Objectives:

1. Introduce students to the fundamentals of VLSI signal processing and expose them to examples of applications.
2. Design and optimize VLSI architectures for basic DSP algorithms.
3. Design and optimize VLSI architectures for basic DSP algorithms.

Course Outcomes:

1. Understand VLSI design methodology for signal processing systems.
2. Be familiar with VLSI algorithms and architectures for DSP.

UNIT– 1 07 Hours

Pipelining and Parallel Processing: Introduction, Pipelining of FIR Digital Filters, Parallel Processing. Pipelining and Parallel Processing for Low Power. Retiming: Introduction, Definition and Properties, Solving System of Inequalities, Retiming Techniques.

UNIT– 2 07 Hours

Unfolding: Introduction an Algorithms for Unfolding, Properties of Unfolding, Critical Path, Unfolding and Retiming Application of Unfolding.

UNIT– 3 07 Hours

Folding: Introduction to Folding Transformation, Register Minimization Techniques, Register Minimization in Folded Architectures, Folding in Multirate Systems.

UNIT– 4 07 Hours

Systolic Architecture Design: Introduction, Systolic Array Design Methodology, FIR Systolic Arrays, Selection of Scheduling Vector, Matrix Multiplication and 2D Systolic Array Design, Systolic Design for Space Representations Containing Delays.

UNIT– 5 07 Hours

Fast Convolution: Introduction, Cook, Toom Algorithm, Winogard Algorithm, Iterated Convolution, Cyclic Convolution Design of Fast Convolution Algorithm by Inspection

TEXT/REFERENCE BOOKS:

1. Keshab K. Parhi. VLSI Digital Signal Processing Systems, Wiley-Inter Sciences,1999.
2. Mohammed Ismail, Terri, Fiez, Analog VLSI Signal and Information Processing, McGraw Hill, 1994.
3. Kung. S.Y., H.J. While house T.Kailath, VLSI and Modern singal processing, Prentice Hall,1985.
4. Jose E. France, YannisTsividls, Design of Analog Digital VLSI Circuits for Telecommunications andSignal Processing"Prentice Hall, 1994.

BTETPE603G VLSI Design & Technology 4 Credits

Course Objectives:

1. To study HDL based design approach.
2. To learn digital CMOS logic design.
3. To nurture students with CMOS analog circuit designs.
4. To realize importance of testability in logic circuit design.
5. To overview SoC issues and understand PLD architectures with advanced features.

Course Outcomes:

After successfully completing the course, students will be able to

1. Model digital circuit with HDL, simulate, synthesis and prototype in PLDs.
2. Understand chip level issues and need of testability.
3. Design analog & digital CMOS circuits for specified applications

UNIT – 1 VHDL Modeling: 07 Hours

Data objects, Data types, Entity, Architecture & types of modeling, Sequential statements, Concurrent statements, Packages, Sub programs, Attributes, VHDL Test bench, Test benches using text files. VHDL modeling of Combinational, Sequential logics & FSM,Meta-stability.

UNIT – 2PLDArchitectures: 07 Hours

PROM, PLA, PAL: Architectures and applications. Software Design Flow, CPLD Architecture, Features, Specifications, Applications, FPGA Architecture, Features, Specifications, Applications.

UNIT – 3 SoC & Interconnect: **07 Hours**

Clock skew, Clock distribution techniques, clock jitter, Supply and ground bounce, power distribution techniques. Power optimization, Interconnect routing techniques; wire parasitic, Signal integrity issues, I/O architecture, pad design, Architectures for low power.

UNIT – 4 Digital CMOS Circuits: **07 Hours**

MOS Capacitor, MOS Transistor theory, C-V characteristics, Non ideal I-V effects, Technology Scaling. CMOS inverters, DC transfer characteristics, Power components, Power delay product, Transmission gate. CMOS combo logic design, Delays: RC delay model, Effective resistance, Gate and diffusion capacitance, Equivalent RC circuits; Linear delay model, Logical effort, Parasitic delay, Delay in a logic gate, Path logicalefforts.

UNIT – 5 Analog CMOS Design and Testability: **07 Hours**

Current sink and source, Current mirror, Active load, Current source and Push-pull inverters, Common source, Common drain, Common gate amplifiers. Cascade amplifier, Differential amplifier and Operational amplifier.

Testability: Types of fault, Need of Design for Testability (DFT), Testability, Fault models, Path sensitizing, Sequential circuit test, BIST, Test pattern generation, JTAG & Boundary scan, TAP Controller.

TEXT/REFERENCE BOOKS:

1. Charles H. Roth, “Digital systems design using VHDL”,PWS.
2. Wyane Wolf, “Modern VLSI Design (System on Chip)”, PHI Publication.
3. Allen Holberg, “Analog CMOS Design”, Oxford University Press.
4. NeilH. E. Weste, David Money Harris, “CMOS VLSI Design: A Circuit & System Perspective”, Pearson Publication.

BTETOE604A IoT and Industry4.0 — 4 Credits

Course Objectives:

1. Industry 4.0 concerns the transformation of industrial processes through the integration of modern technologies such as sensors, communication, and computational processing. Technologies such as Cyber Physical Systems (CPS),

Internet of Things (IoT), Cloud Computing, Machine Learning, and Data Analytics are considered to be the different drivers necessary for the transformation.

2. Industrial Internet of Things (IIoT) is an application of IoT in industries to modify the various existing industrial systems. IIoT links the automation system with enterprise, planning and product lifecycle.

Course Outcomes:

1. Understand the drivers and enablers of Industry4.0
2. Appreciate the smartness in Smart Factories, Smart cities, smart products and smart services
3. Able to outline the various systems used in a manufacturing plant and their role in an Industry 4.0world
4. Appreciate the power of Cloud Computing in a networkedeconomy.
5. Understand the opportunities, challenges brought about by Industry 4.0 and how organizations and individuals should prepare to reap the benefits

UNIT – 1 Introduction and Industry4.0: 07 Hours

Introduction: Sensing & actuation, Communication-Part I, Part II, Networking-Part I, Part II Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, Industry 4.0: Cyber Physical Systems and Next Generation Sensors, Collaborative Platform and Product Lifecycle Management, Augmented Reality and Virtual Reality, Artifical Intelligence, Big Data and Advanced Analysis, Cyber security in Industry4.0

UNIT – 2 Basics of Industrial IoT and Introduction: 07 Hours

Basics of Industrial IoT: Industrial Processes-Part I, Part II, Industrial Sensing & Actuation, Industrial Internet Systems. IIoT-Introduction, Industrial IoT: Business Model and Referece Architecture: IIoT-Business Models-Part I, Part II, IIoT Reference Architecture-Part I, Part II, Industrial IoT- Layers: IIoT Sensing-Part I, Part II, IIoT Processing-Part I, Part II, IIoT Communication-Part I.

UNIT – 3 Industrial IoT-Layers: 07 Hours

Industrial IoT- Layers: IIoT Communication-Part II, Part III, IIoT Networking-Part I, Part II, Part III., Industrial IoT: Big Data Analytics and Software Defined Networks: IIoT Analytics -

Introduction, Machine Learning and Data Science - Part I, Part II, R and Julia Programming, Data Management with Hadoop.

UNIT – 4 Industrial IoT: Big Data Analytics and Software Defined Networks: 07 Hours

Industrial IoT: Big Data Analytics and Software Defined Networks: SDN in IIoT-Part I, Part II, Data Center Networks, Industrial IoT: Security and Fog Computing: Cloud Computing in IIoT-Part I, Part II, Industrial IoT: Security and Fog Computing - Fog Computing in IIoT, Security in IIoT-Part I, Part II, Industrial IoT- Application Domains: Factories and Assembly Line, Food Industry.

UNIT – 5 Industrial IoT-Application Domains: 07 Hours

Industrial IoT- Application Domains: Healthcare, Power Plants, Inventory Management & Quality Control, Plant Safety and Security (Including AR and VR safety applications), Facility Management.

Industrial IoT- Application Domains: Oil, chemical and pharmaceutical industry, Applications of UAVs in Industries, Real case studies:

Case study - I : Milk Processing and Packaging Industries

Case study - II: Manufacturing Industries - Part I

Case study - III : Manufacturing Industries - Part II

Case study - IV : Student Projects - Part I

Case study - V : Student Projects - Part II

Case study - VI : Virtual Reality Lab

Case study - VII : Steel Technology Lab

TEXT/REFERENCE BOOKS:

1. “Industry 4.0: The Industrial Internet of Things”, by Alasdair Gilchrist(Apress)
2. “Industrial Internet of Things: Cyber manufacturing Systems”by Sabina Jeschke, Christian Brecher, Houbing Song, Danda B. Rawat(Springer)
3. Research papers.

BTETOE604B Deep Learning **4Credits**

Pre-Requisites: Machine Learning

Course Objectives:

The objective of this course is to cover the fundamentals of neural networks as well as some advanced topics such as recurrent neural networks, long short term memory cells and convolution neural networks.

Course Outcomes:

After successfully completing the course, students will be able to

1. Understand the fundamentals of neural networks as well as some advanced topics such as recurrent neural network.
2. Understand convolution neural networks.

UNIT –1 Basics: **07 Hours**

Biological Neuron, Idea of computational units, McCulloch–Pitts unit and Thresholding logic, Linear Perceptron, Perceptron Learning Algorithm, Linear separability. Convergence theorem for Perceptron Learning Algorithm.

UNIT – 2 Feed forward Networks: **07 Hours**

Multilayer Perceptron, Gradient Descent, Back propagation, Empirical Risk Minimization, regularization, auto encoders.

UNIT – 3 Deep Neural Networks and Better Training of Neural Networks: 07 Hours

Deep Neural Networks: Difficulty of training deep neural networks, Greedy layerwise training. Better Training of Neural Networks: Newer optimization methods for neural networks (Adagrad, adadelta, rmsprop, adam, NAG), second order methods for training, Saddle point problem in neural networks, Regularization methods (dropout, drop connect, batch normalization).

UNIT – 4 Recurrent Neural Networks and Convolutional Neural Networks: 07 Hours

Recurrent Neural Networks: Back propagation through time, Long Short Term Memory, Gated Recurrent Units, Bidirectional LSTMs, Bidirectional RNNs

Convolutional Neural Networks: LeNet, AlexNet.

UNIT – 5 Generative models, recent trends and Applications: **07 Hours**

Generative models: Restrictive Boltzmann Machines (RBMs), Introduction to MCMC and Gibbs Sampling, gradient computations in RBMs, Deep Boltzmann Machines.

Recent trends: Variation Auto encoders, Generative Adversarial Networks, Multi-task Deep Learning, Multi-view Deep Learning

Applications: Vision, NLP, Speech (just an overview of different applications in 2-3 lectures)

TEXT/REFERENCE BOOKS:

1. Deep Learning, Ian Goodfellow and YoshuaBengio and Aaron Courville, MIT Press, 2016.
2. Neural Networks: A Systematic Introduction, Raúl Rojas,1996
3. Pattern Recognition and Machine Learning, Christopher Bishop,2007

BTETOE604C Computer Network 4 Credits

Course Objectives:

1. To develop an understanding of modern network architectures from a design and performance perspective.
2. To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
3. To provide an opportunity to do network programming
4. To provide a WLAN measurement idea.

Course Outcomes:

1. To master the terminology and concepts of the OSI reference model and the TCP‐IP reference model.
2. To master the concepts of protocols, network interfaces, and design/performance issue s in local area networks and wide area networks.
3. To be familiar with wireless networking concepts.
4. To be familiar with contemporary issues in networking technologies.
5. To be familiar with network tools and network programming.
6. For a given requirement (small scale) of wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs) design it based on the market available component.
7. For a given problem related TCP/IP protocol developed the network programming.

8. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software andtools.

UNIT – 1 Physical Layer: 07 Hours

Data Communications, Networks, Network types, Protocol layering, OSI model, Layers in OSI model, TCP / IP protocol suite, Addressing, Guided and Unguided Transmission media. Switching: Circuit switched networks, Packet Switching, Structure of a switch.

UNIT – 2 Data Link Layer: 07 Hours

Introduction to Data Link Layer, DLC Services, DLL protocols, HDLC, PPP, Media Access Control: Random Access, Controlled Access, Channelization. Wired LAN: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Giagabit Ethernet, 10 Gigabit Ethernet.

UNIT– 3 Wireless LANS & Virtual Circuit Networks and Network Layer: 07 Hours

Introduction, Wireless LANS: IEEE 802.11 project, Bluetooth, Zigbee, connecting devices and Virtual LANS: Connecting devices, Virtual LANS.

Network Layer: Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

UNIT – 4Transport Layer: 07 Hours

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques: Leaky Bucket and Token Bucket algorithm.

UNIT – 5ApplicationLayer:07 Hours

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

TEXT/REFERENCE BOOKS:

1. Data Communication and Networking, 4th Edition, Behrouz A. Forouzan,McGraw-Hill.
2. TCP/IP Protocol Suite, 4th Edition, Behrouz A. Forouzan, TataMcGraw-Hill.
3. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice HallIndia.
4. Computer Networks, 8th Edition, Andrew S. Tanenbaum, Pearson New International Edition.

5. Internetworking with TCP/IP, Volume 1, 6th Edition Douglas Comer, Prentice Hall of India.
6. TCP/IP Illustrated, Volume 1, W. Richard Stevens, Addison-Wesley, United States of America.

BTETOE604D Industrial Drives and Control 4 Credits

Course Objectives:

To expose the students to the Engineering fundamentals of various Drives and its control, Dynamic operation and their Applications.

Course Outcomes:

At the end of the course, students will demonstrate the ability to gain an ability to design and conduct performance experiments, as well as to identify, formulate and solve drives related problems.

UNIT – 1 Electrical Drives: 07 Hours

Introduction &Dynamics Introduction, Advantages of Electrical Drives, Parts of Electrical Drives, Choice of Electrical Drives, Status of DC and AC Drives, Fundamental Torque equations, Speed Torque conventions and Multi-quadrant Operation, Equivalent values of Drive Parameter, Measurement of Moment of Inertia, Components of Load Torques, Nature and Classification of Load Torques, Calculation of Time and Energy-Loss in Transient Operations, Steady State Stability, Load Equalization.

UNIT – 2 Selection of Motor Power Rating and Control of Electrical Drives: 07 Hours

Thermal Model of Motor for Heating and Cooling, Classes of Motor Rating, Determination of Motor Rating. Control of Electrical Drives: Modes of Operation, Speed Control, Drive Classification, and Closed loop Control of Drives

UNIT – 3 DC Drives: 07 Hours

Review of Speed Torque relations for Shunt, Series and Separately excited Motors, Review of Starting, Braking (Regenerative, Dynamic, Plugging), Review of Speed control, Controlled rectifier fed DC drives (separately excited only): Single phase fully-controlled Rectifier, Single phase Half controlled Rectifier, Three phase fully-controlled Rectifier, Three phase Half-controlled Rectifier, Dual Converter Control, Chopper Control – Motoring and Braking of separately excited and Series Motor. (No numerical from thismodule).

UNIT – 4 AC Drives: **07 Hours**

Induction Motor drives, Review of Speed-Torque relations, Review of Starting methods, Braking (Regenerative, Plugging and AC dynamic braking), Transient Analysis, Speed Control: Stator voltage control, Variable frequency control from voltage source, Static Rotor Resistance control, Slip Power Recovery - Static Scherbius Drive, Review of d-q model of Induction Motor, Principle of Vector Control, Block diagram of Direct Vector Control Scheme, Comparison of Scalar control and Vector control, Basic Principle of Direct Torque Control (block diagram) of induction motor. Introduction to Synchronous Motor Variable Speed drives.

UNIT – 5 Special Motor Drives: **07Hours**

Stepper Motor drives- Types, Torque vs. Stepping rate characteristics, Drive circuits, Introduction to Switched reluctance motor drives and Brushless DC motor drives.

TEXT/REFERENCE BOOKS:

1. Fundamentals of Electrical Drives by G. K. Dubey, NarosaPublication
2. A First Course on Electrical Drives by S. K. Pillai, New AgeInternational.
3. Electrical Drives: Concepts and Applications by VedamSubramanyam,T.M.H
4. Modern Power Electronics and AC Drives by B. K. Bose, Prentice HallPTR
5. Special Electrical Machines by E.G. Janardanan,PHI
6. Electric Motor Drives: Modeling, Analysis and Control by Krishnan. R,PHI
7. Power Electronics by Joseph Vithayathil, Tata McGrawHill
8. Power Semiconductor Controlled Drives by G. K. Dubey, Prentice HallInternational.

BTETOE604E Robotics Design **4Credits**

Course Objectives:

1. To prepare students with basics of robotics
2. To familiarize students with kinematics & dynamics of robots
3. To familiarize students with path & Trajectory planning of robots
4. To familiarize students with robot vision

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Describe kinematics and dynamics of stationary and mobile robots
2. Describe trajectory planning for robots.
3. Implement trajectory generation and path planning various algorithms
4. Work in interdisciplinary projects.

UNIT – 1 Fundamentals of Robotics: 07 Hours

Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate frames, workspace, applications.

UNIT – 2 Forward & Inverse Kinematics of Robots: 07 Hours

Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation, Denavit-Hatenberg representation of forward kinematics, Inverse kinematic solutions, Casestudies

UNIT – 3 Velocity Kinematics & Dynamics and Robot Motion Planning: 07 Hours

Differential motions and velocities: Differential relationship, Jacobian, Differential motion of a frame and robot, Inverse Jacobian, Singularities. Dynamic Analysis of Forces: Lagrangian mechanics, Newton Euler formulation, Dynamic equations of robots, Transformation of forces and moment between coordinate frames.

Robot Motion Planning: Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug

UNIT – 4 Potential Functions and Visibility Graphs: 07 Hours

Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi diagrams and graphs, Silhouette methods

UNIT – 5 Trajectory planning and Robot Vision: 07 Hours

Trajectory planning: Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories. Robot Vision Image representation, Template matching, Polyhedral objects, Shape analysis, Segmentation, Iterative processing, Perspective transform.

TEXT/REFERENCE BOOKS:

1. Robert Shilling, Fundamentals of Robotics - Analysis and control, Prentice Hall of India
2. Saeed Benjamin Niku, “Introduction to Robotics – Analysis, Control, Applications”, Wiley India Pvt. Ltd., Second Edition,2011
3. Howie Choset, Kevin M. Lynch, Seth Hutchinson, George Kantor, Wolfram Burgard, Lydia E. Kavraki and Sebastian Thrun, “Principles of Robot Motion – Theory, Algorithms and Implementations”, Prentice-Hall of India, 2005.
4. Mark W. Spong , Seth Hutchinson, M. Vidyasagar, “Robot Modeling & Control ”, Wiley India Pvt. Ltd.,2006
5. John J. Craig, “Introduction to Robotics – Mechanics & Control”, Third Edition, Pearson Education, India,2009
6. Aaron Martinez & Enrique Fernandez, “Learning ROS for Robotics Programming”, Shroff Publishers, First Edition,2013.
7. Mikell P. Groover et.al,” Industrial Robots-Technology, Programming & applications”, McGraw Hill, New York, 2008

BTETOE604F Patents and IPR 4Credits

Course Objectives:

1. The course has been developed with orientation towards research related activities and recognizing the ensuing knowledge as property.
2. It will create consciousness for Intellectual Property Rights and its constituents.
3. Learners will be able to perform documentation and administrative procedures relating to IPR in India as well as abroad.

Course Outcomes:

At the end of the course, students will demonstrate their ability to:

1. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
2. Understand that IPR protection provides an incentive to inventors for further research

work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

UNIT –1 Patents: **07 Hours**

Designs, Trade and Copyright, Classification of patents in India, Categories of Patent, Special Patents, Patent document, Granting of patent, Rights of a patent, Patent Searching, Patent Drafting, filing of a patent, different layers of the international patent system, Utility models

UNIT – 2 Patent Rights: **07 Hours**

Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications.

UNIT – 3 Overview of Intellectual Property: **07 Hours**

Introduction of IPR, Need for intellectual property right (IPR), IPR in India – Genesis and Development IPR in abroad,

UNIT – 4 New Developments in IPR: **07 Hours**

Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge, Case Studies.

UNIT – 5 Case studies: **07 Hours**

Case studies related to patents and IPR

TEXT/REFERENCE BOOKS:

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007.Saeed Benjamin Niku, "Introduction to Robotics – Analysis, Control, Applications", Wiley India Pvt. Ltd., Second Edition,2011
2. Mayall, "Industrial Design", McGraw Hill,1992
3. Niebel , "Product Design", McGraw Hill,1974.
4. Asimov, "Introduction to Design", Prentice Hall,1962.
5. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age",2016.
6. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand,2008

BTETOE604G Acoustic Engineering **4 Credits**

Course Objectives:

1. The learner develops a basic understanding of audio production equipment and software.
2. The Learner develops a basic understanding sound and acoustics
3. Learners will become proficient with an industry standard DAW user interface and related peripheral technology
4. Learners will demonstrate project management skills.

Course Outcomes:

At the end of the course, students will demonstrate their ability to:

1. understanding of audio production
2. basic understanding sound and acoustics
3. learners will come to know about Radiation and diffraction of acoustic, Cavities and waveguides, Resonators and filters

UNIT – 1 Fundamentals of Acoustics: **07 Hours**

Equation of state, Equation of continuity , Euler‟s equation , Linearized wave equation , Speed of sound in fluids , Harmonic plane waves , Energy density , Acoustic intensity , Specific acoustic impedance, Spherical waves , Decibel scales

UNIT – 2 Transmission and reflection: **07 Hours**

Transmission from one fluid to another - normal incidence , Transmission through a fluid layer - normal incidence , Transmission from one fluid to another - oblique incidence , Transmission through a fluid layer - oblique incidence , Reflection at a solid surface – normal incidence , Reflection at a solid surface – oblique incidence

UNIT – 3 Radiation and diffraction: **07 Hours**

Pulsating sphere , Acoustic reciprocity , Simple sources , Acoustic dipoles , Acoustic line source , Directivity and beam patterns , Plane circular piston , Near field and far field , Acoustic radiation impedance , Phased arrays

UNIT – 4 Cavities and waveguides: **07 Hours**

Resonance in pipes , Open-ended pipes , Standing waves , Absorption in pipes , Pipes with drivers

UNIT – 5 Resonators and filters: **07 Hours**

Helmoltz resonator, Acoustic impedance (radiation impedance and mechanical impedance), Waves in a pipe , Acoustic filters

TEXT/REFERENCEBOOKS:

1. Kinsler and Frey, „Fundamentals of Acoustics‟, 4thedition

BTHM605 Employability & Skill Development 3 Credits

Course Objectives:

1. To develop analytical abilities.
2. To develop communication skills.
3. To introduce the students to skills necessary for getting, keeping and being successful in a profession.
4. To expose the students to leadership and team-building skills.

Course Outcomes:

On completion of the course, student will be able to:

1. Have skills and preparedness for aptitude tests.
2. Be equipped with essential communication skills (writing, verbal and non-verbal)
3. Master the presentation skill and be ready for facing interviews.
4. Build team and lead it for problem solving.

UNIT – 1 Soft Skills & Communication basics: 07 Hours

Soft skills Vs hard skills, Skills to master, Interdisciplinary relevance, Global and national perspectives on soft skills, Resume, Curriculum vitae, How to develop an impressive resume, Different formats of resume – Chronological, Functional, Hybrid, Job application or cover letter, Professional presentation- planning, preparing and delivering presentation, Technical writing.

UNIT – 2 07 Hours

Interpersonal Skills: Critical Thinking, Assertiveness, Decision Making, Problem Solving, Negotiation, Building Confidence, Time Management, Personal Presentation, Assertiveness, negotiation, avoiding Stress.

Commercial Awareness: Professional etiquettes and manners, Global negotiating and Persuading, Integrity. Global trends and statistics about civil engineering businesses.

UNIT – 3 Grammar and Comprehension: 07 Hours

English sentences and phrases, Analysis of complex sentences, Transformation of sentences, Paragraph writing, Story writing, Reproduction of a story, Letter writing, précis writing, Paraphrasing and e-mail writing.

UNIT – 4 Skills for interviews: 07 Hours

Interviews- types of interviews, preparatory steps for job interviews, interview skill tips, Group discussion- importance of group discussion, types of group discussion, difference between group discussion, panel discussion and debate, personality traits evaluated in group discussions, tips for successful participation in group discussion, Listening skills- virtues of listening, fundamentals of good listening, Non-verbal communication-body movement, physical appearance, verbal sounds, closeness, time.

UNIT – 5 Problem Solving Techniques: 07 Hours

Problem solving model: 1. Define the problem, 2. Gather information, 3. Identify various solution, 4. Evaluate alternatives, 5. Take actions, 6. Evaluate the actions.

Problem solving skills: 1. Communicate. 2. Brain storming, 3. Learn from mistakes.

TEXT/REFERENCE BOOKS:

1. R. Gajendra Singh Chauhan, Sangeeta Sharma, “Soft Skills- An integrated approach to maximize personality”, ISBN: 987-81-265-5639-7, First Edition 2016, WileyWren and Martin, "English grammar and Composition", S. Chandpublications.
2. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chandpublications.
3. Philip Carter, "The Complete Book of Intelligence Test", John Willey & SonsLtd.
4. Philip Carter, Ken Russell, "Succeed at IQ test", KoganPage.
5. Eugene Ehrlich, Daniel Murphy, "Schaum‟s Outline of English Grammar", McGraw Hills.
6. David F. Beer, David A. McMurrey, “A Guide to Writing as an Engineer”, ISBN: 978-1-118-30027-5 4th Edition, 2014, Wiley.

SEMESTER VII

BTETC701 Microwave Engineering 4 Credits

Course Objectives:

1. To lay the foundation for microwave engineering.
2. To understand the applications of microwave engineering.
3. Carryout the microwave network analysis.

Course Outcomes:

After successfully completing the course students will be able to

1. Formulate the wave equation in wave guide for analysis.
2. Identify the use of microwave components and devices in microwave applications.
3. Understand the working principles of all the microwave tubes.
4. Understand the working principles of all the solid-state devices.
5. Choose a suitable microwave tube and solid-state device for a particular application.
6. Carry out the microwave network analysis.
7. Choose a suitable microwave measurement instruments and carry out the required measurements.

UNIT – 1 Transmission Lines and Waveguides: 10 Hours

RF and Microwave transmission Lines, Standing Waves, General Analysis of Time Harmonic waves, Introduction to coaxial line, Equivalent circuit parameters of Transmission Lines, Smith Chart, Single stub and Double stub matching, Microwave Frequency bands. General solution for TEM, TE and TM waves, Rectangular waveguide, Circular waveguide, Wave guide parameters, Rectangular waveguide cavity resonators, Circular waveguide cavity resonators.

UNIT – 2 Microwave Network Theory and Passive Devices: 07 Hours

Introduction Properties of Z and Y matrices for reciprocal Networks, Scattering or S Matric representation of Multiport Network, Microwave Passive Components. Introduction and applications of Impedance and Equivalent voltages and currents, Impedance and Admittance matrices, The Transmission (ABCD) matrix Scattering Matrix: -Significance, formulation and properties. S-Matrix calculations for-2 port network junction, E plane, H-plane and E-H (Magic Tee) Tees, Directional coupler, Isolator and Circulator. Relatedproblems.

UNIT – 3 Microwave Tubes: 10 Hours

Limitations of conventional tubes, O and M type classification of microwave tubes, reentrant cavity, velocity modulation. O type tubes Two cavity Klystron: Construction and principle of operation, velocity modulation and bunching process Applegate diagram. Reflex Klystron: Construction and principle of operation, velocity modulation and bunching process, Applegate diagram, Oscillating modes, o/p characteristics, efficiency, electronic & mechanical tuning. M-type tubes Magnetron: Construction and Principle of operation of 8 cavity cylindrical travelling wave magnetron, hull cutoff condition, modes of resonance, PI mode operation, o/p characteristics, Applications. Slow wave devices Advantages of slow wave devices, Helix TWT: Construction and principle of operation, Applications.

UNIT – 4 Measurement devices and Microwave Measurements: 07 Hours

Measurement devices: Slotted line, Tunable detector, VSWR meter, Power Meter, S-parameter measurement, frequency measurements, Power measurement, Attenuation measurement, Phase shift measurement, VSWR measurement, Impedance measurement, Q of cavity resonator measurement.

UNIT – 5 Microwave Strip Lines Network Analysis and Microwave Hazards: 07 Hours

Striplines: Structural details and applications of Striplines, Microstrip line, Parallel Strip line, Coplanar Strip line, Shielded Strip Line.

Hazards: Hazards of Electromagnetic Radiation, Radiation Hazard Levels for Personnel, Radiation Hazard Limits and Radiation Protection.

TEXT/REFERENCE BOOKS:

1. Microwave Engineering – Annapurna Das, Sisir K Das TMH Publication, 2nd,2010
2. Microwave Devices and circuits- Liao / PearsonEducation
3. Antennas and Wave Propagation, John D. Krauss, Ronald J Marhefka and Ahmad S Khan, 4thSpecial Indian Edition, McGraw- Hill Education Pvt. Ltd.,2010.
4. Microwave Engineering – David M Pozar, John Wiley India Pvt. Ltd., 3rdEdn,2008
5. Microwave Engineering – Sushrut Das, Oxford Higher Education, 2ndEdn,2015
6. Antennas and Wave Propagation – Harish and Sachidananda: Oxford University Press, 2007.

BTETPE702A Digital Image Processing 4Credits

Course Objectives:

An ability to use current techniques, skills, and tools necessary for computing practice with an understanding of the limitations

Course Outcomes:

After completion of this course students will be able to

1. Review the fundamental concepts of digital image processing system.
2. Analyze images in the frequency domain using various transforms.
3. Categories various compression techniques.
4. Interpret image segmentation and representation techniques.

UNIT –1 Introduction: 07 Hours

Introduction to Digital Image Processing & Applications, Image Digitalization, Sampling, Quantization, Signal Reconstruction from Samples: Convolution Concept, Signal Reconstruction from Image using convolution, Basic Relationship Between Pixels: Relationship of Adjacency and Connected Components Labeling, Basic Transform: Translation, Rotation, Scaling, Image Formation

UNIT – 2 Image Transformation: 07 Hours

Image Geometry, Stereo Imaging Model, Interpolation and Resampling, Interpolation Techniques, Separable Transformation, Basis Images, Fourier transformation, Properties of FT, Rotation Invariance Property, DCT and Walsh Transform, Hadamard Transformation, KL-transform

UNIT – 3 Image Enhancement and morphological image processing: 07 Hours

Dilation, Erosion, Opening, Closing, Hit-miss transformation, Thinning, Thickening, Point Processing Techniques, Contrast Stretching Operation, Histogram Equalization, Histogram Implementation, Mask Processing Techniques: Linear smoothing filter, median filter, sharpening filter, Unsharp masking, High boost filter, first order derivative operator, Frequency Domain Processing Techniques: Smoothening (Ideal low pass filter, Butterworth LPF), Sharpening filters: (Ideal high pass filter, Butterworth HPF), Laplacianmask

UNIT – 4 Image Restoration and colour image processing: 07 Hours

Image restoration techniques: Inverse filtering, minimum mean square error (wiener) filtering, constrained least square filter, difference between image enhancement and image restoration, Image formation process, Estimation of degradation Model: by observation, by experimentation, Mathematical modeling, Primary and Secondary colours, colour characteristics, chromaticity diagram, RGB colour model, HIS colour model, conversion from one model to another, Pseudo color image processing

UNIT – 5 Image Segmentation and Object Recognition 07 Hours

Different approaches for image segmentation: discontinuity based (point, line and edge detection) and region based, global thresholding, local thresholding, Adaptive thresholding, Edge detection: Roberts operator, prewitt operator, sobel operator, Laplacian operator, linking of edge points: local processing and global processing (Hough transform), region based segmentation: region growing technique, region merging and splitting technique, object recognition.

TEXT/REFERENCE BOOKS:

1. Rafael C. Gonzalez and Woods, "Digital Image Processing", Addison Wesley,1998

2. A. K. Jain, "Digital Image Processing", PHI, New Delhi, 1997

3. Pratt W.K., "Digital Image Processing", 2nd Edition, John Wiley, New York,2001

4. Edward R. Dougherty, "Random Processes for Image and Signal Processing",PHI-2001

BTETPE702B RF Circuit Design 4Credits

Course Objectives:

1. To study RF issues related to active and passive components.
2. To study circuit design aspects at RF
3. To learn design and modeling of circuits at RF.

Course Outcomes:

After successfully completion of the course students will be able to

1. Understand behavior of passive components at high frequency and modeling of HF circuit.
2. Design HF amplifiers with gain bandwidth parameters.
3. Understand Mixer types and characteristics.
4. Gain the knowledge about PLLs and Oscillators with respect to their circuit topologies.

UNIT – 1 RF Behavior of Passive Components: 07 Hours

HF Resistors, HF Capacitors, HF Inductors, Chip Components. Circuit Board Considerations: Chip Resistors, Chip Capacitors, Surface Mounted Inductors.

UNIT – 2 Bandwidth Estimation: 07 Hours

Open Circuit Time Constant Method: Observations & Interpretations, Accuracy of OC τs, Considerations, and Design examples. Short Circuit Time Constant Method: Background, Observations & Interpretations, Considerations. Delay of a system in cascade, Rise time of systems in cascade, Relation between Rise Time and Bandwidth.

UNIT – 3 High Frequency Amplifier Design: 07 Hours

Shunt Peaked Amplifier, Shunt Series peak Amplifier, Two port bandwidth enhancement, Design example. Bandwidth enhancement techniques. Tuned Amplifier: Common Source Amplifier with Single Tuned Load, Analysis of Tuned Amplifier. Neutralization and uni lateralization. Characteristics of RF amplifier. Amplifier power relations. Stability considerations, Stabilization methods.

UNIT – 4 Low Noise Amplifier Design: 07 Hours

MOSFET two port noise parameters, LNA topologies, Power-constrained noise optimization. Design examples: Single ended LNA, Differential LNA. Linearity and large signal performance. Spurious free dynamic range.

UNIT – 5 Oscillators and Mixers: 07 Hours

Problem with Purely Linear Oscillators, Describing Functions, Describing Function for MOS. Colpitts Oscillator: Describing Function Model and Start-up Model of Colpitts Oscillator. Resonators: Quarter-Wave Resonators, Quartz Crystals. Tuned Oscillators: Basic LC Feedback Oscillators, Crystal Oscillator. Negative Resistance Oscillator.

Mixers: Mixer Fundamentals. Significant Characteristics of Mixer: Conversion Gain, Noise Figure, Linearity and Isolation, Spurs. Non-Linear Systems as Linear Mixers. Multiplier Based Mixers: Single Balanced Mixer, Linearization techniques of Mixer, Active Double Balanced Mixer. Passive Double Balanced Mixer, Diode Ring Mixers.

TEXT/REFERENCE BOOKS:

1. Reinhold Ludwig, Pavel Bretchko, “RF Circuit Design Theory and Applications”, Pearson Education.
2. Thomas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, Second Edition, Cambridge Publications.
3. T. Yettrdal, Yunhg Cheng, “Devices modeling for analog and RF COMS circuits design”, John Wiley publication.
4. Calvin Plett, “Radio frequency Integrated Circuits Design”, Artechhouse.

BTETPE702C Satellite Communication — 4 Credits

Course Objectives:

1. To provide students with good depth of knowledge in radar and Satellite communication.
2. Knowledge of theory and practice of advanced communication techniques e.g. TDMA, CDMA,FDMA.
3. This will equip the students for further studies and research knowledge of modern applications in radar and Satellite communication.

Course Outcomes:

At the end of the course, the students will have:

1. Knowledge of theory and practice related to radar and Satellite communication.
2. Ability to identify, formulate and solve engineering problems related to radar and Satellite communication.
3. The student would be able to analyze the various aspects of establishing a geo-stationary satellite communication link.
4. Acquired knowledge about Satellite Navigation System.
5. Acquired knowledge about Radar and Radar Equations.

UNIT – 1 Basic Principles and Earth Station: 07 Hours

Basic Principles: General features, frequency allocation for satellite services, properties of satellite communication systems.

Earth Station: Introduction, earth station subsystem, different types of earth stations.

UNIT – 2Satellite Orbits: **07 Hours**

Introduction, Kepler's laws, orbital dynamics, orbital characteristics, satellite spacing and orbital capacity, angle of elevation, eclipses, launching and positioning, satellite drift and station keeping.

UNIT – 3 Satellite Construction (Space Segment): **07 Hours**

Introduction; attitude and orbit control system; Telemetry Tracking and command; Power systems, communication subsystems, antenna subsystem, equipment reliability and space qualification.

UNIT – 4 Satellite Links: **07 Hours**

Introduction, general link design equation, system noise temperature, uplink design, downlink design, complete link design, effects of rain.

UNIT – 5 The Space Segment Access and Utilization: **07 Hours**

Introduction, space segment access methods: TDMA, FDMA, CDMA, SDMA, assignment methods.

The Role and Application of Satellite Communication

Introduction to Digital Satellite and Mobile Satellite Communication.

TEXT/REFERENCE BOOKS:

1. Timothy Pratt, Charles W. Bostian, Satellite Communications, John Wiley &Sons.
2. Dennis Roddy, Satellite Communications, 3rd Ed., McGraw-Hill International Ed.2001.
3. W. L. Pritchard, J. A. Sciulli, Satellite Communication Systems Engineering, Prentice-Hall, Inc.,NJ.
4. M. O. Kolawole, Satellite Communication Engineering, Marcel Dekker, Inc.NY.
5. Robert Gagliardi, "Satellite Communication" , CBSPublication.
6. Ha, "Digital Satellite Communication", McGraw- Hill.
7. Timothy Pratt and Charles Bostian, "Satellite Communications", John Wiley andSons.

BTETPE702D Fiber Optic Communication **4Credits**

Course Objectives:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
3. To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
4. Understand the functionality of each of the components that comprise a fiber-optic communication system: transmitter, fiber, amplifier, and receiver.
5. Understand the properties of optical fiber that affect the performance of a communication link.
6. Understand basic optical amplifier operation and its effect on signal power and noise in the system.
7. Apply concepts listed above to the design of a basic communication link.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the principles fiber-optic communication, the components and the bandwidth advantages.
2. Understand the properties of the optical fibers and optical components.
3. Understand operation of lasers, LEDs, and detectors.
4. Analyze system performance of optical communication systems.
5. Design optical networks and understand non-linear effects in optical fibers.

UNIT –1Introduction: **07 Hours**

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wavemodel.

UNIT – 2 Types of optical fibers: **07 Hours**

Different types of optical fibers, Modal analysis of a step index fiber, Signal degradation on optical fiber due to dispersion and attenuation. Fabrication of fibers and measurement techniques like OTDR.

UNIT – 3 Optical sources: 07 Hours

LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsively, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties

UNIT – 4 Optical switches and Optical amplifiers: 07 Hours

Coupled mode analysis of directional couplers, electro-optic switches. Optical amplifiers: EDFA, Raman amplifier, WDM and DWDM systems, Principles of WDM networks.

UNIT – 5 Non linear effects in fiber optic links: 07 Hours

Nonlinear effects in fiber optic links, Concept of self-phase modulation, group velocity dispersion and solition based communication.

TEXT/REFERENCE BOOKS:

1. J. Keiser, Fibre Optic communication, McGraw-Hill, 5th Ed. 2013 (Indian Edition).
2. T. Tamir, Integrated optics, (Topics in Applied Physics Vol.7), Springer-Verlag,1975.
3. J. Gowar, Optical communication systems, Prentice Hall India,1987.
4. S.E. Miller and A.G. Chynoweth, eds., Optical fibres telecommunications, Academic Press,1979.
5. G. Agrawal, Nonlinear fibre optics, Academic Press, 2nd Ed.1994.
6. G. Agrawal, Fiber optic Communication Systems, John Wiley and sons, New York,1997
7. F.C. Allard, Fiber Optics Handbook for engineers and scientists, McGraw Hill, New York (1990).

BTETPE702E Bio-medical Signal Processing 4 Credits

Course Objectives:

1. To understand the basic signals in the field of biomedical.
2. To study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, evoked potentials, and EMG.
3. To understand Sources and characteristics of noise and artifacts in biosignals.
4. To understand use of bio signals in diagnosis, patient monitoring and physiological investigation.
5. To explore research domain in biomedical signal processing.
6. To explore application of established engineering methods to complex biomedical signal problems.

Course Outcomes:

After successfully completing the course students will be able to:

1. The student will be able to model a biomedical system
2. The student will be able to understand various methods of acquiring bio signals.
3. The student will be able to understand various sources of bio signal distortions and its Remedial techniques
4. The students will be able to analyze ECG and EEG signal with characteristic feature points.
5. The student will have a basic understanding of diagnosing bio-signals and classifying them.

UNIT – 1 Introduction to Biomedical Signals: 07 Hours

ECG, EEG, EMG, ENG etc. Event related potentials Biomedical Signal Analysis- Computer Aided Diagnosis. Concurrent, coupled and correlated processes - illustration with case studies. Noise Filtering: Random noise structured noise and physiological interference- noise and artifacts in ECG.

UNIT – 2 Time domain filters and Frequency domain Filters: 07 Hours

Principles of adaptive filters- Winer Filtering- Steepest Descent algorithms- WidrowHopf Least mean square adaptive algorithms- Adaptive noise canceller- Interference cancellation in Electrocardiography- noise cancellation in electrosurgery.

UNIT – 3 Events Detection: 07 Hours

Detection of P, QRS and T waves in ECG- EEG rhythms- Correlation and coherence analysis of EEG channels- Detection of EEG spike and wave complexes- Homomorphic filtering. Analysis of event related potential – Morphological analysis of ECG waves- Envelope extraction and analysis- Analysis of activity: zero crossingrates.

UNIT – 4 Fourier Spectrum, Estimation of power spectral density and Modeling of Biomedical systems: 07Hours

Moments and spectral power ratio. Power Cepstrum- Complex Cepstrum Biomedical applications of Cepstrum analysis.

Modeling of Biomedical systems: Point processes- Parametric system modeling- All-pole, pole zero modeling, electromechanical models of signal generation. Analysis of non-stationary signals: Characterization- Fixed segmentation- Short Time Fourier Transform- Adaptive segmentation Adaptive filters for segmentation- RLS and Lattice Filter.

UNIT – 5 Pattern classification and diagnostic decision: 07 Hours

Supervised and unsupervised pattern classification Probabilistic models and statistical decisions- Logistic regression analysis- training and test steps neural networks- Measures of diagnostic accuracy and cost- Reliability of classifiers and decisions. Application: Normal versus Ectopic ECG beats- Detection of Knee Joint cartilagepathology.

TEXT/REFERENCE BOOKS:

1. Rangaraj M. Rangayyan, “Biomedical Signal Analysis: A case study Approach”, Wiley Interscience2002.24.
2. D. C. Reddy, “Biomedical Signal Processing: Principles and techniques”, Tata McGrawHill, NewDelhi,2005.
3. MetinAkay, “Biomedical Signal Processing”, Academic press,Inc.
4. Bruce, “Biomedical Signal Processing & Signal Modeling,” Wiley,2001.
5. Sornmo, “Bioelectrical Signal Processing in Cardiac & Neurological Applications”, Elsevier.
6. Semmlow, Marcel Dekker “Biosignal and Biomedical Image Processing”,2004.
7. Enderle, “Introduction to Biomedical Engineering,” 2/e, Elsevier,2005.

BTETPE702F Principles of Modern Radar Engineering 4 Credits

Course Objectives:

1. To list basic terminology, principles and concepts related to the modern RADAR systems and operation
2. To describe theory of operation of a simple RADAR including RADAR range equation, waveform design, Doppler effect, resolution, coverage and multipath
3. To explain how RADAR works and compare different type of RADAR system functionality, and configurations along with associated applications
4. To discuss principles, procedures, techniques and evolution of RADAR technology
5. To sketch a high-level architecture of a simple RADAR system covering components and subsystems including transmitters, receivers, antennas, clutter and noise, detection, signal processing modules
6. To provide detection, identification, and classification of objects/targets using different RADAR systems
7. To understanding environmental and terrain effects on RADAR operations RADAR

countermeasures target probability of detection and probability of falsealarm.

Course Outcomes:

8. Demonstrate an understanding of the factors affecting the radar performance using Radar Range Equation.
2. Analyze the principle of FM-CW radar and apply it in FM- CW Altimeter.
3. Differentiate between a MTI Radar and a Pulse Doppler Radar based on their working principle.
4. Demonstrate an understanding of the importance of Matched Filter Receivers in Radars.
5. Familiarize with the different types of Radar Displays and their application in real time scenario
6. Know the suitable measurement methodologies to characterize and verify the performance of radar systems
7. Design radar systems and to undertake measurements to characterize and verify the performance of radar systems

UNIT– 1 **07 Hours**

Basic Principles: Radar equation, Radar Cross section, CW Radar, FMCW Radar, Pulsed Radar Principles.

UNIT– 2 **07 Hours**

Clutter Analysis, MTI Improvement Factor, Pulsed Doppler Radar, Tracking Radar, Angular resolution, Mono pulse Technique.

UNIT– 3 **07 Hours**

Detection Theory: Match Filtering, Radar Ambiguity Function, Imaging Radar: Resolution Concept, Pulse Compression, Synthetic Aperture Processing, ISAR Imaging

UNIT– 4 **07 Hours**

Probability of false alarm and Detection, Modified Radar Range Equation with Swerling Models, Ground Penetrating Radar for close sensing

UNIT– 5 **07 Hours**

Radar Tomography and Radar based Microwave Imaging, Emerging and Modern Applications of Radar Principles

TEXT/REFERENCE BOOKS:

1. Introduction to Radar Systems, M.I. Skolnik, 3rdEdition, Tata Mcgraw hill edition,2001

2. Radar Systems Analysis and Design using MATLAB, B.R.Mahafza, 3rd Edition, CRC Press,2013
3. Monopulse Principles and Techniques, S.M.sherman and D.K.Barton, 2ndEdition,Artech house, 2011
4. Fundamentals of Radar Signal Processing, M.A.Richards, TMH,2005
5. Ground Penetrating Radar: Theory and Applications, Ed: H.M. Jolt, Elsevier,2009
6. Microwave Imaging, M.Pastorino, John Wiley,2010

BTETOE703A Wireless Sensor Networks 4 Credits

Course Objectives:

1. To introduce the emerging research areas in the field of wireless sensor networks
2. To understand different protocols and there uses in WSN.

Course Outcomes:

At the end of the course the students will be able to

1. Design wireless sensor networks for a given application
8. Understand emerging research areas in the field of sensor networks
9. Understand MAC protocols used for different communication standards used in WSN
10. Explore new protocols for WSN.

UNIT –1 Introduction: 07 Hours

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

UNIT –2 Networks: 07 Hours

Mobile Ad-hoc Networks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

UNIT –3 Protocols: 07 Hours

Routing protocols, MAC protocols: Classification of MAC Protocols, S-MAC Protocol, B-MAC protocol, IEEE 802.15.4 standard and ZigBee.

UNIT – 4 Dissemination protocol: 07 Hours

Dissemination protocol for large sensor network, Data dissemination, data gathering, and data fusion; Quality of a sensor network; Real-time traffic support and security protocols.

UNIT – 5 Design Principles for WSNs: 07 Hours

Design Principles for WSNs, Gateway Concepts Need for gateway, WSN to Internet

Communication, and Internet to WSN Communication.

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments.

TEXT/REFERENCE BOOKS:

1. WaltenegusDargie, Christian Poellabauer, “Fundamentals of Wireless Sensor Networks Theory and Practice”, By John Wiley & Sons Publications,2011.
2. SabrieSoloman, “Sensors Handbook" by McGraw Hill publication.2009
3. Feng Zhao, Leonidas Guibas, “Wireless Sensor Networks”, ElsevierPublications,2004
4. KazemSohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Interscience
5. Philip Levis, And David Gay "Tiny OS Programming” by Cambridge University Press 2009.

BTETOE703B Block Chain Technology 4 Credits

UNIT – 1 Introduction to Block chain: 07 Hours

History: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, and Privacy.

UNIT – 2 Block chain Architecture and Design and Consensus: 07 Hours

Basic crypto primitives: Hash, Signature, Hash chain to Block chain, Basic consensus mechanisms. Requirements for the consensus protocols, Proof of Work (PoW), Scalability aspects of Block chain consensus protocols, Permissioned Block chains: Design goals, Consensus protocols for Permissioned Block chains

UNIT – 3 Hyper ledger Fabric: 07 Hours

Hyper ledger Fabric I: Decomposing the consensus process, Hyper ledger fabric components, Chain code Design and Implementation

Hyper ledger Fabric II: Beyond Chain code: fabric SDK and Front End, Hyper ledger composer tool

UNIT – 4 Use Cases: 07 Hours

Use case I: Block chain in Financial Software and Systems (FSS): Settlements, KYC, Capital markets, Insurance.

Use case II: Block chain in tradesupply chain: Provenance of goods, visibility, trade supply chain finance, invoice management discounting, etc

Use case III: Block chain for Government: Digital identity, land records and other kinds of record keeping between government entities, public distribution system social welfare systems.

UNIT – 5 Block chain Cryptography Privacy and Security on Block chain: 07 Hours

Research aspects I: Scalability of Block chain consensus protocols, Case Study "Various recent works on scalability,

Research aspects II: Secure cryptographic protocols on Block chain, Case Study "Secured Multi-party Computation, Block chain for science: making better use of the data-mining network, Case Studies: Comparing Ecosystems - Bitcoin, Hyper ledger, Ethereum and more.

TEXT/REFERENCE BOOKS:

1. Mastering Bitcoin: Unlocking Digital Crypto currencies, by Andreas Antonopoulos
2. Blockchain by Melanie Swa,O'Reilly
3. Hyperledger Fabric -https://www.hyperledger.org/projects/fabric
4. Zero to Blockchain - An IBM Redbooks course, by Bob Dill, David Smits - https://www.redbooks.ibm.com/Redbooks.nsf/RedbookAbstracts/crse0401.html

BTETOE703C Cyber Security 4 Credits

Course Objectives:

1. For secured and under control since the information stored and conveyed is ultimately an invaluable resource of the business.
2. The growing number of the computer Network(internet/intranet) attacks and sophistication in attack technologies has made this task still morecomplicated
3. To update the knowledge of the personnel manning networks and systems on the network security issues and solutions.

Course Outcomes:

Students should be able to understand:

1. The difference between threat, risk, attack andvulnerability.
2. How threats materialize intoattacks.
3. Where to find information about threats, vulnerabilities andattacks.
4. Typical threats, attacks and exploits and the motivations behindthem.

UNIT – 1 Introduction to Cyber Security: 07 Hours

Overview of Cyber Security, Internet Governance – Challenges and Constraints, Cyber Threats – Cyber Warfare-Cyber Crime-Cyber Terrorism-Cyber Espionage, need for a Comprehensive Cyber Security Policy, Need for a Nodal Authority, Need for an International convention on Cyberspace.

UNIT – 2 Cyber Security Vulnerabilities and Cyber Security Safeguards: 07 Hours

Cyber Security Vulnerabilities-Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Poor Cyber Security Awareness. Cyber Security Safeguards- Overview, Access control, Audit, Authentication, Biometrics, Cryptography, Deception, Denial of Service Filters, Ethical Hacking, Firewalls, Intrusion Detection Systems, Response, Scanning, Security policy, Threat Management.

UNIT – 3 Securing Web Application, Services and Servers: 07 Hours

Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Security Considerations, Challenges.

Intrusion Detection and Prevention: Intrusion, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.

UNIT – 4 Cryptography and Network Security: 07 Hours

Introduction to Cryptography, Symmetric key Cryptography, Asymmetric key Cryptography, Message Authentication, Digital Signatures, Applications of Cryptography. Overview of Firewalls- Types of Firewalls, User Management, VPN Security Security Protocols: - security at the Application Layer- PGP and S/MIME, Security at Transport Layer- SSL and TLS, Security at Network Layer-IPSec.

UNIT – 5 Cyberspace and the Law, Cyber Forensics: 07 Hours

Introduction, Cyber Security Regulations, Roles of International Law, the state and Private

Sector in Cyberspace, Cyber Security Standards. The INDIAN Cyberspace, National Cyber Security Policy 2013 Introduction to Cyber Forensics, Handling Preliminary Investigations, Controlling an Investigation, Conducting disk-based analysis, Investigating Information-hiding, Scrutinizing E-mail, Validating E-mail header information, Tracing Internet access, Tracing memory in real-time.

TEXT/REFERENCE BOOKS:

1. Charles P. Pfleeger Shari Lawrence Pfleeger Jonathan Margulies, Security in Computing, 5th Edition, Pearson Education,2015
2. George K.Kostopoulous, Cyber Space and Cyber Security, CRC Press,2013.
3. MarttiLehto, Pekka Neittaanmäki, Cyber Security: Analytics, Technology and Automation edited, Springer International Publishing Switzerland2015.
1. NelsonPhillipsandEnfingerSteuart,―ComputerForensicsandInvestigations‖,Cengage Learning, New Delhi,2009.

BTETOE703D Mobile Computing 4Credits

Course Objectives:

1. To provide guidelines, design principles and experience in developing applications for small, mobile devices, including an appreciation of context and location aware services.
2. To introduce wireless communication and networking principles, that support connectivity to cellular networks, wireless internet and sensordevices.
3. To appreciate the social and ethical issues of mobile computing, including privacy.

Course Outcomes:

1. At the end of the course, the student will be able to demonstrate:
2. A working understanding of the characteristics and limitations of mobile hardware devices including their user-interface modalities
3. The ability to develop applications that are mobile-device specific and demonstrate current practice in mobile computing contexts.
4. A comprehension and appreciation of the design and development of context-aware solutions for mobile devices.
5. An awareness of professional and ethical issues, in particular those relating to security and privacy of user data and user behavior.

UNIT– 1 **07 Hours**

Mobile Computing, Mobile Computing vs. wireless Networking, Mobile Computing Applications, Characteristics of Mobile computing, Structure of Mobile Computing Application.

UNIT– 2 **07 Hours**

MAC Protocols, Wireless MAC Issues, Fixed Assignment Schemes, Random Assignment Schemes, Reservation Based Schemes.

UNIT– 3 **07 Hours**

Overview of Mobile IP, Features of Mobile IP, Key Mechanism in Mobile IP, route Optimization. Overview of TCP/IP, Architecture of TCP/IP- Adaptation of TCP Window, Improvement in TCP Performance, Global System for Mobile Communication (GSM), General Packet Radio Service (GPRS), Universal Mobile Telecommunication System (UMTS).

UNIT– 4 **07 Hours**

Ad-Hoc Basic Concepts, Characteristics, Applications, Design Issues, Routing, Essential of Traditional Routing Protocols, Popular Routing Protocols, Vehicular Ad Hoc networks (VANET), MANET vs. VANET, Security.

UNIT– 5 **07 Hours**

Mobile Device Operating Systems, Special Constrains & Requirements, Commercial Mobile Operating Systems, Software Development Kit: iOS, Android, BlackBerry, Windows Phone, M Commerce, Structure, Pros & Cons, Mobile Payment System, Security Issues.

TEXT/REFERENCE BOOKS:

1. Principles of Mobile Computing, 2nd Edition, UweHansmann, LotharMerk, Martin Nicklous, Thomas Stober,Springer
2. Mobile Computing, Tomasz Imielinski,Springer.

BTETOE703E Mobile Communication and Networks 4Credits

Course Objectives:

1. To provide an overview of Mobile Communication Networks area and its applications in communication engineering.
2. To appreciate the contribution of mobile communication networks to overall technological growth.
3. To explain the various terminology, principles, devices, schemes, concepts, algorithms and different methodologies used in Mobile Communication Networks.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand the working principles of the mobile communication systems.
2. Understand the relation between the user features and underlying technology.
3. Analyze mobile communication systems for improved performance.

UNIT – 1Cellularconcept: 07 Hours

Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

UNIT – 2 Signal propagation: 07 Hours

Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading-Doppler shift, statistical multipath channel models, narrowband and wideband fading models, power delay profile, average and rms delay spread, coherence bandwidth and coherence time, flat and frequency selective fading, slow and fast fading, average fade duration and level crossing rate, Capacity of flat and frequency selective channels.

UNIT – 3 Antennas and Multiple access schemes: 07 Hours

Antennas for mobile terminal- monopole antennas, PIFA, base station antennas and arrays. FDMA, TDMA, CDMA and SDMA, Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM

UNIT – 4 Receiver structure: 07 Hours

Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme, MIMO and space time signal processing, spatial multiplexing, diversity/multiplexing tradeoff

UNIT – 5 Performance measures: 07 Hours

Outage, average SNR, average symbol/bit error rate, System examples- GSM, EDGE, GPRS, IS-95, CDMA 2000 and WCDMA.

TEXT/REFERENCE BOOKS:

1. WCY Lee, Mobile Cellular Telecommunications Systems, McGraw Hill,1990.
2. WCY Lee, Mobile Communications Design Fundamentals, Prentice Hall,1993.
3. Raymond Steele, Mobile Radio Communications, IEEE Press, New York,1992.
4. AJ Viterbi, CDMA: Principles of Spread Spectrum Communications, Addison Wesley, 1995.
5. VK Garg &JE Wilkes, Wireless & Personal Communication Systems, Prentice Hall, 1996.

BTETOE703F EMI and EMC 4 Credits

Course Objectives:

1. To provide an overview of EMI and EMC
2. To provide the knowledge to compare and contrast the strengths and weaknesses of various errors correctingcode

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Be familiar with importance of error correction methods in data communication and storage.
2. Have gained experience of use of mathematical tools from from groups and finite fields, in the design of codes and sequences.
3. Develop an ability to compare and contrast the strengths and weaknesses of various errors correcting code for a given application.
4. Develop and model different error correcting codes for appraise of reaching data rate to Shannon limit.
5. Demonstrate competence in analyzing and evaluating the practice of different error correcting coded in digital communication system

UNIT –1 Introduction: 07 Hours

History of EMI/EMC, Analysis of EMI, Type of Noise and Interference, Electromagnetic Compatibility, Benefits of Good EMC Design, EMC Regulations (Government, Commercial And Military), Examples of EMC Related Problems.

UNIT–2 EMC requirements for electronic systems: 07 Hours

Radiated Emission Limits For Class A, Class B, FCC And CICPR, Measurement of Emissions For Verification of Compliance, Radiated Emission And Susceptibility, Conducted Emissions And Susceptibility, Typical Product Emissions, Additional Product Requirements, Design Constraints For Products, Advantages of EMC Design.

UNIT–3 Conducted emission and susceptibility: 07 Hours

Measurement of Conducted Emission: LISN, Common And Differential Mode Currents, Power Supply Filters, Basic Properties of Filters, A Generic Topology, Effect of Filter Elements on Common And Differential Mode Currents, Separation of Conducted Emissions In to Common And Differential Mode Components For Diagnostic Purpose, Power Supplies: Linear And SMPS, Effect of Power Supply Components on Conducted Emissions, Power Supply And Filter Placement, Conducted Susceptibility.

UNIT–4 Radiated emission and susceptibility: 07 Hours

Simple Emission Models For Wires and PCB Lands: Differential Mode versus Common Mode Currents, Differential Mode Current Emission Model, Common Mode Current Emission Model, Current Probes, Simple Susceptibility Models for Wires and PCB Lands: Shielded Cables and Surface Transfer Impedance.

UNIT–5 Shielding and system design for EMC: 07 Hours

Shielding Effectiveness, Far Field Sources, Exact Solution, and Approximate Solution, Near Field Sources: Near Field Versus Far Field, Electric Sources, Magnetic Sources, Low Frequency, Magnetic Fielding Shielding, And Effect of Apertures.

Shielding and Grounding, PCB Design, System Configuration and Design, Electrostatic Discharge, Diagnostic Tools.

TEXT/REFERENCE BOOKS:

1. Paul Clayton,"Introduction to Electromagnetic Compatibility", Wiley Interscience, 2nd Ed., 2006.
2. Ott H. W.,"Noise Reduction Techniques in Electronic Systems", Wiley Interscience, 2nd Ed., 1988.
3. Goedbloed,"Electromagnetic Compatibility", Prentice Hall, 1st English Language Ed., 1993
4. Kaiser K. L.,"Electromagnetic Shielding", CRC Press, 1st Ed.,2006.
5. Stallings W.,"Cryptography and Network Security Principles and Practices", Pearson Education, 3rd Ed.,2007.
6. Michel Mardiguian,"EMI Troubleshooting Techniques", McGraw-Hill Professional, 1st Ed., 1999.

BTETOE704A Soft Computing 4Credits

Course Objectives:

1. Introduce a relatively new computing paradigm for creating intelligent machines useful for solving complex real-world problems.
2. Insight into the tools that make up the soft computing technique: fuzzy logic, artificial neural networks and hybrid systems Techniques.
3. To create awareness of the application areas of soft computing technique.
4. Provide alternative solutions to the conventional problem-solving techniques in image/signal processing, pattern recognition/classification, control system.

Course Outcomes:

After the successful completion of this course, students will be able to:

1. Use a new tool /tools to solve a wide variety of real-world problems.
2. Find an alternate solution, which may offer more adaptability, resilience and optimization.
3. Identify the suitable antenna for a given communication system.
4. Gain knowledge of soft computing domain which opens up a whole new career option.
5. Tackle real world research problems.

UNIT – 1 Artificial Neural Network–I: 07 Hours

Biological neuron, Artificial neuron model, concept of bias and threshold, McCulloch‐ Pits Neuron Model, implementation of logical AND, OR, XOR functions Soft Topologies of neural networks, learning paradigms: supervised, unsupervised, reinforcement, Linear neuron model: concept of error energy, gradient descent algorithm and application of linear neuron for linear regression, Activation functions: binary, bipolar (linear, signup, log sigmoid, tan sigmoid)Learning mechanisms: Hebbian, Delta Rule o Perceptron and its limitationsDraft.

UNIT – 2 Artificial Neural Network-II: 07 Hours

Multilayer perceptron (MLP) and back propagation algorithm o Application of MLP for classification and regression o Self‐ organizing Feature Maps, k‐ means clustering o Learning vector quantization Radial Basis Function networks: Cover"s theorem, mapping functions (Gaussian, Multi-quadrics, Inverse multi quadrics, Application of RBFN for classification and regression o Hopfield network, associativememories.

UNIT – 3 Fuzzy Logic –I: 07 Hours

Concept of Fuzzy number, fuzzy set theory (continuous, discrete) o Operations on fuzzy sets, Fuzzy membership functions (core, boundary, and support), primary and composite linguistic terms, Concept of fuzzy relation, composition operation (T-norm,T‐conorm) o Fuzzy if-then rules.

UNIT – 4 Fuzzy Logic –II: 07 Hours

Fuzzification, Membership Value Assignment techniques, De‐fuzzification (Max membership principle, Centroid method, Weighted average method), Concept of fuzzy inference, Implication rules- Dienes‐Rescher Implication, Mamdani Implication, Zadeh Implication, Fuzzy Inference systems ‐Mamdani fuzzy model, Sugeno fuzzy model , Tsukamoto fuzzy model, Implementation of a simple two‐input single output FIS employing Mamdani model Computing.

UNIT – 5 Fuzzy Control Systems and Adaptive Neuro-Fuzzy Inference Systems (ANFIS): 07Hours

Control system design problem 1.5, Control (Decision) Surface, Assumptions in a Fuzzy Control System Design V, Fuzzy Logic Controllers Soft o Comparison with traditional PID control, advantages of FLC, Architecture of a FLC: Mamdani Type, Example Aircraft landing control problem.

ANFIS architecture, Hybrid Learning Algorithm, Advantages and Limitations of ANFIS Application of ANFIS/CANFIS for regression.

TEXT/REFERENCE BOOKS:

1. Fundamentals of Neural Networks: Architectures, Algorithms and Applications, LaureneFausett, Pearson Education, Inc,2008.
2. Fuzzy Logic with Engineering Applications, Third Edition Thomas, Timothy Ross, John Wiley & Sons,2010.
3. Neuro- Fuzzy and Soft Computing, J.S. Jang, C.T. Sun, E. Mizutani, PHI Learning Private Limited.
4. Principles of Soft Computing, S. N. Sivanandam, S. N. Deepa, John Wiley & Sons,2007.
5. Introduction to the theory of neural computation, John Hertz, Anders Krogh, Richard Palmer, Addison –Wesley Publishing Company,1991.
6. Neural Networks A comprehensive foundation,, Simon Haykin, Prentice Hall InternationalInc-1999.
7. NeuralandAdaptiveSystems:FundamentalsthroughSimulations,JoséC.PrincipeNeil R. Euliano, W. Curt Lefebvre, John-Wiley & Sons, 2000.
8. Pattern Classification, Peter E. Hart, David G. Stork Richard O. Duda, Second Edition, 2000.
9. Pattern Recognition, SergiosTheodoridis, KonstantinosKoutroumbas, Fourth Edition, Academic Press,2008.
10. A First Course in Fuzzy Logic, Third Edition, Hung T. Nguyen, Elbert A. Walker, Taylor & Francis Group, LLC,2008.
11. Introduction to Fuzzy Logic using MATLAB, S. N. Sivanandam, S. Sumathi, S. N. Deepa, Springer Verlag,2007.

BTETOE704B Big Data Analytics **4 Credits**

Course Objectives:

1. To provide an overview of an exciting growing field of Big Data analytics.
2. To discuss the challenges traditional data mining algorithms face when analyzing Big Data.
3. To introduce the tools required to manage and analyze big data like Hadoop, NoSql Map Reduce.
4. To teach the fundamental techniques and principles in achieving big data analytics with scalability and streaming capability
5. To introduce to the students several types of big data like social media, web graphs and data streams
6. To enable students to have skills that will help them to solve complex real-world problems in for decision support.

Course Outcomes:

At the end of this course, Students will able to:

1. Explain the motivation for big data systems and identify the main sources of Big Data in the real world.
2. Demonstrate an ability to use frameworks like Hadoop, NOSQL to efficiently store retrieve and process Big Data for Analytics.
3. Implement several Data Intensive tasks using the Map Reduce Paradigm
4. Apply several newer algorithms for Clustering Classifying and finding associations in BigData.

UNIT – 1 Big Data Platforms: **07 Hours**

Big Data Platforms for the Internet of Things: network protocol- data dissemination –current state of art- Improving Data and Service Interoperability with Structure, Compliance, Conformance and Context Awareness: interoperability problem in the IoT context- Big Data Management Systems for the Exploitation of Pervasive Environments - Big Data challenges and requirements.

UNIT – 2YATRAP: **07 Hours**

YA TRAP – Necessary and sufficient condition for false authentication prevention - Adaptive Pipelined Neural Network Structure in Self-aware Internet of Things: self-healing systems

Role of adaptive neural network- Spatial Dimensions of Big Data: Application of Geographical Concepts and Spatial Technology to the Internet of Things- Applying spatial relationships, functions, and models.

UNIT – 3 Fog Computing: 07 Hours

Fog Computing: A Platform for Internet of Things and Analytics: a massively distributed number of sources - Big Data Metadata Management in Smart Grids: semantic inconsistencies - role of metadata.

UNIT – 4 Web Enhanced Building and Technologies for Healthcare: 07 Hours

Toward Web Enhanced Building Automation Systems: heterogeneity between existing installations and native IP devices - loosely-coupled Web protocol stack –energy saving in smart building- Intelligent Transportation Systems and Wireless Access in Vehicular Environment Technology for Developing Smart Cities: advantages and achievements.

Emerging Technologies in Health Information Systems: Genomics Driven Wellness Tracking and Management System (GO-WELL) – predictive care – personalized medicine.

UNIT – 5 Sustainability Data and Analytics: 07 Hours

Sustainability Data and Analytics in Cloud-Based M2M Systems - potential stakeholders and their complex relationships to data and analytics applications - Social Networking Analysis - Building a useful understanding of a social network - Leveraging Social Media and IoT to Bootstrap Smart Environments: lightweight Cyber Physical Social Systems - citizen actuation.

TEXT/REFERENCE BOOKS:

1. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.," Big Data and the Internet of Things Enterprise Information Architecture for A New Age", Apress, 2015. 2. Dr. John Bates, "Thingalytics - Smart Big Data Analytics for the Internet of Things", john Bates,2015.
2. Dr. John Bates, "Thingalytics - Smart Big Data Analytics for the Internet of Things", john Bates,2015.

BTETOE704C Data Structure & Algorithms Using Java Programming 4 Credits

Prerequisites: Basic knowledge of Java Programming fundamentals required.

Course Objectives:

1. To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
2. To choose the appropriate data structure and algorithm design method for a specified application.
3. To study the systematic way of solving problems, various methods of organizing large amounts ofdata.
4. To solve problems using data structures such as linear lists, stacks, queues, binary trees, binary search trees, and graphs and writing programs for these solutions.
5. To employ the different data structures to find the solutions for specific problems

Course Outcomes:

On completion of the course, student will be able to:

1. To impart the basic concepts of data structures and algorithms.
2. To understand concepts about searching and sorting techniques
3. Describe how arrays, records, linked structures are represented in memory and use them in algorithms.
4. To understand basic concepts about stacks, queues, lists trees and graphs.
5. To enable them to write algorithms for solving problems with the help of fundamental data structures.

UNIT –1 Introduction: 07 Hours

Basic Terminologies: Elementary Data Organizations, Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis

UNIT – 2 Stacks and Queues: 07 Hours

ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their analysis.

UNIT – 3 Linked Lists: **07 Hours**

Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Header nodes, doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexityanalysis.

UNIT –4Trees: **07 Hours**

Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Binary Search Tree, AVL Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis.

UNIT – 5 Sorting and Hashing: **07 Hours**

Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexityanalysis.

TEXT/REFERENCE BOOKS:

1. Algorithms, Data Structures, and Problem Solving with C++", Illustrated Edition by Mark Allen Weiss, Addison-Wesley PublishingCompany
2. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, PearsonEducation.
3. Ellis Horowitz, SartajSahni, "Fundamentals of Data Structures", Galgotia Books Source. ISBN 10:0716782928.
4. Richard F. Gilberg&Behrouz A. Forouzan, Data Structures: A Pseudocode Approach with C, Cengage Learning, second edition. ISBN-10:0534390803.
5. Seymour Lipschutz, Data Structure with C, Schaum"s Outlines, Tata Mc Graw Hill. ISBN-10:1259029964.
6. E Balgurusamy - Programming in ANSI C, Tata McGraw-Hill, Third Edition. ISBN-10: 1259004619.
7. YedidyahLangsam, Moshe J Augenstein, Aaron M Tenenbaum – Data structures using C and C++ - PHI Publications, Second Edition). ISBN 10:8120311779.

BTETOE704D Entrepreneurship Development **4Credits**

Course Objectives:

1. To Develop and Strengthen Entrepreneurial Quality and Motivation in Students and To Impart Basic Entrepreneurial Skills and Understanding to Run a Business Efficiently and Effectively.
2. The students develop and can systematically apply an entrepreneurial way of thinking that will allow them to identify and create business opportunities that may be commercialized successfully.

Course Outcomes:

After the completion of the course, the students will be able to:

1. Have the ability to discern distinct entrepreneurial traits.
2. Know the parameters to assess opportunities and constraints for new business ideas.
3. Understand the systematic process to select and screen a business idea.
4. Design strategies for successful implementation of ideas.
5. Write a business plan.

UNIT –1Entrepreneurship: **07 Hours**

Entrepreneur – Types of Entrepreneurs – Difference Between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT –2 Motivation: **07 Hours**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT –3 Business: **07 Hours**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps Involved in Setting Up A Business – Identifying, Selecting A Good Business Opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT – 4 Financing and Accounting: **07 Hours**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of Working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – SalesTax.

UNIT – 5 Support to Entrepreneurs: **07 Hours**

Sickness in Small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in Small Industry – Expansion, Diversification, Joint Venture, Merger And Sub Contracting.

TEXT/REFERENCE BOOKS:

1. Khanka. S.S., “Entrepreneurial Development” S. Chand & Co. Ltd., Ram Nagar, New Delhi,2013.
2. Donald F Kuratko, “Entreprenuership – Theory, Process and Practice”, 9th Edition, Cengage Learning2014.
3. Hisrich R D, Peters M P, “Entrepreneurship” 8th Edition, Tata McGraw-Hill,2013.
4. Mathew J Manimala, “Enterprenuership Theory At Cross Roads: Paradigms and Praxis” 2nd Edition Dream Tech,2005.
5. Rajeev Roy, „Entrepreneurship‟ 2nd Edition, Oxford University Press,2011.
6. EDII “Faulty and External Experts – A Hand Book For New Entrepreneurs Publishers: Entrepreneurship Development”, Institute of India, Ahmadabad,1986.
8. , Design of analog filters by, Prentice-Hall 1990 (or neweradditions).
9. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford University Press, First Indian edition,2008.

BTETOE704E Software Defined Radio 4 Credits

Course Objectives:

1. The objective of this course is to provide knowledge of fundamental and state-of the art concepts in software defined radio.

2. To understand the various components of software-defined-radios with the understanding of their limitation and application of „software-defined-solutions" to overcome suchlimitations.
3. To Understanding the interplay of analog and digital signal processing for power as well as spectrum efficient transmission and reception of signal leads to an optimized, yet, practical radiosolution.

Course Outcomes:

1. The student will study Needs, Characteristics, Benefits and Design Principles of a Software Radio.
2. The student will be study design aspects of software radios.
3. The student will understand concept of Smart Antennas.
4. The student will study key hardware elements and related Trade-Offs.

UNIT – 1 Fundamentals of SDR: 07 Hours

Software Radios, Needs, Characteristics, Benefits, Design Principles of a Software Radio, Radio frequency implementation issues, Principal Challenge of Receiver Design

UNIT – 2 RF and SDR: 07 Hours

RF Receiver Front-End Topologies, Enhanced Flexibility of the RF Chain with Software Radios, Transmitter Architectures and their issues, Noise and Distortion in the RF Chain, Timing Recovery in Digital Receivers Using Multirate Digital Filters

UNIT – 3 Signals in SDR: 07 Hours

Approaches to Direct Digital Synthesis, Analysis of Spurious Signals, Spurious Components due to Periodic Jitter, Band-pass Signal Generation, Hybrid DDS-PLL Systems, Generation of Random Sequences, Parameters of data converters

UNIT – 4 Smart Antennas: 07 Hours

Concept of Smart Antennas, Structures for Beam-forming Systems, Smart Antenna Algorithms, Digital hardware choices, Key Hardware Elements, DSP Processors, Field Programmable Gate Arrays, Trade-Offs in Using DSPs, FPGAs and ASICs.

UNIT – 5 Case studies in Radio System: **07 Hours**

Power Management Issues, Object-oriented representation of radios and network resources, Mobile Application Environments, Joint Tactical Radio System, Case studies in software radio design.

TEXT/REFERENCE BOOKS:

1. Jeffrey H. Reed, "Software Radio: A Modern Approach to Radio Engineering", Prentice Hall PTR; May 2002 ISBN:0130811580
2. Dillinger, Madani, Alonistioti (Eds.), "Software Defined Radio, Architectures, Systems and Functions", Wiley2003
3. Bard, Kovarik, "Software Defined Radio, The Software Communications Architecture", Wiley2007
4. Johnson, C.R. and W.A. Sethares, "Telecommunication Breakdown: Concepts of Communication Transmitted via Software-Defined Radio, Pearson Prentice Hall,2004
5. Bard, John and Kovarik, Vincent, "Software Defined Radio: The Software Communications Architecture", Wiley Series in Software Radio,2007.

BTETOE704F E Waste Management **4 Credits**

Course Objectives:

1. To understand the problems of municipal waste, biomedical waste, hazardous waste, e-waste, industrial waste etc
2. To understand health and environmental issues related to E waste and management.

UNIT– 1 **07 Hours**

E-Waste Overview, E-waste Management Overview

UNIT– 2 **07 Hours**

Environmental and Public Health Issues, E-waste Health Risk Assessment

UNIT– 3 **07 Hours**

Environmental and Public Health Issues, Recovery of Materials from E-Waste

UNIT– 4 **07 Hours**

Metal Recovery Process, Recovery of Metals from Electronic Waste

UNIT– 5 **07 Hours**

E-waste Management, Electronics and LCA, LCA applications for Electronics

TEXT BOOKS/REFERENCES:

1. G H Eduljee, R M Harrison, “Electronic Waste Management” 2nd edition.
2. Hugo Marcelo Veit, Andréa Moura Bernardes, “Electronic Waste: Recycling Techniques”Springer.
3. Anish Khan, Inamuddin, Abdullah M. Asiri, “E-waste Recycling and Management: Present Scenarios and Environmental Issues”Springer.

BTHM705 Engineering Economics and Financial Mathematics 3 Credits

Course Objective:

- After completing this course, students will be able to conduct simple economic studies. They will also be able to make evaluation of engineering projects and make decisions related to investment.

UNIT – 1 Introduction Engineering Economy: **07 Hours**

Introduction to Economics- Flow in an economy, Law of supply and demand, Concept of Engineering − Economics − Engineering efficiency, Economic efficiency, Scope of engineering economics − Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis, P − V ratio, Elementary economic Analysis− Material selection for product, Design selection for a product, Process planning.

UNIT – 2 Value Engineering: **07 Hours**

Make or buy decision, Value engineering − Function, aims, Value engineering procedure. Interest formulae and their applications− Time value of money, Single payment compound amount factor, Single payment present worth factor, Equal payment series sinking fund factor,EqualpaymentseriespaymentPresentworthfactor–equalpaymentseriescapital recovery factor − Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

UNIT – 3 Cash Flow: **07 Hours**

Methods of comparison of alternatives − Present worth method (Revenue dominated cash flow diagram), Future worth method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), Annual equivalent method (Revenue dominated cash flow diagram, Cost dominated cash flow diagram), rate of return method, Examples in all the methods.

UNIT – 4 Replacement And Maintenance Analysis: **07 Hours**

Replacement and Maintenance analysis − Types of maintenance, types of replacement problem, determination of economic life of an asset, Replacement of an asset with an ewasset − capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely.

UNIT –5 Depreciation: **07 Hours**

Depreciation − Introduction, Straight line method of depreciation, − Declining balance method of depreciation − Sum of the years digits method of depreciation, − Sinking fund method of depreciation/Annuity method of depreciation, service output method of depreciation − Evaluation of public alternatives − Introduction − Examples – Inflation adjusted decisions − Procedure to adjust inflation, Examples on comparison of alternatives and determination of economic life of asset.

TEXT BOOKS/REFERENCES:

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi,2001.
2. Suma Damodaran, " Managerial economics", Oxford university press2006
3. A Text book of Economic Theory: by stonier and hauge,pearsonPublication.
4. Modern Economic Theory: by Sampat Mukherjee, New Age InternationalPublisher
5. Engineering Economics: by Degramo, prenticeHall.
6. International Economics: by Bo Sodersten,Macmillan.

7. Principle of Macroeconomics : by Rangarajan and Dholokia, Tata McGrawHill.
8. Monetary Economics: by SurajB.Gupta, Schand.
9. Project planning analysis, Selection, Implementation and review: by Prasanna Chandra, Tata McGraw Hill Education.8.Cost Accounting: by Jawahar Lal ,McGrawHill.

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM NPTEL

Sr. No	SEMESTER	COURSE CODE	NAME OF SUBJECT AS PER CURRICULUM	SWAYAM / NPTEL COURSE	NAME OF THE INSTITUTE OFFERING COURSE	RELEVANCE %	DURATION OF COURSE
1	SEM-III	BTBS301	Engineering Mathematics – III	Differential equations for engineers	IIT Madras	80%	12 WEEK
2		BTETC302	Electronic Devices & Circuits	Fundamentals of semiconductor devices	IISc Bangalore	80%	12 WEEK
3		BTETC303	Digital Electronics	Digital Circuits	IIT Madras	60%	14 WEEK
4		BTES304	Electrical Machines and Instruments	Electrical Machines - I	IIT Kharagpur	70%	12 WEEK
5	SEM-IV	BTETC401	Network Theory	Network Analysis	IIT Kharagpur.	80%	12 WEEK
6		BTETC402	Signals and Systems	Signals and Systems	IIT Bombay	90%	11 WEEK
7		BTHM403	Basic Human Rights	Human Rights, International Law and International Humanitarian Law	O.P. Jindal Global University	80%	08 WEEK
8		BTBS404	Probability Theory and Random Processes	Probability and Random rocesses(Video)	IIT Kharagpur.	90%	12 WEEK
9		BTETPE405 A	(A) Numerical Methods and Computer Programming	Numerical Methods and Computations	IIT Delhi	60%	12 WEEK
		BTETPE405 B	(B) Data Compression & Encryption	Multimedia Processing (Web)	IIT Kharagpur.	90%	09 WEEK
		BTETPE405 C	(C) Computer Organization and Architecture	Computer Arcitecture and Organization	IIT Kharagpur.	80%	09 WEEK
		BTETPE405 D	(D) Introduction to MEMS	MEMs and Microsystems	IIT Kharagpur.	90%	9 WEEK
		BTETPE405 E	(E) Python Programming	Programming, Data Structures and Algorithms using Python	IIT Madras	40%	8 WEEK
10	SEM-V	BTETC501	Electromagnetic Field Theory	Electomagnetic Theory	IIT KHARAGPUR	90%	12 WEEK
11		BTETC502	Digital Signal Processing	Digital Signal Processing	IIT Delhi	90%	12 WEEK
12		BTETC503	Analog Communication	Analog Communication	IIT KHARAGPUR	90%	12 WEEK
13		BTETPE504 A	(A) Analog Circuits	Analog Circuits	IIT Delhi	70%	12 WEEK

		BTETPE504 B	(B) Embedded System Design	Embedded System Design	IIT KHARAGPUR	70%	6 WEEK
		BTETPE504 C	(C) Digital System Design	Digital System Design	IIT KHARAGPUR	70%	6 WEEK
		BTETPE504 E	(E) Mixed Signal Design	Mixed Signal Design	IITBombay	90%	8 WEEK
		BTETPE504 F	(F) Power Electronics	Power Electronics	IIT DELHI	55%	12 WEEK
14		BTETOE505 A	(A) Control System Engineering	Control Engineering	IIT Madras	90%	12 WEEK
		BTETOE505 B	(B) Artificial Intelligence and Machine learning	Introduction to AI	IIT DELHI	90%	12 WEEK
		BTETOE505 D	(D) Project Management and Operation Research	Project Management for managers	IIT ROORKEE	90%	12 WEEK
		BTETOE505 E	(E) Augmented, Virtual and Mixed Reality	Virtual Reality	IIT Madras	90%	12 WEEK
15	SEM-VI	BTETC601	Antennas and Wave Propagation	Antennas	IIT Bombay	70%	12 WEEK
16		BTETC602	Digital Communicatio n	Principles of Digital Communication	IIT DELHI	50%	12 WEEK
17		BTETPE603 A	(A) Microprocessor s and Microcontroller s	Microprocessors And Microcontrollers	IIT KHARAGPUR	90%	12 WEEK
17		BTETPE603 B	(B) CMOS Design	CMOS Digital VLSI Design	IIT ROORKEE	30%	8 WEEK
		BTETPE603 D	(D) Advanced Digital Signal Processing	Multirate DSP	IIT Madras	25%	12 WEEK
		BTETPE603 E	(E) Information Theory and Coding	Information Theory	IISC BANGLORE	40%	12 WEEK
		BTETPE603 F	(F) VLSI Signal Processing	VLSI Signal Processing	IIT KHARAGPUR	30%	8 WEEK
		BTETPE603 G	(G) VLSI Design & Technology	CMOS Digital VLSI Design	IIT ROORKEE	20%	8 WEEK
18		BTETOE604 A	(A) IoT and Industry 4.0	Introduction to Industry 4.0 and Industrial Internet of Things	IIT KHARAGPUR	90%	12 WEEK
		BTETOE604 B	(B) Deep Learning	Deep Learning	IIT KHARAGPUR	25%	12 WEEK
		BTETOE604 C	(C) Computer Network	Computer Networks and Internet Protocol	IIT KHARAGPUR	70%	12 WEEK

		BTETOE604 F	(F) Patents and IPR	Patent Search for Engineers and Lawyers	IIT KHARAGPUR	20%	8 WEEK
19	SEM-VII	BTETC701	Microwave Engineering	Microwave theory and Technique	IIT Bombay	60%	12 WEEK
20		BTETPE702 A	(A) Digital Image Processing	Digital Image Processing	IIT KHARAGPUR	70%	12 WEEK
		BTETPE702 D	(D) Fiber Optic Communication	Optical Engineering	IIT Madras	50%	12 WEEK
21		BTETOE703 A	(A) Wireless Sensor Networks	Principles of modern CDMA/MIMO/OFDM,Wireless communication,Introduction to wireless and cellular communication	IIT KANPUR	30%	8 WEEK
		BTETOE703 D	(D) Mobile Computing	Cloud computing	IIT KHARAGPUR	25%	8 WEEK
		BTETOE703 E	(E) Mobile Communication and Networks	Introduction to wireless and cellular communication	IIT Madras	60%	12 WEEK
22		BTETOE704 B	(B) Big Data Analytics	Data science and Engineering	IIT Madras	60%	8 WEEK
		BTETOE704 C	(C) Data Structure & Algorithms Using Java Programming	Data Structure & Algorithms Using Java	IIT Kharagpur	60%	12 WEEK

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM COURSERA

Sr. No	SEMESTER	COURSE CODE	NAME OF SUBJECT AS PER CURRICULUM	COURSERA COURSE	NAME OF THE INSTITUTE OF OFFERING COURSE	RELEVANCE %	DURATION OF COURSE
1	SEM-III	BTBS301	Engineering Mathematics – III	Differential Equations for Engineers	The Hong Kong University of Science and Technology (HKUST)	70%	6 WEEK
2		BTETC302	Electronic Devices & Circuits	Introduction to Electronics	The Georgia Institute of Technology	80%	7 WEEK
3		BTETC303	Digital Electronics	Digital Systems: From Logic Gates to Processors-	Universitat Autònoma de Barcelona	70%	8 WEEK
4		BTES304	Electrical Machines and Instruments	Motors and Motor Control Circuits	University of Colorado Boulder	60%	5 WEEK
5	SEM-IV	BTETC401	Network Theory	Linear Circuits 1: DC Analysis	The Georgia Institute of Technology	60%	7 WEEK
6		BTETC402	Signals and Systems	Digital Signal Processing 3: Analog vs Digital	École Polytechnique Fédérale de Lausanne	60%	4 WEEK
7		BTHM403	Basic Human Rights	Human Rights for Open Societies	Utrecht University	60%	6 WEEK

8		BTBS404	Probability Theory and Random Processes	Probability Theory, Statistics and Exploratory Data Analysis	National Research University Higher School of economics	80%	6 WEEK
9		BTETPE405 A	(A) Numerical Methods and Computer Programming	Introduction to numerical analysis	National Research University Higher School of Economics	50%	7 WEEK
		BTETPE405 C	(C) Computer Organization and Architecture	Computer Architecture	Princeton University	80%	11 WEEK
		BTETPE405 E	(E) Python Programming	Python Data Structures	University of Michigan	80%	7 WEEK
10	SEM-V	BTETC502	Digital Signal Processing	Digital Signal Processing 2: Filtering	École Polytechnique Fédérale de Lausanne	70%	3 WEEK
11		BTETPE504 B	(B) Embedded System Design	Embedded Hardware and Operating System	University of Turku,Finland	30	3 WEEK
		BTETPE504 F	(F) Power Electronics	Converter Circuits	University of Colorado Boulder	60%	4 WEEK
12		BTETOE505 B	(B) Artificial Intelligence and Machine learning	Machine Learning	Stanford University	70%	11 WEEK
		BTETOE505 C	(C) Optimization Techniques	Discrete Optimization	MelbourneUnivers ity	70%	8 WEEK
		BTETOE505 D	(D) Project Management and Operation Research	Managing Project Risks and Changes	University of California, Irvine	50%	5 WEEK
		BTETOE505 E	(E) Augmented, Virtual and Mixed Reality	Introduction to XR: VR, AR, and MR Foundations	Unity Technologies	60%	4 WEEK
13	SEM-VI	BTETC602	Digital Communicatio n	Digital Signal Processing 4: Applications	École Polytechnique Fédérale de Lausanne	40%	3 WEEK
14		BTETPE603 A	(A) Microprocessor s and Microcontroller s	Introduction to the Internet of Things and Embedded Systems	University of California, Irvine	30%	4 WEEK
		BTETPE603 E	(E) Information Theory and Coding	Information Theory	The Chinese University of Hong Kong	70%	11 WEEK
		BTETPE603 G	(G) VLSI Design & Technology	VLSI CAD Part I: Logic	University of Illinois at Urbana-Champaign	50%	5 WEEK
15		BTETOE604 A	(A) IoT and Industry 4.0	" Introduction to the Internet of Things and Embedded Systems	University of California, Irvine	30%	4 WEEK
15	SEM-VI	BTETOE604 B	(B) Deep Learning	Neural Networks and Deep Learning	deeplearning.ai	60%	4 WEEK
		BTETOE604 C	(C) Computer Network	The Bits and Bytes of Computer Networking	Google	80%	6 WEEK
		BTETOE604 E	(E) Robotics Design	Robotics: Mobility	University of Pennsylvania	50%	4 WEEK

		BTETOE604 F	(F) Patents and IPR	Introduction to Intellectual Property	University of Pennsylvania	60%	4 WEEK
16	SEM-VII	BTETPE702 A	(A) Digital Image Processing	Fundamentals of Digital Image and Video Processing	Northwestern University	60%	12 WEEK
		BTETPE702 E	(E) Bio-medical Signal Processing	The Development of Mobile Health Monitoring Systems	Saint Petersburg State University	40%	5 WEEK
17		BTETOE703 B	(B) Block Chain Technology	Blockchain: Foundations and Use Cases	Consensys Academy	70%	5 WEEK
		BTETOE703 C	(C) Cyber Security	Web Connectivity and Security in Embedded Systems	EIT Digital	60%	6 WEEK
		BTETOE703 E	(E) Mobile Communication and Networks	Wireless Communications for Everybody	Yonsei University	60%	6 WEEK
18		BTETOE704 A	(A) Soft Computing	Neural Networks and Deep Learning	deeplearning.ai	30%	4 WEEK
		BTETOE704 B	(B) Big Data Analytics	Introduction to Big Data	University of California San Diego	30%	3 WEEK
		BTETOE704 C	(C) Data Structure & Algorithms Using Java Programming	Data Structures	University of California San Diego	60%	6 WEEK
		BTETOE704 D	(D) Entrepreneurship Development	Entrepreneurship 1: Developing the Opportunity	University of Pennsylvania	40%	4 WEEK

COURSE CURRICULUM MAPPING WITH MOOC PLATFORM Edx

Sr. No	SEMESTER	COURSE CODE	NAME OF SUBJECT AS PER CURRICULUM	EDX COURSE	NAME OF INSTITUTE OFFERING COURSE	RELEVANCE %	DURATION OF COURSE
1	SEM-III	BTETC302	Electronic Devices & Circuits	Principle of Semiconductor Devices Part I: Semiconductors, PN Junctions and Bipolar Junction Transistors	The Hong Kong University of Science and Technology	70%	8 WEEK
2		BTETC303	Digital Electronics	Computation Structures - Part 1: Digital Circuits	Massachusetts Institute of Technology	60%	10 WEEK
3	SEM-IV	BTETC401	Network Theory	Principles of Electric Circuits	Tsinghua University	40%	18 WEEK
4		BTETC402	Signals and Systems	1) Discrete Time Signals and Systems, Part 1: Time Domain , Discrete Time Signals and Systems, Part 2: Frequency Domain 2) Discrete Time Signals and Systems	Rice University	70%	1)4 WEEK 2)8 WEEK
5		BTHM403	Basic Human Rights	Human Rights Defenders	Amnesty International	40%	4 WEEK
6		BTBS404	Probability Theory and Random Processes	Probability: Basic Concepts & Discrete Random Variables	Purdue University	50%	6 WEEK

7		BTETPE405 E	(E) Python Programming	Introduction to Python: Fundamentals	Microsoft	50%	5 WEEK
8	SEM-V	BTETC501	Electromagnetic Field Theory	Electromagnetism	Tsinghua University	30%	7 WEEK
9		BTETPE504 F	(F) Power Electronics	Power Electronics	Massachusetts Institute of Technology	45%	12 WEEK
10		BTETOE505 A	(A) Control System Engineering	Introduction to Control System Design - A First Look	Massachusetts Institute of Technology	40%	4 WEEK
		BTETOE505 B	(B) Artificial Intelligence and Machine learning	AI, ML	Columbia University	40%	12 WEEK
		BTETOE505 E	(E) Augmented, Virtual and Mixed Reality	How Virtual Reality Works	The University of California, San Diego	40%	6 WEEK
11	SEM-VI	BTETC602	Digital Communication	A System View of Communications: From Signals to Packets (Part 1)+(Part2)+(Part3)	The Hong Kong University of Science and Technology	40%	7/5/6 WEEK
12		BTETPE603 A	(A) Microprocessors and Microcontrollers	Embedded Systems - Shape The World: Microcontroller Input/Output	The University of Texas at Austin	50%	8 WEEK
13		BTETOE604 E	(E) Robotics Design	Robotics	Columbia University	50%	10 WEEK
14	SEM-VII	BTETPE702 A	(A) Digital Image Processing	Image Processing and Analysis for Life Scientists	École polytechnique fédérale de Lausanne	50%	7 WEEK
		BTETPE702 D	(D) Fiber Optic Communication	Optical Materials and Devices	Massachusetts Institute of Technology	20%	6 WEEK
15		BTETOE703 B	(B) Block Chain Technology	Blockchain: Understanding Its Uses and Implications	The Linux Foundation	50%	14 WEEK
		BTETOE703 C	(C) Cyber Security	Introduction to Cybersecurity	University of Washington	40%	6 WEEK

Dr. Babasaheb Ambedkar Technological University
(Established as University of Technology in the State of Maharashtra) (Under Maharashtra Act No. XXIX of 2014)
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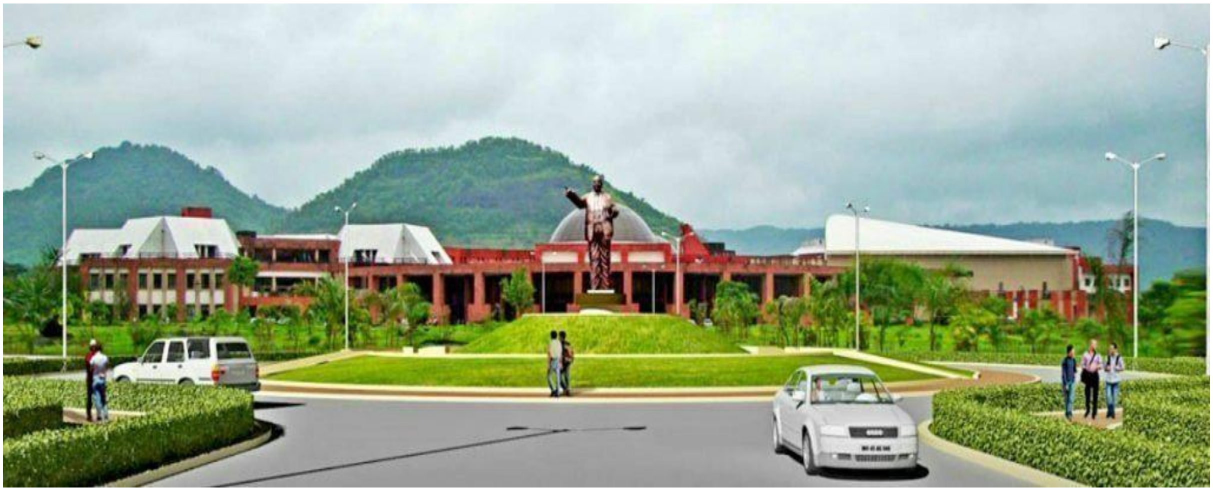
CURRICULUM

UNDER GRADUATE PROGRAMME

B.TECH.

2nd and 3rd Year MECHANICAL ENGINEERING/MECHANICAL ENGINEERING(SANDWICH)

ACADEMIC YEAR 2023-2024



Abbreviations

BSC: *Basic Science Course*

ESC: *Engineering Science Course*

PCC: *Professional Core Course*

PEC: *Professional Elective Course*

OEC: *Open Elective Course*

HSSMC: *Humanities and Social Science including Management Courses*

PROJ: *Project work, seminar and internship in industry or elsewhere*

Course Structure for Semester III
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) (2022-23)

Semester III										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
BSC7	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
PCC1	BTMC302	Fluid Mechanics	3	1	-	20	20	60	100	4
PCC2	BTMC303	Thermodynamics	3	1	-	20	20	60	100	4
ESC10	BTMES304	Materials Science and Metallurgy	3	1	-	20	20	60	100	4
PCC3	BTMCL305	Machine Drawing and CAD Lab	-	-	4	60	-	40	100	2
PCC4	BTMCL306	Mechanical Engineering Lab – I	-	-	4	60	-	40	100	2
PROJ-2	BTES209P	IT – 1 Evaluation	-	-	-	-	-	100	100	1
		Total	**12**	**4**	**8**	**200**	**80**	**420**	**700**	**21**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
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Course Structure for Semester IV
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) (2022-23)

Semester IV										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC 5	BTMC401	Manufacturing Processes – I	3	1	-	20	20	60	100	4
PCC 6	BTMC402	Theory of Machines-I	3	1	-	20	20	60	100	4
HSSMC3	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
ESC11	BTMES404	Strength of Materials	3	1	-	20	20	60	100	4
PEC 1	BTMPE405A-C	Elective-I	3	-	-	20	20	60	100	3
PCC7	BTMCL406	Mechanical Engineering Lab-II	-	-	4	60	-	40	100	2
PROJ-3	BTMI407	Field Training /Industrial Training (minimum of 4 weeks which can be completed partially in the third and fourth semester or in one semester itself)	-	-	-	-	-	-	-	Credits to be evaluated in Sem V
		Total	**15**	**4**	**4**	**160**	**100**	**340**	**600**	**20**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course

PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course

HSSMC = Humanities and Social Science including Management Courses

Elective I

Sr. No	Course code	Course Name
1	BTMPE405A	Numerical Methods in Engineering
2	BTMPE405B	Sheet Metal Engineering
3	BTMPE405C	Fluid Machinery

Course Structure for Semester V
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) (2022-23)

Semester V											
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				No. of Credits
			L	T	P	CA	MSE	ESE	Total	
PCC 8	BTMC 501	Heat Transfer	3	1	-	20	20	60	100	4
PCC 9	BTMC 502	Machine Design – I	3	1	-	20	20	60	100	4
PCC 10	BTMC 503	Theory of Machines- II	3	1	-	20	20	60	100	4
PEC 2	BTMPE 504A-C BTAPE504A,D	Elective-II	3	-	-	20	20	60	100	3
OEC 1	BTMOE 505A-D	Open Elective-I	3	-	-	20	20	60	100	3
PCC 11	BTMC 506	Applied Thermodynamics	3		-	20	20	60	100	3
PCC12	BTMCL 507	Mechanical Engineering Lab – III	-	-	6	60	-	40	100	3
PROJ-3	BTMI 408	IT – 2 Evaluation	-	-	-	-	-	100	100	1
		Total	**18**	**3**	**6**	**180**	**120**	**500**	**800**	**25**

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Elective II

Sr. No	Course code	Course Name
1	BTMPE504A	Refrigeration and Air conditioning
2	BTMPE504B	Steam and Gas Turbines
3	BTMPE504C	Engineering Tribology
4	BTAPE504A	Fundamentals of Automobile Design
5	BTAPE504D	Automobile Engineering

Open Elective I

Sr.No.	Course code	Course Name
1	BTMOE505A	Solar Energy
2	BTMOE505B	Renewable Energy Sources
3	BTMOE505C	Human Resource Management
4	BTMOE505D	Product Design Engineering

Course Structure for Semester VI
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) (2022-23)

Semester VI											
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC12	BTMC 601	Manufacturing Processes-II	3	1	-	20	20	60	100	4
PCC13	BTMC 602	Machine Design-II	3	1	-	20	20	60	100	4
PEC3	BTMPE 603A-C BTAPE 603C,E	Elective-III	3		-	20	20	60	100	3
PEC4	BTMPE 604A-D BTAPE 604B	Elective-IV	3		-	20	20	60	100	3
OEC2	BTMOE 605A-E	Open Elective-II	3	-	-	20	20	60	100	3
PCC14	BTMCL 606	Mechanical Engineering Lab – IV	-	-	6	60	-	40	100	3
PROJ-4	BTMS607	B Tech Seminar	-	-	2	60		40	100	1
PROJ-5	BTMP 608	Mini Project (TPCS)	-	-	2	60	-	40	100	1
PROJ-6	BTMI 609 (IT-3)	Field Training / Industrial Training (minimum of 4 weeks which can be completed partially in fifth semester and sixth semester or in one semester itself).	-	-	-	-	-	-	-	Credits to be evaluated in Sem VII
		Total	**15**	**2**	**10**	**280**	**100**	**420**	**800**	**22**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Elective III:

Sr.No	Course code	Course Name
1	BTMPE603A	IC Engines
2	BTMPE603B	Mechanical Vibrations
3	BTMPE603C	Machine Tool Design
4	BTMPE603D	Engineering Metrology and Quality Control
5	BTAPE603C	Advance Automobile Design
6	BTAPE603E	E – Vehicles

Elective IV:

SrNo	Course code	Course Name
1	BTMPE604A	Process Equipment Design
2	BTMPE604B	Product Life Cycle Management
3	BTMPE604C	Finite Element Method
4	BTMPE604D	Robotics
5	BTAPE604B	Computational Fluid Dynamics

Open Elective II:

Sr.No	Course code	Course Name
1	BTMOE605A	Quantitative Techniques and Project Management
2	BTMOE605B	Nanotechnology
3	BTMOE605C	Energy Conservation and Management
4	BTMOE605D	Wind Energy
5	BTMOE605E	Introduction to Probability Theory and Statistics

Semester III

Engineering Mathematics-III

BTBS301	Engineering Mathematics-III	BSC 7	3L-1T-0P	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Network analysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Vector differentiation and integration required in Electro-magnetic and Wave theory.
4. Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Course Outcomes:

On completion of the course, students will be able to:

- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
- Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
- Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.
- Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.
- Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Course Contents:

Unit 1: Laplace Transform [09 Hours]

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform [09 Hours]

Introductory remarks ; Inverse transforms of some elementary functions; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients

Unit 3: Fourier Transform [09 Hours]

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications [09 Hours]

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one-dimensional heat flow equation ($\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$), and one-dimensional wave equation (i.e. $\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$).

Unit 5: Functions of Complex Variables [09 Hours]

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata McGraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill , New York.

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
3. The minimum number of assignments should be eight covering all topics.

Fluid Mechanics

BTMC302	PCC 1	Fluid Mechanics	3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs./week Tutorial: 1 hr./week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs.)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

Course Outcomes	Content	Level
CO1	Explain basic properties of fluid, fluid statics, kinematics and dynamics.	**Understanding**
CO2	Identify various types of flow, flow patterns and their significance.	**Understanding**
CO3	Explain concepts of flow through pipes, boundary layer theory, forces on immersed bodies and dimensionless parameters.	**Understanding**
CO4	Derive various equations in fluid mechanics such as Euler's, Bernoulli's, Momentum, Continuity etc.	**Apply**
CO5	Solve the problems related to properties of fluid, fluid kinematics, fluid dynamics, laminar flow, pipe flow, dimensional analysis, boundary layer theory, and forces on immersed bodies.	**Apply**

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2											
CO2	2											
CO3	2											
CO4	2											
CO5	3	2										

Course Contents:

Unit 1: Fluid Properties and Fluid Statics: [07 Hours]

A) **Fluid Properties:** Definition of fluid, Fluid as a continuum, Properties of fluid, Viscosity, Types of fluid, Compressibility, Surface tension, Capillarity and vapor pressure.

B) **Fluid Statics:** Pascal's law, Hydrostatic law of pressure, Total Pressure, Centre of Pressure, Buoyancy, Meta center, Condition of Equilibrium of floating and submerged bodies (No Numerical Treatment on fluid Statics)

Unit 2: Fluid Kinematics and Dynamics [07 Hours]

A) **Fluid Kinematics**: Eulerian and Langragian approach of fluid flow ,Types of flow, Definition of steady, Unsteady, Uniform, Non uniform, Laminar, Turbulent, Compressible, incompressible, rotational, Irrotational flow, 1D-2D flows, Stream line, Streak line, Path line, concept of Velocity, potential & stream function flow net (no numerical treatment),Continuity equation for steady, Unsteady, Uniform, non-uniform, Compressible, incompressible.

B) Fluid Dynamics: Euler's equation, Bernoulli's equation along a streamline for incompressible flow, Practical applications of Bernoulli's equation - Pitot tube, Venturi meter, Orifice meter

Unit 3: Laminar Flow and Turbulent Flow [07 Hours]

A) Laminar Flow: Introduction to flow of viscous fluid through circular pipes, two parallel plates derivation and numerical.

B) Turbulent Flow: Major and minor losses. Loss of energy due to friction (Darcy's and Chezy's equation). Minor energy losses in transition, expansion and contraction. Concept of HGL and TEL, flow through syphon, flow through pipes in series or compound pipes, equivalent pipe, parallel pipes, branched pipes, Power transmission through pipes. Moody's Diagram.

Unit 4: Forces on Immersed Bodies and Boundary Layer Theory [07 Hours]

A) Forces on Immersed Bodies: Lift and Drag, Drag on a flat plate and on aerofoil. Types of drags, Development of lift. (Magnus effect) stalling condition of aerofoil.

B) Boundary Layer Theory: Boundary layer thickness, its characteristics, laminar and turbulent boundary layers, separation, boundary layer control.

Unit 5: Dimensional analysis [07Hours]

Introduction to dimensional analysis, dimensional homogeneity, methods of dimensional analysis- Rayleigh's method, Buckingham's π-theorem, dimensionless numbers. (No numerical treatment)

Text Books:

1) P. N. Modi, S. M. Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House,10th edition, 1991.
2) Robert W. Fox, Alan T. McDonald, "Introduction to Fluid Mechanics", John Wile and Sons,5th edition.
3) Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal , Laxmi Publication, Delhi, 2005

References Books:

1) V. L. Streeter, K. W. Bedford and E. B. Wylie, "Fluid Dynamics", Tata McGraw-Hill,9th edition, 1998.
2) S. K. Som, G.Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGrawHill, 2nd edition, 2003

Thermodynamics

BTMC303	PCC2	Thermodynamics	3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define the terms like system, boundary, properties, equilibrium, work, heat, ideal gas, entropy etc. used in thermodynamics.
CO2	Studied different laws of thermodynamics and apply these to simple thermal systems to study energy balance .
CO3	Studied Entropy, application and disorder.
CO4	Studied various types of processes like isothermal, adiabatic, etc. considering system with ideal gas and represent them on p-v and T-s planes.
CO5	Represent phase diagram of pure substance (steam) on different thermodynamic planes like p-v, T-s, h-s, etc. Show various constant property lines on them.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1										
CO2	1	2	1									
CO3		1	1									
CO4	2											
CO5	1	1										

Course Contents:

Unit 1: Fundamental Concepts and Definitions [07 Hours]

Thermodynamic system and its type; Macroscopic vs. Microscopic viewpoint, properties, processes and cycles, point function, path function. Thermodynamic equilibrium, Quasi-static process.

Work and heat Transfer: Work transferred and other types of work, Heat transfer, temperature and its measurement (principle of measurement, various instruments etc.). Zeroth law of thermodynamics, specific heat and latent heat, relationship between C_P and C_V.

Unit 2: First Law of Thermodynamics [07 Hours]
First law of thermodynamics for a closed system undergoing a cycle and change of state, Energy, different forms of energy, Enthalpy, PMM-I control volume.
Application of first law of steady flow processes (nozzle, turbine, compressor, pump, boiler,throttle valve etc.)

Unit 3: Second Law of Thermodynamics [07 Hours]
Limitation of first law of thermodynamics, cycle heat engine, refrigerator and heat pump, Kelvin- Plank and Clausius statements and their equivalence, Reversibility and Irreversibility, Carnot cycle, Carnot theorem, Absolute thermodynamic temperature scale.
Entropy: Introduction, Clausius theorem, T-s plot, Clausius inequality, Entropy and Irreversibility, Entropy principle and its application, combined I and II law, Entropy and direction, Entropy and disorder.

Unit 4: Ideal gas [07 Hours]
Boyle's law, Charl's law, Avogadro's law, universal gas constant, ideal processes with question, other equation of states.

Unit 5:Properties of Pure Substance [07Hours]
Phase change phenomenon of pure substance, phase diagram of pure substance, p-v, T-s, and h-s diagrams properties of steam, critical point parameters, triple point, property table, representation of processes of steam on p-v, T-s, and other diagrams, Dryness fraction and its measurement.

Texts:

1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill, New Delhi, 3rd edition,2005.
2. Y. A. Cengel, M. A. Boles, "Thermodynamics - An Engineering Approach", Tata McGraw Hill, 5th edition, 2006.

References:

1. G. J. Van Wylen, R. E. Sonntag, "Fundamental of Thermodynamics", John Wiley and Sons, 5th edition, 1998.
2. J. Moran, H. N. Shapiro, "Fundamentals of Engineering Thermodynamics", John Wiley and Sons, 4th edition, 2004.

Material Science and Metallurgy

BTMES304	ESC10	Materials Science and Metallurgy	3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Study various crystal structures of materials
CO2	Understand mechanical properties of materials and calculations of same using appropriate equations
CO3	Evaluate phase diagrams of various materials
CO4	Suggest appropriate heat treatment process for a given application
CO5	Prepare samples of different materials for metallography
CO6	Recommend appropriate NDT technique for a given application

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1									
CO2	3	2	2	3	2							
CO3	2	1	2	1	1							
CO4	1	2	2	1	2	1	2	1	1	1		
CO5	1	1	1	3	2		1		1			
CO6	1	1	2	2	2	1	2		1	1		

Course Contents:

Unit 1: Fundamentals

a) Structure of Materials **[07 Hours]**

Crystal structures, indexing of lattice planes, Imperfections in crystals-point defects, line defects, Mechanism of plastic deformation, plastic deformation of polycrystalline materials.

b) Mechanical Properties and their Testing

Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, compression test, formability, hardness testing, and different hardness tests-Vickers, Rockwell, Brinnel, Impact test.

Unit 2: Equilibrium Diagrams **[07 Hours]**

Definitions of terms, rules of solid-solubility, Gibb's phase rule, solidification of a pure metal, plotting of equilibrium diagrams, lever rule, Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, non-equilibrium cooling of steels, classification and application of steels, specification of steels, TTT diagram, critical cooling rate, CCT diagram.

Unit 3: Heat Treatment **[07 Hours]**

Heat treatment of steels, cooling media, annealing processes, normalizing, hardening, tempering, quenching and hardenability, surface hardening processes-nitriding, carbo-nitriding, flame hardening, induction hardening.

Unit 4: Metallography **[07 Hours]**

Microscopy, specimen preparation, polishing abrasives and cloths, specimen mounting, electrolytic polishing, etching procedure and reagents, electrolytic etching, optical metallurgical microscope, Sulphur printing, flow line observations, examination of fractures, spark test, electron microscope.

Unit 5: Strengthening Mechanisms and Non-destructive Testing **[07 Hours]**

Refinement of grain size, cold working/strain hardening, solid solution strengthening, dispersion strengthening, Precipitation hardening. Magnetic particle inspection, dye Penetrant inspection, ultrasonic inspection, radiography, eddy current testing.

Texts:

1. V. D. Kodgire, S.V. Kodgire, "Material Science and Metallurgy for Engineers", EverestPublishing House, Pune, 24th edition, 2008.
2. W. D. Callister, "Materials Science and Engineering: An Introduction", John Wiley andSons, 5th edition,2001.
3. V. Raghvan, "Material Science Engineering", Prentice Hall of India Ltd., 1992.

References:

1. V. B. John, "Introduction to Engineering Materials", ELBS, 6thedition, 2001.
2. G. F. Carter, D. E. Paul, " Materials Science and Engineering", ASM International, 3rdedition, 2000.
3. T. E. Reed-Hill, R. Abbaschian, "Physical Metallurgy Principles", Thomson, 3rdedition

Machine Drawing and CAD Lab

BTMCL305	PCC3	Machine Drawing and CAD	0-0-4	2 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 4 hrs/week	Continuous Assessment: 60 Marks External Exam: 40 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Interpret the object with the help of given sectional and orthographic views.
CO2	Construct the curve of intersection of two solids
CO3	Draw machine element using keys, cotter, knuckle, bolted and welded joint
CO4	Assemble details of any given part. i. e. valve, pump , machine tool part etc.
CO5	Represent tolerances and level of surface finish on production drawings
CO6	Understand various creating and editing commands in Auto Cad

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1
CO1	2								3	2		1
CO2	2	1							2	1		1
CO3	2								2	1		
CO4	2	2			1				2	1		1
CO5	1	1			1				2	1		1
CO6	1	1			1				2	2		1

List of Practical's/ Experiments/ Assignments (minimum six assignments should be completed)

1. One full imperial drawing sheet consisting the drawing/sketches of representation of standard components, symbols of pipe joints, weld joints, rivet joint etc., surface finish symbols and grades, limit, fit and tolerance sketches.
2. Two full imperial drawing sheets, one consisting of assembly and the other consisting of details of any one standard component such as valves, components of various machine tools, pumps, joints, engine parts, etc.
3. Two assignments of AutoCAD: Orthographic Projections of any one simple machine component such as bracket, Bearing Housing or Cast component for Engineers such as connecting rod, Piston, etc.; with dimensioning and detailing of three views of components.
4. 3-D model at least one simple machine component.

Texts:

1. N. D. Bhatt, "Engineering Drawing", Charotar Publishing House, Anand, India.
2. N. D. Bhatt, "Machine Drawing", Charotar Publishing House, Anand, India.
3. Ajeet Sing, "Working with AutoCAD 2000", Tata McGraw Hill, New Delhi.
4. George Omura, "ABC of AutoLISP", BPB Publications, New Delhi.

References:

1. Narayana, Kannaiah, Reddy, "Machine Drawing", New Age International Publishers.
2. AutoCAD and Auto LISP manuals from Autodesk Corp. U.S.A.
3. IS Code: SP46-1988, Standard Drawing Practices for Engineering Institutes.

Mechanical Engineering Lab - I

BTMCL306	PCC4	Fluid Mechanics + Material Science and Metallurgy	0-0-4	2 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 4 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Group A (Fluid Mechanics)

List of Practicals/Experiments/Assignments (Any Five from Group A)

1. Flow visualization technique: characteristics of laminar and turbulent flow patterns using Helleshaw Apparatus.
2. Verification of Bernoulli’s theorem
3. Determination of Critical Reynolds number using Reynolds Apparatus
4. Determination of pressure drop in pipes of various cross-sections
5. Determination of pressure drops in pipes of various pipe fittings etc.
6. Viscosity measurement using viscometer(at least one type)
7. Verification of momentum equation using impact of jet apparatus
8. Determination of metacentric height of a floating body
9. Calibration of a selected flow measuring device and Bourdon pressure gauge
10. Gauge and differential pressure measurements using various types of manometers, Bourdon type pressure gauge.
11. Demonstration of measurement using these instruments Lab.
12. Experiment to study hydraulic jump.

Group B (Material Science and Metallurgy)

List of Practical’s/Experiments/Assignments (Any Four from Group B

1. Brinell Hardness Test
2. Rockwell Hardness test
3. Erichson Cupping Test
4. Magnaflux Test
5. Dye Penetrant Test
6. Specimen Preparation for Microscopy
7. Sulphur Print Test
8. Spark Test
9. Study and drawing of microstructures of plain carbon steels of varying carbon percentage
10. Study and drawing of microstructures of heat treated steels
11. Jominy End Quench Test
12. Study and drawing of microstructures of cast irons

13. Study and drawing of microstructures of non-ferrous alloys
14. Hardening of steels of varying carbon percentage

IT – 1 Evaluation

BTES209P (Internship – 1)	Internship – 1 Evaluation	PROJ-2	0L-0T-0P	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: --	Continuous Assessment: -- Mid Semester Exam: -- End Semester Exam: 100 Marks

Semester IV

Manufacturing Processes-I

BTMC401	PCC 5	Manufacturing Processes-I	3-1-0	4 Credits

Pre-Requisites: None

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify castings processes, working principles and applications and list various defects in metal casting
CO2	Understand the various metal forming processes, working principles and applications
CO3	Classify the basic joining processes and demonstrate principles of welding, brazing and soldering.
CO4	Study center lathe and its operations including plain, taper turning, work holding devices and cutting tool.
CO5	Understand milling machines and operations, cutters and indexing for gear cutting.
CO6	Study shaping, planning and drilling, their types and related tooling's

Mapping of course outcomes with program outcomes

Course	Program Outcomes

Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		1	1				1		1
CO2	2	2	1		1	1				1		1
CO3	2	1	1		1	1				1		1
CO4	1		1		1	1				1		1
CO5	2		1		1	1				1		1
CO6	1				1	1				1		1

Course Contents:

Unit 1: Introduction and Casting Processes [07 Hours]

What is manufacturing? Selection of manufacturing processes, Introduction to casting; solidification of metals: Pure metals, Alloys; fluid flow; fluidity of molten metal; heat transfer: Solidification time, Shrinkage; defects: Porosity; Metal casting processes: Introduction; sand casting, shell molding, investment casting; Permanent-mold casting, vacuum casting, die casting, centrifugal casting.

Unit 2: Metal Forming

a) Rolling and Forging Processes [07Hours]

Introduction to Rolling; Flat-rolling Process: Roll Force, Torque, and Power Requirements, Geometric Considerations; Flat-rolling Practice: Defects in Rolled Plates and Sheets; Rolling Mills; Various Rolling Processes and Mills.

Introduction to forging, Open-die forging; Impression-die and Closed-die forging; various forging Operations; Forging Defects; Forging Machines.

b) Extrusion and Drawing

Introduction; Extrusion Process; Hot Extrusion; Cold Extrusion: Impact extrusion, Hydrostatic Extrusion; Extrusion Defects; Extrusion Equipment; Drawing Process; Drawing Practice; Drawing Defects and Residual Stresses; Drawing Equipment.

Unit 3: Joining Processes [07Hours]

Oxy-fuel-gas Welding; Arc-Welding Processes: Non consumable Electrode; Arc-welding Processes: Consumable Electrode, Shielded Metal-arc Welding, Submerged-arc Welding, Gas Metal-arc Welding; Electrodes for Arc Welding; The Weld joint, Quality, and Testing: Weld Quality, Weldability, Testing of Welds.

Introduction to solid state welding, Friction Welding, Resistance Welding: Spot, Seam, Projection Welding. Introduction to brazing and soldering.

Unit 4: Machining Processes: Turning and Hole Making [07 Hours]

Introduction; The Turning Process; Lathes and Lathe Operations: Lathe Components, Work holding Devices and Accessories, Lathe Operations, Types of Lathes. Types of chips, Boring andBoring Machines; Drilling Machines: Drills, Drill Materials and Sizes, Drilling Practice, DrillingMachines, Reaming operation and Reamers; Tapping and Taps.

Unit 5: Machining Processes: Milling, Broaching and Gear Manufacturing [07 Hours]

Introduction, Milling and Milling Machines: Peripheral Milling, Face Milling, End Milling, Other Milling Operations and Milling Cutters, Tool holders, Milling Process Capabilities, Milling Machines; Planning and Shaping; Broaching and Broaching Machines; Gear Manufacturing by Machining: Form Cutting, Gear Generating, Cutting Bevel Gears, Gear-finishing Processes.

Text:

1. Serope Kalpak Jain and Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte. India Ltd., 6th edition, 2009.

References:

1. Milkell P. Groover, " Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley and Sons, New Jersey, 4th edition, 2010.
2. Paul DeGarmo, J.T. Black, Ronald A. Kohser, "Materials and Processes in Manufacturing", Wiley, 10th edition, 2007.

Theory of Machines- I

BTMC402	PCC 6	Theory of Machines-I	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define basic terminology of kinematics of mechanisms
CO2	Classify planar mechanisms and calculate its degree of freedom
CO3	Perform kinematic analysis of a given mechanism using ICR and RV methods
CO4	Introduction of different types of lubrication system.
CO5	Perform kinematic analysis of slider crank mechanism using Klein's construction and analytical approach
CO6	Perform balancing of unbalance forces in rotating masses, different types of single/multi cylinder reciprocating engines in different positions.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				1								3
CO2				1								3
CO3	1	1		2								3

CO4	1											
CO5	1	1		3								2
CO6	1	1										2

Course Contents:

Unit 1: Velocity Acceleration Analysis **[07 Hours]**

Definition of link, pair, kinematics chain, inversions, inversions of single and double slider crank chain, kinematic diagrams of mechanisms, equivalent linkage of mechanism, degree of freedom.
Study of various mechanisms such as straight line mechanisms, pantograph, Geneva mechanism, steering gear mechanisms. Instantaneous centre of rotation, body and space centrodes, Kennedy's theorem.
Velocity and acceleration analysis and its purpose, velocity and acceleration diagrams using relative velocity method, Corioli's component of acceleration.
Velocity and acceleration of slider crank mechanism by analytical method and Klein's construction.

Unit 2: Friction and Lubrication **[07 Hours]**

Dry friction, friction between nut and screw with different types of threads, Uniform wear theory and uniform pressure theory, Frication at pivot and collars, Friction in turning pair, Friction circle and friction axis, Friction in mechanisms.
Lubrication, Viscosity, Viscous flow, Boundary lubrication, Thick film lubrication, Hydrostatic and hydrodynamic lubrications.

Unit 3: Clutch, Brakes and Dynamometers **[07 Hours]**

Friction Clutches: Single plate and multi-plate clutch, Cone clutch, Centrifugal clutch, Torque transmitting capacity, Clutch operating mechanism.
Brakes: Shoe brake, Internal and external shoe brakes, Block brakes, Band brakes, Band and block brakes, Braking torque.
Dynamometers: Different types of absorption and transmission type dynamometers, Construction and working of eddy current dynamometer, Torque measurement.

Unit 4: Cams and Followers **[07 Hours]**

Types of cams and followers, Analysis of motion, Jump and ramp of cam, Determination of cam profiles for a given follower motion, Circular arc cam, Tangent cam, Cycloidal cam.

Unit 5: Balancing **[07 Hours]**

Balancing of rotating masses in one and several planes, balancing of reciprocating, masses in single and multi-cylinder engine viz., inclined, radial and v-type engines, Primary and secondary balancing analysis, Concept of direct and reverse cranks, Balancing of locomotive engines, Effect of partial balancing, Static and dynamic balancing.

Texts:

1. A. Ghosh, A. K. Malik, "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi.
2. S. S. Rattan, "Theory of Machines", Tata McGraw Hill, New Delhi.

References:

1. Thomas Beven, "Theory of Machines", CBS Publishers and Distributors, Delhi.
2. J. E. Shigely, J. J. Uicker, "Theory of Machines and Mechanisms", Tata McGraw Hill Publications, New York, International Student Edition, 1995.

Basic Human Rights

BTHM403	HSSMC3	Basic Human Rights	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the history of human rights.
CO2	Learn to respect others caste, religion, region and culture.
CO3	Be aware of their rights as Indian citizen.
CO4	Understand the importance of groups and communities in the society.
CO5	Realize the philosophical and cultural basis and historical perspectives of human rights.
CO6	Make them aware of their responsibilities towards the nation.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO1
CO1						2						
CO2												
CO3												
CO4									3			
CO5								2		2		

CO6												1

Course Contents:

Unit 1: The Basic Concepts, Fundamental Rights and Economic Program [07 Hours]
Individual, group, civil society, state, equality, justice. Human Values, Human rights and HumanDuties. Declaration of independence, Rights of citizen, Rights of working and exploited people Society, religion, culture, and their inter-relationship. Impact of social structure on humanbehavior.
Social Problems: Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

Unit 2: Workers and Human Rights [07 Hours]
Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy.

Unit 3: NGOs and Human Rights in India [07 Hours]
Land, Water, Forest issues.

Unit 4: Human Rights in Indian Constitution and Law [07 Hours]
i) The constitution of India: Preamble
ii) Fundamental rights.
iii) Directive principles of state policy.
iv) Fundamental duties.
v) Some other provisions.

Unit 5: UDHR and Indian Constitution [07 Hours]
Universal declaration of human rights and provisions of India; Constitution and law; National human rights commission and state human rights commission.

References:

1. Shastry, T. S. N., “India and Human Rights: Reflections”, Concept Publishing Company India (P Ltd.), 2005.
2. C. J. Nirmal, “Human Rights in India: Historical, Social and Political Perspectives (Law in India)”, Oxford

Strength of Materials

BTMES404	ESC11	Strength of Materials	3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: Engineering Mechanics

Course Outcomes: At the end of the course, students will be able to:

CO1	State the basic definitions of fundamental terms such as axial load, eccentric load, stress, strain, E, μ, principle stresses, etc.
CO2	Analyze the stresses and strain energy in different load cases
CO3	Design the columns based on deflection
CO4	Design a beam based on bending and shafts based on torsion
CO5	Analyze given beam for calculations of SF and BM
CO6	Calculate slope and deflection at a point on cantilever /simply supported beam using double integration, Macaulay's , Area-moment and superposition methods

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1		1				1				2
CO2	1	1	2	2								2
CO3	1	1	2	2		1						3
CO4	1	3	2	1								2
CO5	1	1	2	3								2

Course Contents:

Unit 1: Simple Stresses and Strains **[07 Hours]**

Mechanical properties of materials, analysis of internal forces, simple stresses and strains, stress-strain curve, Hooke's law, modulus of elasticity, shearing, thermal stress, Hoop stress, Poisson's ratio, volumetric stress, bulk modulus, shear modulus, relationship between elastic constants.

Principal Stresses and Strains

Uni-axial stress, simple shear, general state of stress for 2-D element, ellipse of stress, principal stresses and principal planes, principal strains, shear strains, strain rosettes.

Unit 2: Strain energy, resilience and Combined Stresses

[10 Hours]

Strain energy, resilience: Load-deflection diagram, strain energy, proof resilience, stresses due to gradual, sudden and impact loadings, shear resilience, Combined axial and flexural loads, middle third rule, kernel of a section, eccentrically applied load.

Columns and Struts: Concept of short and long Columns, Euler and Rankine's formulae, limitation of Euler's formula, equivalent length, eccentrically loaded short compression members.

Unit 3: Stresses in Beams **[10 Hours]**

Moment of inertia of different sections, bending and shearing stresses in a beam, theory of simple bending, derivation of flexural formula, economic sections, horizontal and vertical shear stress, distribution shear stress for different geometrical sections-rectangular, solid circular, I-section, other sections design for flexure and shear.

Torsion

Introduction and assumptions, derivation of torsion formula, torsion of circular shafts, stresses and deformation indeterminate solid/homogeneous/composite shafts, torsional strain energy.

Unit 4: Shear Force and Bending Moment Diagram **[10 Hours]**

Introduction to different types of beams, different types of supports & loads. Concept and definition of shear force and bending moment in determinant beams due to concentrated loads, UDL, UVL and couple. Relation between SF, BM and intensity of loading, construction of shear force and bending moment diagram for cantilever, simple and compound beams, defining critical and maximum value and position of point of contra flexure. Construction of BMD and **load** diagram from SFD, Construction of load diagram and SFD from BMD.

Unit 5. Deflection of beams **[08 Hours]**

Differential equation of deflected beam, slope and deflection at a point, calculations of deflection for determinate beams by double integration, Macaulay's method, theorem of areamoment method (Mohr's theorems), moment diagram by parts, deflection of cantilever beams, deflection in simple supported beams, mid-span deflection, conjugate beam method, deflection by method of superstition.

Texts:

S. Ramamrutham, "Strength of Materials", Dhanpat Rai and Sons, New Delhi.
F. L. Singer, Pytle, "Strength of Materials", Harper Collins Publishers, 2002.
S. Timoshenko, "Strength of Materials: Part-I (Elementary Theory and Problems)", CBS Publishers, New Delhi.

References:

E. P.Popov, "Introduction to Mechanics of Solid", Prentice Hall, 2nd edition, 2005.
S. H. Crandall, N. C. Dahl, T. J. Lardner, "An introduction to the Mechanics of Solids", Tata McGraw Hill Publications, 1978.
S. B. Punmia, "Mechanics of Structure", Charotar Publishers, Anand.

Numerical Methods in Mechanical Engineering

BTMPE405A	PEC 1	Numerical Methods in Engineering	3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Course Outcomes: At the end of the course, students will be able to:

CO1	Describe the concept of error
CO2	Illustrate the concept of various Numerical Techniques
CO3	Evaluate the given Engineering problem using the suitable Numerical Technique
CO4	Develop the computer programming based on the Numerical Techniques

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		1	3							
CO2	3	3		1	3							
CO3	3	3		1	3							
CO4	3	3		1	3							

Course Contents:

Unit1: Error Analysis **[07 Hours]**

Significant figures, round-off, precision and accuracy, approximate and true error, truncation error and Taylor series, machine epsilon, data uncertainties, error propagation, importance of error sin computer programming.

Unit2: Roots of Equations **[07 Hours]**

Motivation, Bracketing methods: Bisection methods, Open methods: Newton Raphson method, Engineering applications.

Unit3: Numerical Solution of Algebraic Equations **[07 Hours]**

Motivation, Cramer's rule, Gauss- Elimination Method, pivoting, scaling, engineering applications.

Unit4: Numerical Integration and Differentiation **[07 Hours]**

Motivation, Newton's Cotes Integration Formulas: Trapezoidal Rule, Simpson's rule, engineering applications Numerical differentiation using Finite divide Difference method

Unit5: Curve, Fitting and Interpolation and Computer Programming **[07 Hours]**

Motivation, Least Square Regression: Linear Regression, Polynomial regression. **Interpolation:** Newton's Divide Difference interpolation, engineering applications. **Solution to Ordinary Differentiation Equations:** Motivation**,** Euler' sand Modified Euler's Method, Hen's method, Runge–Kutta Method, engineering applications.

Computer Programming

Overview of programming language, Development of at least one computer program based on each unit.

Texts:

1. Steven C Chapra, Reymond P. Canale,
   "Numerical Methods for Engineers", Tata Mc Graw HillPublications,2010.
2. E. Balagurusamy, "Numerical Methods" Tata McGraw HillPublications,1999.

References:

1. V. Rajaraman, "Fundamental of Computers " Prentice Hall of India,NewDelhi,2003.
2. S. S. Sastri, "Introductory Methods of Numerical Methods", Prentice Hall of India, New Delhi,3rd edition,2003.
3. K. E. Atkinson, "An Introduction to Numerical Analysis", Wiley,1978.
4. M.J. Maron, "Numerical Analysis: A Practical Approach", Macmillan, New York, 1982

Sheet Metal Engineering

BTMPE405B	PEC 1	Sheet Metal Engineering	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Recognize common manufacturing processes of Sheet Metal Fabrication
CO2	Understand the principles of design and fabricate of sheet metal products and recognize common material used in the industry
CO3	Distinguish Shearing, Drawing and Pressing etc. processes.
CO4	Know types of dies and formability.
CO5	Select mechanical or hydraulic presses for the given process

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1	3	2				2	1		1
CO2	3			1	3	2	3					2
CO3	1	1		3	3	2	1		3		1	3
CO4	3	3	1	1	3		1	1	1			

CO5	3	2			3	3	2				1	3

Course Contents:

Unit1: Introduction [07 Hours]
Importance of sheet metal engineering, materials used, desirable properties of materials in sheet metal products

Unit2: Basic Applications [07 Hours]
Shearing processes like blanking, piercing, and punching.

Unit3: Drawing Processes [07 Hours]
Shallow and deep drawing of cylindrical and rectangular bodies, forming and bending including spring-back.

Unit4: Types of Dies and Mechanical Presses [07Hours]
Dies: Compound dies, progressive dies, and combination dies
Mechanical Presses
Mechanical and hydraulic presses, modern development sin press tools, formability.

Unit 5: Case Studies [07 Hours]
Case studies for manufacturing of sheet metal products in various engineering applications
Texts:
1. Donaldson al., “Tool Design”, Tata McGraw-Hill Publications, New Delhi, 1998.

References:
1. P.N.Rao,“ManufacturingTechnology,Foundry,FormingandWelding”,Vol.I,TataMcGrawHill PublishingCo.Ltd,NewDelhi,3rd edition, 2004.
2. ASMH and book, “Metal Forming”, Vol. XV, ASM Publication, Metals Park, Ohio,10th edition,1989.
3. A. S. Deshpande, “Die Design Hand book”, ASTME.
4. Sheet Metal Engineering Notes, IITBombay,1999.

Fluid Machinery

BTMPE405C	PEC 1	Fluid Machinery	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand and apply momentum equation
CO2	Understand and explain Hydrodynamic Machines
CO3	Explain difference between impulse and reaction turbines
CO4	Find efficiencies, draw velocity triangles
CO5	Explain governing mechanisms for hydraulic turbines
CO6	Explain working of various types of pumps, draw velocity diagrams, do simple Calculations
CO7	Design simple pumping systems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1									1
CO2	3		3				2					1

CO3	3	2										1
CO4	3	3	2									1
CO5			3									1
CO6	3	3	3	1	1							1
CO7	3	3		3								1

Course Contents:

Unit 1: Momentum Equation and its Applications **[07 Hours]**

Impulse momentum, Principle, Fixed and moving flat inclined plates, Curved vanes, Series of plates and vanes, Velocity triangle and their analysis, Water wheels. Hydrodynamic Machines: Classification, General theory, Centrifugal head, Fundamental equations, and Euler's equation, Degree of reaction, Head on machine, various efficiencies, Condition for maximum hydraulic efficiency.

Unit 2: Impulse and Reaction Turbines **[07 Hours]**

Impulse principle, Construction of Pelton wheel, Velocity diagrams and its analysis, Number of buckets, Jets, Speed ratio, Jet ratio.

Reaction Turbines: Constructional details of Francis, Kaplan and Propeller turbine, Deciaz turbine, and Draft tube types, Efficiencies, Cavitation.

Unit 3: Governing of Turbines **[07 Hours]**

Methods of governing, Performance characteristics, Safety devices, Selection of turbines, Unit quantities, Specific speed, Principles of similarity and model testing.

Unit 4: Centrifugal Pump **[07 Hours]**

Construction, Classification, Terminology related to pumps, Velocity triangle and their analysis, Cavitation, NPSH, Thoma's cavitation factor, Priming, Methods of priming, Specific speed, Performance characteristics, Actual thrust and its compensation, Troubleshooting.

Multistage Pumps: Pump H-Q characteristics and system H-Q Characteristics, Series and parallel operation of pumps, Systems in series and parallel, Principle of model testing and similarity.

Unit 5: Special Purpose Pumps **[07 Hours]**

Chemical pumps, nuclear pumps, Sewage pumps, Submersible deep well pumps, Pump installation, Energy efficient pumps.

Failure of Pumping System: Pump failures, Remedies, Source failure, Causes and remedies, Trouble shooting.

Miscellaneous Pumps: Reciprocating pump, Gear pump, Vane pump, Lobe pump, etc., Application field (no mathematical treatment).

Texts:

1. P. N. Modi, S. M. Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House, Rajsons Publications Pvt. Ltd., 20th edition.
2. R. K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Lakshmi Publications Pvt. Ltd., 9th edition.

References:

1. Yunus A. Çengel, John M. Cimbala, Fluid Mechanics: Fundamentals and Applications", McGraw Hill, 3rd edition, 2014.

Mechanical Engineering Lab II

BTMCL406	PCC7	Manufacturing Processes Lab I+Theory of Machines Lab -I Strength of Materials Lab	0-0-4	2 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 4 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Group A (Manufacturing Processes Lab I)

List of Practical's/Experiments/Assignments (Any Three from Group

A)

Making a job with a process plan involving plain, step and taper turning as well thread cutting as operations on a Centre lathe.

1. Preparation of process planning sheet for a job including operations such as milling, drilling and shaping.
2. Making a spur gear using universal dividing head on milling machine.
3. Making a simple component by sand casting using a split pattern.
4. Cutting of a steel plate using oxyacetylene flame cutting /plasma cutting.
5. Making a butt joint on two stainless steel plates using TIG/MIG Welding.
6. An experiment on shearing operation.
7. An experiment on blanking operation.
8. An experiment on drawing operation

Group B (Theory of Machines Lab - I)

List of Practical's/Experiments/Assignments (Any Three from Group B)

1. **Four sheets** (half imperial size)
   Graphical solution of problems on velocity, acceleration in mechanisms by relative velocity method, instantaneous center of rotation method and Klein's construction. At least one problem containing Corioli's component of acceleration.
2. **Experiments (any 2**
   a) Experimental determination of velocity and acceleration of Hooke's joint.
   b) Determination of displacement of slider-crank mechanism with the help of model and to plot velocity and acceleration curves from it.
   c) Experiment on Corioli's component of acceleration.
3. **Assignment**

Develop a computer program for velocity and acceleration of slider-crank mechanism.

Group C (Strength of Materials Lab)

List of Practical's/Experiments/Assignments (Any Three from Group C)

1. Tension test on ferrous and non-ferrous alloys (mid steel/cast iron/aluminum, etc.
2. Compression test on mild steel, aluminum, concrete, and wood
3. Shear test on mild steel and aluminum (single and double shear tests)
4. Torsion test on mild steel and cast-iron solid bars and pipes
5. Flexure test on timber and cast-iron beams
6. Deflection test on mild steel and wooden beam specimens
7. Graphical solution method for principal stress problems
8. Impact test on mild steel, brass, aluminum, and cast-iron specimens
9. Experiments on thermal stresses
10. Strain measurement in stress analysis by photo-elasticity
11. Strain measurement involving strain gauges/ rosettes
12. Assignment involving computer programming for simple problems of stress, strain Computations.

Semester - V

Heat Transfer

BTMC 501	PCC 8	Heat Transfer	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the laws of heat transfer and deduce the general heat conduction equation and to explain it for 1-D steady state heat transfer in regular shape bodies
CO2	Describe the critical radius of insulation, overall heat transfer coefficient, thermal conductivity and lumped heat transfer
CO3	Interpret the extended surfaces
CO4	Illustrate the boundary layer concept, dimensional analysis, forced and free convection under different conditions
CO5	Describe the Boiling heat transfer, Evaluate the heat exchanger and examine the LMTD and NTU methods applied to engineering problems
CO6	Explain the thermal radiation black body, emissivity and reflectivity and evaluation of view factor and radiation shields

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1			1				1			
CO2	3	2			1							
CO3	3	1			2		2		1			
CO4	3	3		1	1				1			
CO5	3	3	3		1		2					
CO6	2	3		2	2		2		1			

Course Contents:

Unit1: Introduction **[07 Hours]**
Heat transfer mechanism, conduction heat transfer, Thermal conductivity, Convection heat transfer, Radiation heat transfer, laws of heat transfer Steady State Conduction: General heat conduction equation, Boundary and initial Conditions, one dimensional steady state conduction : the slab, the cylinder, the sphere, composite systems.

Unit2: Overall Heat Transfer and Extended Surfaces **[07 Hours]**
Thermal contact resistance, Critical radius of insulation, Electrical analogy, and Overall heat transfer coefficient, Heat sources systems, Variable thermal conductivity, extended surfaces. Unsteady State Con duction: Lumped system analysis, Biot and Fourier number, Heisler chart **(Numerical examples).**

Unit3: Principles of Convection **[07 Hours]**
Continuity, Momentum and Energy equations, Hydro dynamic and Thermal boundary layer for aflat plate and pipe flow. Dimensionless groups force convection, relation between fluid friction and heat transfer, turbulent boundary layer heat transfer. Forced Convection:
Empirical relations for pipe and tube flow, flow a cross cylinders, spheres, tube banks. Free Convection**:** Free convection from a vertical, inclined and horizontal surface, cylinder and sphere. **(Numericalexamples).**

Unit4: Heat Exchangers **[07 Hours]**
Heat Exchangers: Classification of heat exchangers, temperature distribution in parallel counter flow arrangement, the overall heat transfer coefficient, Analysis of heat exchangers, the log mean temperature difference (LMTD) method, the effectiveness – NTU method, selection of heat exchangers, Introduction to TEMA standard. **(Numerical examples).**

Unit5: Radiation Heat Transfer **[07 Hours]**
Introduction, thermal radiation, Black body radiation, radiation laws, Radiation properties, Atmospheric and Solar radiation, The view factor Radiation heat transfer from black surfaces, gray surfaces, diffuses surfaces, Radiation shield sand the radiation effect. **(Numerical examples).**

Texts:

1. F. P. Incoropera, D. P.Dewitt, “FundamentalsofHeatandMassTransfer”,John-Wiley,5th edition,1990.
2. S. P. Sukhatme, “A Text book On Heat Transfer”, Tata McGraw-Hill Publications,3rd edition.

References:

1. Y. A. Cengel, “Heat Transfer – A Practical Approach”, Tata McGraw HillPublications,3rdedition,2006.
2. J. P. Holman, “HeatTransfer”, Tata McGraw Hill Publications,9th edition,2004.

Machine Design - I

BTMC 502	PCC 9	Machine Design - I	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Strength of Materials

Course Outcomes: At the end of the course, students will be able to:

CO1	Formulate the problem by identifying customer need and convert into design Specification
CO2	Understand component behavior subjected to loads and identify failure criteria
CO3	Analyze the stresses and strain induced in the component
CO4	Design of machine component using theories of failures
CO5	Design of component for finite life and infinite life when subjected to fluctuating load
CO6	Design of components like shaft, key, coupling, screw and spring

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1						1				1

CO2	3	2		1		1		1		1		1
CO3	1	1				1		1		1		1
CO4	3	3	2	1		2		1		1		1
CO5	1	1				1		1		1		1
CO6	2	2	2	1		1		1		1		1

Course Contents:

Unit1:MechanicalEngineeringDesignProcess [07 Hours]
Traditional design methods, general industrial design procedure, design considerations, phases in design, creativity in design, use of standardization, preferred series, introduction toISO9000,use of design data book, aesthetic and ergonomic considerations in design.

Unit2:DesignofMachineElementsagainstStaticLoading [07 Hours] Theories of Failure(Yield and Fracture Criteria): Maximum normal stress theory, Maximum shear stress theory, Maximum distortion energy theory, comparisonof various theories of failure, Direct loading and combined loading, Joints subjected to static loadinge.g. cotter and knuckle joint.

Unit3: Design against Fluctuating Loads [07 Hours]
Stress concentration, stress concentration factors, fluctuating stresses, fatigue failure, endurance limit, notch sensitivity, approximate estimation of endurance limit, design for finite life and finite life under reversed stresses, cumulative damage in fatigue, Soderberg and Goodman diagrams, fatigue design under combined stresses.

Unit4:Design of Shafts Keys and Couplings [07 Hours] Various design considerations in transmission shafts, splined shafts, spindle and axles strength,lateral and torsional rigidity, ASME code for designing transmission shaft.
Types of Keys**:** Classification and fitmentin key ways, Design of various types of keys.
Couplings**:** Design consideration, design of rigid, muff and flange type couplings, and design offlexible couplings.

Unit5: Design of Threaded Joints and Mechanical Springs [07 Hours]
Power Screws**:** Forms of threads used for power screw and the it sapplications, torque analysis for square threads, efficiency of screw, overall efficiency, self- locking in power screws, stresses in the power screw, design of screw and nut, differential and compound screw,re-circulating balls crew.
Welded Joints**:** Type of welded joints, stresses in butt and fillet welds, strength of welded jointssubjected to bending moments.
Mechanical Springs: Stress deflection equation for helical spring, Wahl's factor, style of ends, design of helical compression, shot peening.

Texts:

1. V. B. Bhandari, "Design of Machine Elements",TataMcGrawHill Publications,NewDelhi,2008.
2. R. L.Nortan, "Machine Design: An Integrated Approach",PearsonEducationSingapore, 2001.

References:

1. R. C.Juvinall, K. M.Marshek, " Fundamentalofmachinecomponentdesign",John Wiley&SonsInc.,NewYork,3rdedition,2002.
2. B. J. Hamrock,B. JacobsonandSchmidSr., "FundamentalsofMachineElements", InternationalEdition,NewYork,2ndedition,1999.
3. A. S.Hall,A. R.Holowenko, H. G.Langhlin,"TheoryandProblemsofMachine Design",Schaum'sOutlineSeries, Tata McGrawHillbookCompany,NewYork,1982.
4. J. E.ShigleyandC.Mischke, "MechanicalEngineeringDesign", Tata McGrawHill Publications,7thedition, 2004.
5. M. F.Spotts, "DesignofMachineElements",PrenticeHallofIndia,NewDelhi.

Theory of Machines - II

BTMC 503	PCC 10	Theory of Machines - II	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Engineering Mechanics, TOM - I

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify and select type of belt drive for a particular application
CO2	Evaluate gear tooth geometry and select appropriate gears, gear trains
CO3	Characterize flywheels as per application requirement
CO4	Understand gyroscopic effects in ships, aeroplanes, and road vehicles.
CO5	Understand free and forced vibrations of single degree freedom systems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	1		2		1			2		2
CO2	2	3					1					3
CO3		2		1								
CO4	2	3		2								3
CO5	2	3		3								3

Course Contents:

Unit 1: Belt Drives **[07 Hours]**

Flat belts: Effect of slip, Creep, crowing of pulley, Length of belt, Centrifugal tension, Initial tension in belts, ratio of belt tensions, power transmitted.

V- Belts: Advantages of V-Belts over Flat Belt, ratio of belt tensions, torque transmitted.

Unit 2: Toothed Gears **[07 Hours]**

Classification of gears, Terminology of spur gears, Conjugate action, Involute and cycloidal profiles, Path of contact, Arc of contact, Contact ratio, Interference, Undercutting, Backlash. Introduction to Internal gears.

Helical gear terminology, Normal and transverse module, Virtual number of teeth.

Unit 3: Worm & Bevel Gear & Gear Trains **[07 Hours]**

Introduction & terminology of Worm gears & Bevel gear, concept of virtual number of teeth in bevel gear, Efficiency of worm gear.

Types of gear trains, Simple, Compound & Reverted Gear Trains, their Velocity ratios, Simple Epicyclic Gear Train & its Velocity Ratios.

Unit 4: Flywheel and Gyroscope **[07 Hours]**

Flywheel: Turning moment diagram, Energy stored in the flywheel, Fluctuation of energy and speed, Determination of mass of flywheel for four stroke single cylinder IC Engine & simple Punching Press.

Gyroscope: Principles of gyroscopic action, Precession and gyroscopic acceleration, gyroscopic couple, Effect of the gyroscopic couple on Aeroplane, Naval ships and four wheelers.

Unit 5: Vibration **[07 Hours]**

Mechanical Vibration**:** Basic concepts and definitions of Vibration, Single degree of freedom system, Undamped free vibrations, Natural frequency of Longitudinal & transverse vibrations of shaft with point loads (neglecting inertia), Introduction to damped free vibrations & equation of motion, Types of damping. Critical or whirling Speed of shaft in undamped system. Introduction to forced vibrations

Torsional Vibrations**:** Natural frequency & modes of single and two rotor system.

Texts:

1. S. S. Rattan, "Theory of Machines," Tata McGraw Hill Publications, New Delhi.
2. Thomas Beven, "Theory of machines," CBS Publishers, Delhi, 1984.
3. Kelly, Graham S., "Mechanical Vibrations," Schaum's Outline Series, McGraw Hill, New York, 1996.
4. Rao, J.S., "Introductory Course on Theory and Practice of Mechanical Vibration", New age International (P) Ltd, New Delhi, 2nd edition, 1999.

References:

1. Rao Singiresu, "Mechanical Vibrations", Pearson Education, New Delhi, 4th edition 2004.
2. J. E. Shigley, J. J. Vicker, "Theory of Machines and Mechanisms", Tata McGraw Hill International.

Refrigeration and Air Conditioning

BTMPE504A	PEC 2	Refrigeration and Air Conditioning	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Unit 1: Air Refrgeration System [07 Hours]

Introduction, standard rating of refrigerating machine, coefficient of performance of refrigerator and heat pump. , Reversed Carnot cycle and its limitations, reversed Brayton cycle, application to air craft refrigeration. Bootstrap refrigeration cycle, reduced ambient air cooling system, Regenerative air cycle system

Designation of refrigerant, selection of refrigerant, Desirable Properties, Primary and secondary refrigerants, azeotropes and its uses

Unit 2: Vapour Compression System [07 Hours]

Thermodynamics analysis, theoretical and actual cycle, Use of P-h and T-s diagram for problem solving, COP, Effect of evaporator and condenser temperature on cycle performance, Effects of suction superheating

Liquid sub-cooling, liquid-vapour heat exchanger, estimation of compressor displacement, COP and power requirement, waste heat recover opportunities

Unit 3: Compound Vapour Compression System [07 Hours]

Multi-evaporator, multi-compressor systems, cascade system

Vapour Absorption System: Aqua-ammonia system, lithium bromide-water system, Electrolux refrigerator, comparison with vapour compression cycle (descriptive treatment only), use of enthalpy concentration, thermodynamic analysis, and capacity control, solar refrigeration system

Unit 4: Air Conditioning: [07 Hours]

Psychrometry, properties of moist air, Psychometric charts. Psychomeric processes, bypass factor Sensible and latent heat loads, SHF, GSHF, RSHF, All air system, all water system, unitary systems; window air-conditioner, split air-conditioners, refrigeration and air-conditioning controls

Unit 5: Air Conditioning Process Calculation [07 Hours]

Introduction to comfort air conditioning ,human comfort and comfort chart, Load calculation, outside conditions, indoor conditions, estimation of coil capacity required, evaporative cooling

Principle of air distribution, duct design methods, friction chart, duct materials, methods of noise control

Texts:

1. Arora, C.P., Refrigeration and Air Conditioning, Tata McGraw Hills, New Delhi, Second Edition, 2000.

2. Stoeker, W.F. and Jones, J.P., Principles of Refrigeration and Air Conditioning, McGraw Hill, New York, Second Edition, 1982.

References:

1. ASHRAE Handbook – Fundamentals and Equipment, 1993.
2. ASHRAE Handbook – Applications, 1961.
3. ISHRAE Handbook
4. NPTEL Lectures by Prof. RamGopal, IIT Kharagpur
5. Carriern Handbook
6. Jord R.C., and Priester, G.B., Refrigeration and Air Conditioning, Prentice - Hall of India Ltd., New Delhi, 1969.
7. Threlkeld, J.L., Thermal Environmental Engineering, Prentice Hall, New York, 1970.

Steam and Gas Turbine

BTMPE504B	PEC 2	Steam and Gas Turbine	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	State Various properties of Steam, Draw P-V, T-s, H-s (Mollier) diagrams for steam, Describe Theoretical steam turbine cycle.
CO2	Define and Understand Various Types of Design of Turbines.
CO3	Perform analysis of given steam and gas Turbine power plant (Efficiencies, Power Output, Performance)
CO4	Study and apply various Performance improvement Techniques in steam and gas Turbines
CO5	Assess factors influencing performance of thermal power plants,
CO6	Apply various maintenance procedures and trouble shootings to Turbines.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1										
CO2	1	1										
CO3		2			2							
CO4	1				1	2	2					
CO5	1	2										
CO6	1	1		3								

Course Contents:

Unit 1: Introduction **[07 Hours]**

Properties of steam, Theoretical steam turbine cycle. The flow of steam through Impulse andImpulse–Reaction turbine blades

Unit 2: **[07 Hours]**

Vortex flow in steam turbines, Energy lines, State point locus, Reheat factor and Design procedure. Governing and performance of steam turbine

Unit 3: Gas Turbine **[07 Hours]**

Introduction, simple open cycle gas turbine, Actual Brayton cycle, Means of Improving the efficiency and the specific output of simple cycle,

Unit 4: Gas Turbine Cycle Modifications and Performance [07 Hours]

Regeneration, Reheat, Intercooling, closed-cycle gas turbine, turbine velocity diagram and work done.

Unit 5: Turbine Cooling and maintenance [07 Hours]

Turbine blade cooling, material, protective coating, Performance of turbine, Application of turbine. Lubrication, cooling, fuel supply and control, Maintenance and trouble shooting.

Texts:

1. W. J. Kearton, "Steam Turbine Theory and Practice", ELBS.

References:

1. R. Yadav, "Steam and Gas Turbine", Central Publishing Home, Allahabad.
Jack D. Mattingly, "Elements of Gas Turbine propulsion", Tata McGraw Hill Publications.

Engineering Tribology

BTMPE504C	PEC2	Engineering Tribology	3-0-0	Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the basic concepts and importance of tribology.
CO2	Evaluate the nature of engineering surfaces, their topography and surface characterization techniques
CO3	Analyze the basic theories of friction and frictional behavior of various materials
CO4	Select a suitable lubricant for a specific application
CO5	Compare different wear mechanisms
CO6	Suggest suitable material combination for tribological design.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2											
CO2	2	1	2	2		1						
CO3	2	3	1	2	1	1	1					
CO4	2	2	2		1	1	2		1		1	
CO5	1	1	1	1	1							
CO6	2	2	2		2	2	2		1	1	1	

Course Contents:

Unit1: Introduction **[07 Hours]**

Definition of tribology, friction, wear and lubrication; importance of the tri-bological tudies. Surface Topography**:** Methods of assessment, measurement of surface roughness-different statistical parameters (R_a, R_z, R_{max},etc.),contact between surfaces, deformation between single and multiple asperity contact, contact theories involved

Unit2: Friction **[07 Hours]**

Coulomb laws of friction, its applicability and limitations, comparison between static, rollingand kinetic friction, friction theories, mechanical interlocking, molecular attraction, electrostatic forces and welding, shearing and ploughing, models for asperity deformation.

Unit3: Lubrication **[07 Hours]**

Types of lubrication, viscosity, characteristics of fluids lubricant, hydrodynamic lubrication, Reynold's equation, elasto-hydrodynamic lubrication: partial and mixed, boundary lubrication, various additives solid lubrication.

Unit4: Wear **[07 Hours]**

Sliding wear: Abrasion, adhesion and galling, testing method spin-on-disc, block-on-ring, etc . theory of sliding wear, un-lubricated wear of metals, lubricated wear of metals,fretting wear of metals, wear of ceramics and polymers.

Wearing by plastic deformation and brittle fracture. Wear by hard particles: Two-body abrasive wear,three-body abrasive wear, erosion, effects of hardness shape and size of particles.

Unit5: Wear and Design and Materials for Bearings **[07 Hours]**

Introduction, estimation of wear rates, the systems approach, reducing ear by changingthe operating variables, effect of lubrication on sliding wear, selection of materials and surface engineering. Principles and applications of tribo design

Materials for Bearings

Introduction, rolling bearings, Fluid film lubricated bearings, marginally lubricated and dry bearings, gas bearings.

Texts:

1. I. M. Hutchings, "Tribology,Friction and Wear Engineering Materials", Edward Arnold, London.
2. R. C. Gunther, "Lubrication",Baily Brother sand Swinfen Limited.
3. F. T. Barwell, "Bearing Systems, Principles and Practice", Oxford University Press.

References:

1. B. C. Majumdar, "Introduction to Tribology of Bearings", A. H. Wheeler & Co. Private Limited, Allahabad.
2. D. F. Dudley, "Theory and Practice of Lubrication for Engineers", John Willey and Sons.
3. J. Halling, "Principles of Tribology", Mc Millan Press Limited.
4. Cameron Alas Tair, "Basic Lubrication Theory", Wiley Eastern Limited.
5. M. J. Neale, "Tribology Handbook", Butterworth's.
6. D. D. Fuller, "Lubrication".

Fundamentals of Automobile Design

BTAPE504A	Automobile Design (Product Design, PLM, CAE, Catia)	PEC 2	3L-0T-0P	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify the different parts of the automobile.
CO2	Explain the working of various parts like engine, transmission, clutch, brakes etc.,
CO3	Demonstrate various types of drive systems.
CO4	Apply vehicle troubleshooting and maintenance procedures.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1										
CO2	1	2		2		1						
CO3	1	1		1	1							
CO4	2			3	1							

Course Contents:

Domain related training (Approx. 20 Hrs)

Unit 1: [07 Hours]

Introduction to Styling, Basic of Design - Introduction to Design, Good Design & it's Examples of All Time, Industrial Design & its use. Design Process - Typical Product Life Cycle, Automotive Design Process (for production release), Design Studio (Automotive studio) Process or Product Conceptualization Process, Case Study. CAS Surfaces or Digital Clay Models, Class A Surfaces - Role of Class A surface Engineer, Requirements for a Surface to fulfill " Class A Surface" Standards, Case Studies for Class A Surfaces, Class A Surface Creation for Bonnet

Unit 2: [07 Hours]

Introduction to Body In White: Introduction & familiarization to Body In White (BIW), various type of BIW, Types of BIW sub system, various aggregates of BIW. Bonnet Design Case Study: Function of Bonnet, Defined Input to Bonnet, Intended Input to Bonnet Design. Steps in Bonnet design, Study of Class A Surfaces, Hood Package Layout , Typical Sections, Block Surfaces in 3D, Dynamic Clearance Surfaces in 3D, Hood Structural Members, CAE 1(Durability, Crash), Panel Detail Design, Body Assembly Process, CAE 2(Durability, crash, individual panel level), Design Updating & Detailing Prototypes, Design Updating & Production Release

Unit 3: **[07 Hours]**

Introduction to CAE & its importance in the PLM, Introduction to FEA & its applications (NVH, Durability & Vehicle Crashworthiness). Introduction of Pre-Processor, Post-Processor &Solvers. Importance of discretization & Stiffness Matrix (for automobile components). Importance of oil canning on an automobile hood with Case study related to Durability Domain. Modal analysis on the hood (Case Study related to NVH Domain). Introduction of vehicle crashworthiness & Bio-mechanics (Newtonian laws, energy management, emphasis of impulse in car crashes). Head impact analysis as a Case study on the hood of an automobile (Eurocamp test regulation). Importance of Head performance criteria (HPC). Introduction to failure criteria (By explaining the analogy of using uni-axial test results for predicting tri-axial results in reality), Mohr's Circle, Von-Mises stress criteria, application of various failure criteria on brittle or ductile materials

Unit 4: **[07 Hours]**

Introduction to CAD, CAM& CAE, FEA - Definition, Various Domains – NVH, Dura, Crash, Occupant Safety, CFD. Implicit vs. Explicit Solvers, Degree of Freedom, Stiffness Matrix, Pre-Post & Solver; Types of solvers, Animation. Durability -Oil Canning, Oil Canning on Hood, Scope of work, Loading, Boundary Conditions, Results & Conclusions. NVH – Constrained Modal Analysis, Constrained Modal Analysis on Hood, Scope of work, Loading, Boundary Conditions, Results & Conclusions. Crash – Vehicle Crashworthiness, Energy Management, Biomechanics, Head Impact Analysis on Hood, Importance of Failure Criteria, Von-Mises Stress

Unit 5: **[07 Hours]**

Sheet metal design & Manufacturing Cycle, Simultaneous Engineering (SE) feasibility study, Auto Body & its parts, important constituents of an automobile, sheet metal, sheet metal processes. Type of draw dies, Draw Model development & its considerations. Forming Simulations, Material Properties, Forming Limit Curve (FLD), Pre-Processing, Post-Processing, Sheet metal formability- Simulation

Die Design –Sheet metal parts, Sheet metal operations (Cutting, Non-Cutting etc.), Presses, Various elements used in die design, Function of each element with pictures, Types of dies, Animation describing the working of dies, Real life examples of die design. **Fixture Design -** Welding (Spot/Arc Welding), Body Coordinates, 3-2-1 principle, Need for fixture, Design considerations, Use of product GD&T in the fixture design, fixture elements. Typical operations in Sheet metal Fixture (Manual/Pneumatic/Hydraulic fixture), Typical unit design for sheet metal parts (Rest/Clamp/Location/Slide/Dump units/Base), Types of fixture (Spot welding/ Arc welding/ Inspection fixture/Gauges)

Tools related training (Approx. 20 Hrs):

Depending on the tools available in the college, the relevant tool related training modules shall be enabled to the students.

AutoCAD, AutoCAD Electrical, AutoCAD Mechanical, AutoCAD P&ID, Autodesk 3ds Max, Autodesk Alias, Autodesk Sketch Book, Automotive, CATIA V5, CATIA V6, FEA, Autodesk Fusion 360, Autodesk Inventor, Autodesk Navisworks, Autodesk Ravit, Autodesk

Showcase, Autodesk Simulation, PTC Creo, PTC Pro ENGINEER, Solid Edge, SOLIDWORKS.

Texts:

1. Notes of TATA Technologies
2. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 1)", Right Tech, Inc., Kindle Edition.
3. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 2)", Right Tech, Inc., Kindle Edition.
4. Vukato Boljanovic, "Sheet Metal Forming Processes and Die Design", Industrial press Inc., Kindle Edition.

References:

1. Ibrahim Zeid,"CAD/CAM Theoryand Practice", Tata McGraw-Hill Publication,
2. Mikell P. Grover "Automation, Production Systems and Computer-Integrated Manufacturing", Pearson Education, New Delhi.
3. P. Radhakrishnan & S. Subramanyan "CAD/CAM/CIM" Willey Eastern Limited New Delhi.
4. On wubiko, C., "Foundation of Computer Aided Design", West Publishing Company.1989
5. R.W. Heine, C. R. Loper and P.C.Rosenthal, *Principles of Metal Casting*, McGraw Hill,Newyork, 1976.
6. J. H. Dubois And W. I .Pribble, *Plastics Mold Engineering Handbook*, Van Nostrand Reihnhold, New York, 1987.
7. N. K. Mehta, Machine tool design, Tata McGraw-Hill, New Delhi, 1989.
8. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, Product Design for Manufacturing and Assembly, 2nd Edition
9. C. Howard, *Modern Welding Technology*, Prentice Hall, 1979.
10. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
11. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, Springer Verlag, 2004. ISBN 1852338105

Automobile Engineering

BTAPE504D	PEC2	Automobile Engineering	3-0-0	

Teaching Scheme	Examination Scheme
Lecture: 3 Hrs/week	Continuous Assessment: 20 Marks Mid semester examination: 20 Marks End Semester Exam: 60 Marks (3 hrs duration)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to :

CO1	Identify the different parts of the automobile.
CO2	Explain the working of various parts like engine, transmission, clutch, brakes etc.,
CO3	Demonstrate various types of drive systems; front and rear wheels, two and four wheel
drive	
CO4	Apply vehicle troubleshooting and maintenance procedures.
CO5	Analyze the environmental implications of automobile emissions. And suggest suitable regulatory modifications.

Mapping of course outcomes with program outcomes

CourseOutcomesC	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
O1	2	1										
CO2	1	2		2		1						
CO3	1	1		1	1							
CO4	2			3	1							
CO5		2			1	1	2					
CO6	1		2			2						

Course Contents:

Unit1: Introduction
Vehicle specifications, Classifications, Chassis layout, Frame, Main components of automobile and articulated vehicles; Engine cylinder arrangements, Power requirements, Tractive efforts and vehicle performance curves.

Unit2: Steering and Suspension Systems
Steering system; Principle of steering, Centre point steering, Steering linkages, Steering geometry and wheel alignment, power steering.
Suspension system: its need and types, Independent suspension, coil and leaf springs, Suspension systems for multi-axle vehicles, troubleshooting and remedies.

Unit3: Transmission System
Clutch: its need and types, Gearboxes: Types of gear transmission, Shift mechanisms, Over running clutch, Fluid coupling and torque converters, Transmission universal joint, Propeller shaft, Front and rear axles types, Stub axles, Differential and its types, Four wheel drive.

Unit4: Brakes, Wheels and Tyres

Brake: its need and types: Mechanical, hydraulic and pneumatic brakes, Disc and drum type: their relative merits, Brake adjustments and defects, Power brakes

Wheels and Tyres: their types; Tyre construction and specification ; Tyre wear and causes; Wheel balancing.

Unit5: Electrical Systems

Construction, operation and maintenance of lead acid batteries, Battery charging system, Principle and operation of cutout and regulators, Starter motor, Bendix drive, Solenoid drive, Magneto-coil and solid stage ignition systems, Ignition timing.

Vehicle Testing and Maintenance

Need of vehicle testing, Vehicle test standards, Different vehicle tests, Maintenance: trouble shooting and service procedure, over hauling, Engine tune up, Tools and equipment for repair and overhauling, Pollution due to vehicle emissions, Emission control system and regulations.

Texts:

1. Kripal Singh, “Automobile Engineering”,Vol.I and II, Standard Publishers.
2. G.B.S.Narang,“Automobile Engineering”,Dhanpat Rai and Sons.

References:

1. Joseph Heitner, “Automotive Mechanics”, East-West Press.
2. W.H.Crouse, “Automobile Mechanics”, Tata McGraw Hill Publishing Co.

Open Elective-I

Solar Energy

BTMOE505A	OEC1	Solar Energy	3-0-0	3 credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Describe measurement of direct, diffuse and global solar radiations falling on horizontal and inclined surfaces.
CO2	Analyze the performance of flat plate collector, air heater and concentrating type collector.
CO3	Understand test procedures and apply these while testing different types of collectors.
CO4	Study and compare various types of thermal energy storage systems.
CO5	Analyze payback period and annual solar savings due to replacement of conventional systems.
CO6	Design solar water heating system for a few domestic and commercial applications.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1											
CO2	1	2				1						
CO3	2			1	1		2					
CO4	1	1										
CO5		2			1							
CO6			2	3		1	1					

Course Contents

Unit 1: Solar Radiation **[07 Hours]**

Introduction, spectral distribution, solar time, diffuse radiation, Radiation on inclined surfaces, measurement of diffuse, global and direct solar radiation.

Unit 2: Liquid Flat Plate Collectors **[07 Hours]**

Introduction, performance analysis, overall loss coefficient and heat transfer correlations, collect or efficiency factor, collect or heat removal factor, testing procedures.

Unit 3: Solar Air Heaters **[07 Hours]**

Introduction, types of air heater, testing procedure.

Unit 4: Concentrating Collectors **[07 Hours]**

Types of concentrating collectors, performance analysis

Unit 5: Thermal Energy Storage and Economic Analysis [07 Hours]
Introduction, sensible heat storage, latent heat storage and thermo chemical storage
Solar Pond: Solar pond concepts, description, performance analysis, operational problems.
Economic Analysis
Definitions, annular solar savings, payback period.

Texts:
1. J. A. Duffie, W. A. Beckman, "Solar Energy Thermal Processes", John Wiley, 1974.
2. K. Kreith,J. F. Kreider, "Principles of Solar Engineering", Tata McGraw-Hill Publications,1978.

References:
1. H. P. Garg, J. Prakash, "Solar Energy: Fundamentals and Applications", Tata McGraw Hill Publications, 1997.
2. S. P. Sukhatme, "Solar Energy Principles of Thermal Collection and Storage", Tata McGraw Hill Publications, 1996.

Renewable Energy Sources

BTMOE505B	OEC1	Renewable Energy Sources	3-0-0	Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain the difference between renewable and non-renewable energy
CO2	Describe working of solar collectors
CO3	Explain various applications of solar energy
CO4	Describe working of other renewable energies such as wind, biomass , nuclear

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3		2	3	3	3	2	2		2
CO2	1	1	3	1	2	3	3	3	2	2		2
CO3	2	1	1				3	2		1		2
CO4	3	3			2	3	3	2				1

Course Contents:

Unit 1: Solar Energy **[07 Hours]**

Energy resources, Estimation of energy reserves in India, Current status of energy conversion Spectral distribution, Solar geometry, Attenuation of solar radiation in Earth's atmosphere, Measurement of solar radiation, Properties of opaque and transparent surfaces.

Unit 2: Solar Collectors **[07 Hours]**

Flat Plate Solar Collectors: Construction of collector, material, selection criteria for flat plate collectors, testing of collectors, Limitation of flat plate collectors, Introduction to ETC.

Concentrating type collectors: Types of concentrators, advantages, paraboloid, parabolic trough, Heliostat concentrator, Selection of various materials used in concentrating systems, tracking.

Unit 3: Solar Energy Applications **[07 Hours]**

Air/Water heating, Space heating/cooling, solar drying, and solar still, Photo-voltaic conversion.

Unit 4: Wind Energy and Biomass

Introduction to wind energy, Types of wind mills, Wind power availability, and wind power development in India. Evaluation of sites for bio-conversion and Introduction to biomass resources, Location of plants, Biomass conversion process,

Unit 5: Other Renewable Energy Sources **[07 Hours]**
Tidal, Geo-thermal, OTEC, hydro-electric, Nuclear energy

Texts:
1. Chetan singh Solanki, "Renewable Energy Technologies", Prentice Hallo India, 2008.

References:
1. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw-HillPublications,NewDelhi,1992.
2. G. D.Rai, "SolarEnergyUtilization",KhannaPublisher,Delhi,1992.

Human Resource Management

BTMOE505C	OEC1	Human Resource Management	3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Describe trends in the labor force composition and how they impact human resource management practice.
CO2	Discuss how to strategically plan for the human resources needed to meet organizational goals and objectives.
CO3	Define the process of job analysis and discuss its importance as a foundation for human resource management practice
CO4	Explain how legislation impacts human resource management practice.
CO5	Compare and contrast methods used for selection and placement of human resources.
CO6	Describe the steps required to develop and evaluate an employee training program
CO7	Summarize the activities involved in evaluating and managing employee performance.
CO8	Identify and explain the issues involved in establishing compensation systems.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1					2						1	
CO2											3	
CO3										2		
CO4								2		2		
CO5									2	3		
CO6										1		3
CO7										2	2	
CO8											2	

Course Contents:

Unit1: Introduction to Human Resource management [07 Hours]

Concept of management, concept of human resource management, personnel to humanresource management, human resource management model, important environmentalinfluences like government regulations, policies, labor laws and other legislation. Acquisition of humanresources: Human resource planning, Demand for man power, Weaknesses of man power planningg, job analysis, job specification, recruitment sources , recruitment advertising, the selection process, selection devices ,equal opportunities :Indian and foreign practices , socializing the new employee

Unit2: Development of Human resources [07 Hours]

Employee Training and Management Development: Training, Training and Learning ,Identification of training needs , training methods, Manager Development , Methods for developing managers , evaluating training effectiveness
Career Development: Concept of career, value of effective career development,external versus internal dimensions to a career, career stages, linking career dimensions with stages

Unit3:Motivationof Human resources [07 Hours]

Definition of motivation, Nature and Characteristics of Motivation ,The ories of motivation : a slow's Need Hierarchy Theory , Drucker Theory , Likert Theory, Herzberg Two Factortheory, Mc Clell and Theory, McGregor Theory X and Y, etc.,Psychological approach .Job Design and Work Scheduling: Design,SchedulingandExpectancyTheory,Jobcharacteristicsmodel,jobenrichment, job rotation ,work modules, flex-time, new trends in work scheduling.

Unit4: Performance appraisal [07 Hours]

Performance appraisal and expect ancy theory; appraisal process, appraisal methods, factors that can destroy appraisal. Rewarding the Productive Employee: Rewards and expectancy theory, typesof rewards, qualities of effective rewards, criterions for rewards.

Unit5:Maintenanceof Human resources and Labor Relations [07 Hours]

Compensation Administration : Concept of Compensation Administration, Job evaluation, Paystructures,Incentivescompensationplans.BenefitsandServicesBenefits: Something for everybody, Services , Trends in benefits and services .Discipline:ConceptofDiscipline,typesofdisciplineproblems,generalguidelines, disciplinary action,employment-at-will doctrine, disciplining special employee groups Safety and Health:safety programs, health programs, stress, turn out.

Unions, Major labor legislation, goals of group representation. Collective Bargaining: objectives , scope, participants of collective bargaining, process of collective bargaining, trends in collective bargaining Research and the future:What is research? Types of research, hyre searching human resource management, Secondary sources: where to look it up, Primary sources: relevant research methods, current trends and implications for humanresource management.

Texts:

1.David A. De Cenzo, StephenP. Robbins, “Personnel/Human Resources Management”, Prentice Hall of India Pvt. Ltd,3rd edition,2002.
2. Trevor Bolton, “An Introduction to Human Resource Management”, Infinity Books, 2001.

References:

1. Ellen E. Kossek, “Human Resource Management–TransformingtheWorkplace”,InfinityBooks,2001.
2. G.S. Batra, R.C. Dangwal, “Human Resource Management New Strategies”,DeepandDeepPublicationsPvt.Ltd.,2001.
3. D.M. Silvera, “HRD: TheIndianExperience”,NewIndiaPublications,2nd edition,1990.

Product Design Engineering

BTMOE505D	OEC1	Product Design Engineering – I	3-0-0	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3hr/Week	Continuous Assessment: 20 MarksMid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

- **Pre-requisites:** Knowledge of Basic Sciences, Mathematics and Engineering Drawing

Course Outcomes: At the end of the course, students will be able to

CO 01. Understand the need for product design
CO 02. Apply various methods of idea generation
CO 03. Understand various types of prototypes and testing methods
CO 04. Understand the product economics at production scale
CO 05. Appreciate the environmental concerns in product lifecycle

Course Contents:

Unit 1: Introduction to Engineering Product Design **[07 Hours]**

Trigger for Product/Process/System, Problem solving approach for Product Design, Disassembling existing product(s) and understanding relationship of components with each other, identifying materials and their processing for final product, fitting of components, understanding manufacturing as scale of the components, Reverse engineering concept,

Unit 2: Ideation & Conceptualization **[07 Hours]**

Generation of ideas, funneling of ideas, Short-listing of ideas for product(s) as an individual or group of individuals, Market research for need, competitions, Product architecture, Designing of components, Drawing of parts and synthesis of a product from its component parts, 3-D visualization,

Unit 3: Testing and Evaluation Prototyping:

Design Automation, Prototype testing and evaluation, Working in multidisciplinary teams, Feedback to design processes, Process safety and materials, Health and hazard of process operations.

Unit 4: Manufacturing **[07 Hours]**

Design models and digital tools, Decision models, Prepare documents for manufacturing in standard format, Materials and safety data sheet, Final Product specifications sheet, Detail Engineering Drawings (CAD/CAM programming), Manufacturing for scale, Design/identification of manufacturing processes

Unit 5: Environmental Concerns **[07 Hours]**

Product life-cycle management, Recycling and reuse of products, Disposal of product and waste. Case studies.

Reference:

1. Model Curriculum for “Product Design Engineer – Mechanical”, NASSCOM (Ref. ID: SSC/Q4201, Version 1.0, NSQF Level: 7)

2. Eppinger, S., & Ulrich, K.(2015). Product design and development. McGraw-Hill Higher Education.
3. Green, W., & Jordan, P. W. (Eds.).(1999).Human factors in product design: current practice and future trends. CRC Press.
4. Sanders, M. S., & McCormick, E. J. (1993). Human factors in engineering and design. McGRAW-HILLbookcompany.
5. Roozenburg, N. F., &Eekels, J. (1995). Product design: fundamentals and methods (Vol. 2). John Wiley & Sons Inc.
6. Lidwell, W., Holden, K., & Butler, J.(2010). Universal principles of designs,revised and updated: 125 ways to enhance usability, influence perception, increase appeal, make better design decisions, and teach through design. Rockport Pub.

Applied Thermodynamics

BTMC506	PCC11	Applied Thermodynamics	3-0-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define the terms like calorific value of fuel, stoichiometric air-fuel ratio, excess air, equivalent evaporation, boiler efficiency, etc. Calculate minimum air required for combustion of fuel.
CO2	Studied and Analyze gas power cycles and vapour power cycles and derive expressions for the performance parameters like thermal efficiency.
CO3	Classify various types of boilers, nozzle, steam turbine and condenser used in steam power plant.
CO4	Classify various types condenser, nozzle and derived equations for its efficiency.
CO5	Draw P-v diagram for single-stage reciprocating air compressor, with and without clearance volume, and evaluate its performance. Differentiate between reciprocating androtary air compressors.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1										
CO2	1	2										
CO3	1											
CO4			1									
CO5		2										

Course Contents:

Unit 1: Fuels and Combustion **[07 Hours]**

Types of fuels, calorific values of fuel and its determination, combustion equation for hydrocarbon fuel, determination of minimum air required for combustion and excess air supplied conversion of volumetric analysis to mass analysis, fuel gas analysis.

Unit 2: Steam Generators **[07 Hours]**

Classification of boilers, boiler details, requirements of a good boiler; merits and demerits of fire tube and water tube boilers, boiler mountings and accessories.

Boiler Draught: Classification of draught, natural draught, efficiency of the chimney, draught losses, types of boiler draught.

Performance of Boilers: Evaporation, equipment evaporation, boiler efficiency, boiler trial and heat balance, Introduction to IBR.

Unit 3: Vapor and Gas Power Cycles, Steam Nozzles [07 Hours]

Ideal Rankine cycle, Reheat and Regeneration, Stirling cycle, Joule-Brayton cycle. Calculation of thermal efficiency, specific steam/fuel consumption, work ratio for above cycles.

Steam Nozzles: Types of Nozzles, flow of steam through nozzles, condition for maximum discharge, expansion of steam considering friction, super saturated flow through nozzles, General relationship between area, velocity and pressure.

Unit 4: Condensers, Cooling Towers and Steam Turbines [07 Hours]

Condensers and Cooling Towers: Elements of steam condensing plants, advantages of using condensers, types of condensers, thermodynamic analysis of condensers, efficiencies, cooling towers.

Steam Turbines: Advantages and classification of steam turbines, compounding of steam turbines, velocity diagrams, work one done and efficiencies, losses in turbines.

Unit 5: Reciprocating Air Compressor [07 Hours]

Classification constructional details, theoretical and actual indicator diagram, FAD, multi staging, condition for maximum efficiency, capacity control.

Rotary Compressor– Concepts of Rotary compressors, Root-blower and type compressors, Centrifugal compressors. Velocity diagram, construction and expression for work done, introduction to slip factor, power input factor.

Texts:

1. T. D. Eastop, A. McConkey, “Applied Thermodynamics”, Addison Wesley Longman.
2. Rayner Joel, “Basic engineering Thermodynamics”, Addison Wesley Longman.

References:

1. Yunus A. Cengel, “Thermodynamics- An Engineering Approach", Tata McGraw Hill Publications.
2. P. K. Nag, “Basic and Applied Thermodynamics", Tata McGraw Hill Publications.
3. P. K. Nag, “Power Plant Engineering”, Tata McGraw Hill Publications, 2nd edition.
4. Sharma and Mathur, “Internal Combustion Engines”, Tata McGraw Hill Publications.

Mechanical Engineering Lab – III

BTMCL 507	PCC 11	Heat Transfer Lab.+Theory of	0-0-6	3 Credit

		Machines Lab II + Machine Design Practice-I		

Practical Scheme:	Examination Scheme:
Practical: 6 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

Group A (Heat Transfer Lab)

List of Practical's/Experiments/Assignments (Any Three from Group

1. Determination of thermal conductivity of a metal rod.
2. Determination of thermal conductivity of insulating powder.
3. Determination of conductivity of a composite slab.
4. Temperature is distribution on a fin surface.
5. Determination of film heat transfer coefficient for natural convection.
6. Determination of film heat transfer coefficient for forced convection.
7. Determination of heat transfer coefficient for cylinder in cross flow in forced convection.
8. Performance of Double pipe Heat Exchanger/Shell and Tube Heat Exchanger.
9. Determination of emissivity of a metal surface.
10. Determination of Stefan Boltzman's constant.
11. Determination of critical heat flux.
12. Calibration of measuring instruments pressure gauge, thermocouple, flow-meter etc.

Group B (Theory of Machines Lab - II)

Listof Practical's/Experiments/Assignments (Any Three from Group B)

Term work should consist of total 10 experiments from the below given list.

1. Study of various types of gear boxes such as Industrial gear box, Synchromesh gear box, Differential gear box, etc.
2. To draw conjugate profile for any general shape of gear tooth
3. To generate gear tooth profile and to study the effects under cutting and rack shift using models
4. To draw cam profile for various types of follower motions
5. To study various types of lubricating systems
6. To study various types of dynamometers
7. To determine speed vs. lift characteristic curve of a centrifugal governor and to find its coefficient of insensitiveness and stability.
8. Verification of principle of gyroscope and gyroscopic couple using motorized gyroscope
9. Study of any tow gyro-controlled systems
10. To study the dynamic balancing machine and to balance a rotor such as a fan or the rotor of electric motor or disc on the machine

11. To determine the natural frequency of damped vibration of a single degree of freedom system and to find its damping coefficient
12. To verify natural frequency of torsional vibration of two rotor system and position of node
13. To determine critical speed of a single rotor system
14. To determine transverse natural frequency of a beam experimentally using frequency measurement setup
15. To determine the frequency response curve under different damping conditions for the single degree of freedom system
16. To study shock absorbers and to measure transmissibility of force and motion.
17. Study of epicyclic gear train and its dynamic behavior

Group C (Machine Design Practice – I)

List of Practical's/Experiments/Assignments

1. The term work shall consist of 01 design projects based on syllabus of Machine Design-I. Design project shall consist of 2 full imperial size sheets-one involving assembly drawings with a part list and overall dimensions and other sheet involving drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified, where ever necessary, so as to make it a working drawing.
   Make the Project full on AutoCAD or on any 3D Design software print the full sheet on A3 size paper.
2. A design report giving all necessary calculations for the design of components and assembly should be submitted in a separate file. Sheets for one of the projects will be drawn using AutoCAD and computer print outs using plotter of the same will be attached along with the design report.
3. At least two assignments based on topics of syllabus of Machine Design-I.

IT – 2 Evaluation

BTMI408 (IT – 2)	IT – 2 Evaluation	PROJ-3	0L-0T-0P	1 Credits

Teaching Scheme:	Examination Scheme:
Lecture: --	Continuous Assessment: -- Mid Semester Exam: -- End Semester Exam: 100 Marks

Semester - VI

Manufacturing Processes - II

BTMC 601	PCC12	Manufacturing Processes - II	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the process of powder metallurgy and its applications
CO2	Calculate the cutting forces in orthogonal and oblique cutting
CO3	Evaluate the machinability of materials
CO4	Understand the abrasive processes
CO5	Explain the different precision machining processes
CO6	Understanding plastic

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	1			2					1
CO2	3	3										1
CO3	3	3	1	2	3							1
CO4	3	3	2									1
CO5	3	3	1	3								1
CO6	3	1	3	3	3			2				1

Course Contents:

Unit 1: Abrasive Machining and Finishing Operations [07 Hours]
Introduction; Abrasives and Bonded Abrasives: Grinding Wheels, Bond Types, Wheel Grade and Structure; Grinding Process: Grinding-wheel wear, Grinding Ratio, Dressing, Truing and Shaping of Grinding Wheels, Grindability of Materials and Wheel Selection; Grinding Operations and Machines, Finishing Operations

Unit 2: Mechanics of Metal Cutting [07 Hours]
Geometry of single point cutting tools, terms and definitions; chip formation, forces acting on the cutting tool and their measurement; specific cutting energy; plowing force and the "size effect"; mean shear strength of the work material; chip thickness: theory of Ernst and merchant, theory of Lee and Shaffer.

Unit 3: Thermal aspects, Tool wear, and Machinability [07 Hours]

Temperature in Metal Cutting: Heat generation in metal cutting; temperature distribution in metal cutting, effect of cutting speed on temperatures, measurement of cutting temperatures
Tool life and tool Wear: progressive tool wear; forms of wear in metal cutting: crater wear, flank wear, tool-life criteria.
Cutting tool materials: Basic requirements of tool materials, major classes of tool materials: high-speed steel, cemented carbide, ceramics, CBN and diamond, tool coatings; use of cutting fluid.

Unit 4: Processing of Powder Metals [07 Hours]

Introduction; Production of Metal Powders: Methods of Powder Production, Particle Size, Shape, and Distribution, Blending Metal Powders; Compaction of Metal Powders: Equipment, Isostatic Pressing, Sintering; Secondary and Finishing Operations.

Unit 5: Processing of Plastics Ceramics and Glasses [07 Hours]

Plastics: Introduction; Extrusion: Miscellaneous Extrusion Processes, Production of Polymer Reinforcing Fibers; Injection Molding: Reaction-injection Molding; Blow Moulding; Rotational Moulding; Thermoforming; Compression Moulding; Transfer Moulding; Casting; Foam Moulding; Cold Forming and Solid-phase Forming; Processing Elastomers.

Texts:
1. Serope Kalpakjian and Steven R. Schmid, " Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte. India Ltd., 6thedition, 2009.
2. Geoffrey Boothroyd, Winston Knight, "Fundamentals of Machining and Machine Tools", Taylor and Francis, 3rd edition, 2006.

References:
1. Milkell P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley and Sons, New Jersey, 4th edition, 2010.
2. Paul De Garmo, J. T. Black, Ronald A. Kohser, "Materials and Processes in Manufacturing",

Wiley, 10th edition, 2007.
3. M. C. Shaw, "Theory of Metal Cutting", Oxford and I.B.H. Publishing, 1st edition, 1994.

Machine Design - II

BTMC 602	PCC13	Machine Design - II	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define function of bearing and classify bearings.
CO2	Understanding failure of bearing and their influence on its selection.
CO3	Classify the friction clutches and brakes and decide the torque capacity and friction disk parameter.
CO4	Select materials and configuration for machine element like gears.
CO5	Design of elements like gears, belts for given power rating

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1						1				1
CO2	3	2		1		1		1		1		1
CO3	1	1				1		1		1		1
CO4	3	3	2	1		2		1		1		1
CO5	1	1				1		1		1		1

Course Contents:

Unit1: Rolling Contact Bearings **[07 Hours]**

Types, Static and dynamic load carrying capacities, Stribeck's Equation, Equivalent load, load and life relationship, selection of bearing life, Load factor, selection of bearing from manufacturer's catalogue, Taper roller bearings and their selection, Cyclic loads and speeds, Design for probability of survivalotherthan90%Lubricationand mountings of rolling contact bearings.

Unit2: Spur Gear **[07 Hours]**

Gear drives, Classification of gears, Law of gearing, Terminology of spur gear, Standard system of gear tooth force analysis, gear tooth failures, Selection of materials Constructional, Number of teeth, Face with, Beams strength equation, Effective load on gear tooth, Estimation of module based on beams strength. Design for maximum power capacity, Lubrication of gears.

Helical Gears: Terminology, Virtual number of teeth, Tooth proportions, Force analysis, Beam strength equation, Effective load on gear tooth Wear strength equation.

Unit3: Bevel Gears **[07 Hours]**

Types of bevel gears, Terminology of straight bevel, force analysis, Beam and Wear strength, Effective load on gear tooth.

Worm Gears: Terminology, Proportions, Force analysis, Friction in worm gears, Vector method, Selection of materials, Strength and wear rating, Thermal considerations

Unit4: Belt and Flywheel **[07 Hours]**

Flat and V belts, Geometric relationship, analysis of belt tensions,condition for maximum power, Selection of flat and V belts from manufacturer's catalogue,Adjustment of belt tensions. Roller chains, Geometric relationship, polygonal effect.

Flywheel: Introduction, types of flywheels, stresses in disc and armed flywheel.

Unit5: Brakes, Clutches **[07 Hours]**

Types of clutches, torque capacity, single and multi-plate clutches, cone clutch, centrifugal clutch, friction materials.

Types of brakes, energy equation, block with shoe brake, pivoted brake with long shoe, internal expanding shoe brake, thermal considerations.

Texts:

1. V. B. Bhandari, "Design of machine Elements", Tata McGraw Hill Publications,NewDelhi,1998
2. R. L. Nortan, "Machine Design: An Integrated Approach", Pearson Education.

References:

1. J.E. Shigley, C.Mischke, "Mechanical Engineering Design", TataMcGraw Hill Inc, NewYork,6thedition, 2003.
2. R. C. Juvinall, K. M. Marshek, "Fundamentals of Machine Component Design", John Wiley&Sons, Inc,NewYork,2002.

IC Engines

BTMPE603A	PEC3	IC Engines	3-0-0	3Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Applied Thermodynamics – I

Course Outcomes: At the end of the course, students will be able to

CO1	Understand various types of I.C. Engines and Cycles of operation.
CO2	Analyze the effect of various operating variables on engine performance
CO3	Identify fuel metering and fuel supply systems for different types of engines
CO4	Understand normal and abnormal combustion phenomena in SI and CI engines
CO5	Evaluate performance Analysis of IC Engine and Justify the suitability of IC Engine for different application
CO6	Understand the conventional and non-conventional fuels for IC engines and effects of emission formation of IC engines, its effects and the legislation standards

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3						3					
CO2		2										
CO3	2											
CO4	2											
CO5					2		3					
CO6	2											

Course Contents:

Unit 1: Fundamentals of IC Engines **[07 Hours]**

Applications, nomenclature, engine components, Engine classification, two and four stroke cycle engines; fundamental difference between SI and CI engines; valve timing diagrams.

Power Cycles: Air standard Otto, Diesel and Dual cycles; Valve timing diagrams, Fuel-Air cycles and deviation of actual cycles from ideal cycles.

Unit 2: Combustion **[07 Hours]**

Introduction, important qualities and ratings of SI Engines fuels; qualities and ratings of CI Engine fuels.

Combustion in S.I. Engines, flame speed, ignition delay, normal and abnormal combustion, effect of engine variables on flame propagation and ignition delay, Combustion in C.I. Engines, combustion of a fuel drop, stages of combustion, ignition delay, combustion knock; types of SI and CI Engine combustion chambers.

Unit 3: Various Engine Systems and Engine Testing and Performance **[07 Hours]**

Starting systems, fuel supply systems, engine cooling system, ignition system, engine friction and lubrication systems, governing systems.

Engine Testing and Performance of SI and CI Engines

Parameters, Type of tests and characteristic curves.

Super charging in IC Engine: Effect of attitude on power output, types of supercharging.

Engine Emissions and control: Pollutants from SI and CI engines and their control, emission regulations such as Bharat and Euro.

Unit 4: Alternate fuels **[07 Hours]**

Need for alternative fuels, applications, various alternate fuels etc

Gaseous Fuels, Alcohols, Biodiesels, vegetable oil extraction, Trans-esterification process, properties of alternative fuels and fuel blends.

Fuel Cell Technology: Operating principles, Types, construction, working, application, advantages and limitations.

Unit 5: Layout of Electric vehicle and Hybrid vehicles **[07 Hours]**

Advantages and drawbacks of electric and hybrid vehicles, System components, Electronic control system – Different configurations of Hybrid vehicles, Power split device. High energy and power density batteries – Basics of Fuel cell vehicles

Texts References:

1. V. Ganeshan, "Internal Combustion Engines", Tata McGraw Hill Publications, New Delhi, 3rd edition.

2. J. B. Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw Hill Publications, New York, International Edition, 1988.
3. "Alternative Fuels", Dr. S. S. Thipse, Jaico publications.
4. "IC Engines", Dr. S. S. Thipse, Jaico publications.
5. "Engine Emissions, pollutant formation", G. S. Springer and D.J. Patterson, Plenum Press.
6. ARAI vehicle emission test manual.
7. Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, "The Biodiesel Handbook", AOCS Press
8. Champaign, Illinois 2005.
9. Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers,
10. 1997, ISBN 0-76-80-0052-1.

Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.

Mechanical Vibration

BTMPE603B	PEC3	Mechanical Vibration	3-0-0	Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Theory of Machines - II

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the cause and effect of vibration in mechanical system
CO2	Formulate governing equation of motion for physical system
CO3	Understand role of damping, stiffness and inertia in mechanical system
CO	Analyze rotating system and calculate critical speeds
CO5	Estimate the parameters of vibration isolation system
CO6	Estimate natural frequencies and mode shapes of continuous system

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	1	2	1	1					2
CO2	3	3	2	1	1							2
CO3	3	2	2	1	1							2
CO4	3	3	2	2	2							2
CO5	3	3	2	2	2		3					2
CO6	3	3	3	2								2

Course Contents:

Unit 1: Single DOF- Free Vibrations **[07 Hours]**

Basic concepts: Causes and effect of vibrations, practical applications, harmonic and periodic motions, vibration terminology, vibration model, Equation of motion -natural frequency, Energy method, Rayleigh method, principle of virtual work, damping model, viscously damped free vibration, Oscillatory, non-oscillatory and critically damped motions, logarithmic decrement. Coulomb's damping.

Unit 2: Single DOF- Forced Vibrations [07 Hours]

Analysis of linear and torsional system subjected to harmonic force excitation, force transmissibility, Magnification factor, motion transmissibility, vibration isolation, typical isolator and mounts, critical speed of single rotor, undamped and damped.

Unit 3: Two DOF Systems [07 Hours]

Introduction, formulation of equation of motion, equilibrium method, lagrangian method, free vibration response, Eigen values and eigen vector, Normal mode and mode superposition, Coordinate coupling, decoupling equation of motion.

Unit 4: Torsional Vibration [07 Hours]

Simple system with one or two rotor masses, Multi DOF system: transfer matrix method, gearedsystem, and branched system.

Unit 5: Multi Degree of Freedom System and Continuous Systems [07 Hours]

Formulation of equation of motion, free vibration response, natural mode and mode shapes, orthogonality of model vectors, normalization of model vectors, decoupling of modes, model analysis, mode superposition technique. Free vibration response through model analysis. DF

Continuous Systems

Vibration of strings, longitudinal and transverse vibration of rods, transverse vibrations of beams, equation of motions and boundary conditions, transverse vibration of beams, natural frequencies and mode shapes.

Texts:

1. L. Meirovich, “Elements of Vibration Analysis”, Tata McGraw Hill.

References:

1. S. S. Rao, “Mechanical Vibrations”, Pearson education.
2. W. T. Thompson, “Theory of Vibration”, CBS Publisher.

Machine Tool Design

BTMPE603C	PEC3	Machine Tool Design	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Machine design and Manufacturing processes-I

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand basic motion involved in a machine tool.
CO2	Design machine tool structures for conventional and CNC machines.
CO3	Design and analyze system for specified speeds and feeds.
CO4	Understand control strategies for machine tool operations.
CO5	Design of rotary and linear drive for machine tools.
CO6	Analyze machine tool structure for design accuracy.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	1	1				1	1	1
CO2	3	1	3	1	2	1	1		1	1	1	1
CO3	2	1	2	1	1	1			1	1	1	1
CO4	2	1	1	1	1	1	1			1	1	1
CO5	3	1	3	1	1	1	1		1	1	1	1
CO6	2	1	2	1	1	1	1		1	1	1	1

Course Contents:

Unit 1: Introduction **[07 Hours]**

Kinematics of different types of machine tools, selection of cutting conditions and tools, calculations of cutting force on single point and multipoint tools, hole machining, calculation of power, accuracy requirements and standards.

Unit 2: Design of Rotary Drives **[07 Hours]**

Design of spindle drives, AC motors with stepped drive, DC and AC variable speed drive motor characteristics and selection, principle of speed controllers, timing belts and other types of transmission belting, closed loop operation of mail drives, rotary indexing drives.

Unit 3: Design of Feed Drives **[07 Hours]**

Feed drive using feed boxes, axes feed drive of CNC drives, DC and AC servomotors, characteristics controllers and their selection, Ball screws and friction guide ways, linear motion systems, design calculation of drives, closed loop operations of feed drive, linear indexing drives.

Unit 4: Control Elements **[07 Hours]**

Single and multi-axis CNC controllers, hydraulic control, Pneumatic control limit switches, proximity switches, sequencing control using hardwired and PLC systems.

Design of machine tool structures: Static and dynamic stiffness, dynamic analysis of cutting process, stability, forced vibration, ergonomics and aesthetics in machine tool design.

Unit 5: Design of Spindle and Spindle Supports and Design of Special Purpose Machines **[07 Hours]**

Function of spindles, design requirements, standard spindle noses, design calculation of spindles,bearing selection and mounting.

Finite elements analysis of machine tool structures: Examples of static, dynamic and thermal analysis and optimization of typical machine tool structure like column and using a finite element analysis package.

Design of Special Purpose Machines

Modular design concepts, standard modules, example of design of typical SPM with CNC, transfer machines.

Texts:

1. N. K. Mehta, “Machine Tool Design”, Tata McGraw Hill Book Co., 1991.
2. P.C. Sharma, “A Textbook of Machine Tools and Tool Design”, S. Chand & Co. Ltd., 1 January 2005.
3. Sen and Bhattacharya, “Principles of Machine Tools”, 1 Jan 2009.
4. Yoram Koren, “Computer control of manufacturing systems”, Tata McGraw Hill Education, 2009.

References:

1. Aacherkan, “Machine Tool Design”, Vol. I and Vol. III, Mir Publishers, Moscow,1970.
2. W. L. Cheney, “Details of Machine Tool Design (Classic Reprint)”, Forgotten Books, 20 Sep 2016.
3. Central Machine Tool Institute, “Machine Tool Design Handbook”, Tata McGraw Hill Education, 1st Edition, 16 June 2001.
4. Nicholas Lisitsyn, Alexis V Kudryashov, Oleg Trifonov, Alexander Gavryusin, N Acherkan, Nicholas Weinstein, “Machine Tool Design”, Vol. I, University Press of the Pacific, 20 April 2000.

Engineering Metrology and Quality Control

BTMPE603D	PEC 3	Metrology and Quality Control	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Identify techniques to minimize the errors in measurement
CO2	Identify methods and devices for measurement of length, angle, and gear and thread parameters, surface roughness and geometric features of parts.
CO3	Choose limits for plug and ring gauges.
CO4	Explain methods of measurement in modern machineries
CO5	Select quality control techniques and its applications
CO6	Plot quality control charts and suggest measures to improve the quality of product and reduce cost using Statistical tools.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				3								2
CO2		2	2		2							
CO3			2	3	2							
CO4						3						
CO5	1					2		3	3		3	2
CO6	1					2		3	3		2	2

Course Contents:

Unit 1: Measurement Standard and Comparators **[07 Hours]**

Measurement Standard, Principles of Engineering Metrology, Line end, wavelength, Traceability of Standards. Types and Sources of error, Alignment, slip gauges and gauge block, Linear and Angular Measurement (Sine bar, Sine center, Autocollimator, Angle Décor and Dividing head), Calibration. Comparator: Mechanical, Pneumatic, Optical, Electronic (Inductive), Electrical

(LVDT).

Unit 2: Interferometry and Limits, Fits, Tolerances **[07 Hours]**

Principle, NPL Interferometer, Flatness measuring of slip gauges, Parallelism, Laser Interferometer, Surface Finish Measurement: Surface Texture, Measuring Surface Finish by Stylus probe, Tomlinson and Talysurf, Analysis of Surface Traces: Methods.

Design of Gauges: Types of Gauges, Limits, Fits, Tolerance; Terminology for limits and Fits. Indian Standard (IS 919-1963) Taylor's Principle.

Unit 3: Metrology of Screw Thread **[07 Hours]**

Gear Metrology: Gear error, Gear measurement, Gear Tooth Vernier; Profile Projector, Tool marker's microscope. Advancements in Metrology: Co-ordinate Measuring Machine, Universal Measuring Machine, Laser in Metrology.

Unit 4: Introduction to Quality and Quality Tools **[07 Hours]**

Quality Statements, Cost of Quality and Value of Quality, Quality of Design, Quality of Conformance, Quality of Performance, Seven Quality Tools: Check sheet, Flow chart, Pareto analysis, cause and effect diagram, scatter diagram, Brain storming, Quality circles.

Unit 5: Total Quality Management and Statistical Quality Control **[07 Hours]**

Quality Function Deployment, 5S, Kaizan, Kanban, JIT, Poka yoke, TPM, FMECA, FTA, Zero defects.

Statistical Quality Control: statistical concept, Frequency diagram, Concept of Variance analysis, Control chart for variable & attribute, Process Capability.

Acceptance Sampling**:** Sampling Inspection, sampling methods. Introduction to ISO 9000**:** Definition and aims of standardizations, Techniques of standardization, Codification system.

Texts:

1. I. C. Gupta, "Engineering Metrology", Dhanpat and Rai Publications, New Delhi, India.
2. M. S. Mahajan, "Statistical Quality Control", Dhanpat and Rai Publications.

References:

1. R. K. Jain, "Engineering Metrology", Khanna Publications, 17th edition, 1975.
2. K. J. Hume, "Engineering Metrology", McDonald Publications, 1st edition, 1950.
3. A. W. Judge, "Engineering Precision Measurements", Chapman and Hall, London, 1957.
4. K. L. Narayana, "Engineering Metrology", Scitech Publications, 2nd edition.
5. J. F. Galyer, C. R. Shotbolt, "Metrology for Engineers", Little-hampton Book Services Ltd., 5th edition, 1969.
6. V. A. Kulkarni, A. K. Bewoor, "Metrology & Measurements", Tata McGraw Hill Co. Ltd., 1st edition, 2009.
7. AmitavaMitra, "Fundamental of Quality Control and Improvement", Wiley Publication.
8. V. A. Kulkarni, A. K. Bewoor, "Quality Control", Wiley India Publication, 01st August, 2009.

9. Richard S. Figliola, D. E. Beasley, "Theory and Design for Mechanical Measurements", Wiley India Publication.
10. E. L. Grant, "Statistical Quality Control", Tata McGraw Hill Publications.
J. M. Juran, "Quality Planning and Analysis", Tata McGraw Hill Publications.

Advance Automobile Design

BTAPE603C	PEC3	Automobile Body Design	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

Course Contents:

Domain Related Training

Unit 1: **[07 Hours]**

BIW: Requirement Specification in the Pre-Program Stage, Product Life Cycle & Important Gateways for BIW, Identification of Commodities for BIW, Design Concept & Considerations in BIW, BIW Materials & Grades, GD & T for BIW.

Unit 2: **[07 Hours]**

Sheet Metal Joining – Welds, Adhesives, TWBs. DFMEA, Design Verification – CAE Methods & Gateway supports Part A& B, CAE Analysis – NVH, Crash & Durability, Test Validation & Assessment.

Unit 3: **[07 Hours]**

Manufacturing – Sequence, Welding & Assembly, Future Trends in BIW, BIW: Examples & Case Studies

Unit 4: **[07 Hours]**

Trims: Requirement Specification in the Pre-Program Stage, Product Life Cycle & Important Gateways for Trims, Identification of Commodities for Trims, Design Requirements & Considerations, Trim Materials in Automotive.

Unit 5: **[07 Hours]**

Design of Plastic Part, DFMEA, Design Verification – CAE Methods & Gateway supports, CAE Analysis – Moldflow, Crash & Durability, Test Validation & Assessment
Manufacturing Process, Assembly Sequence, Future Trends & Future Material for Trims, Trims: Examples & Case Studies

Texts:

1. Notes of TATA Technologies
2. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 1)", Right Tech, Inc., Kindle Edition.
3. Curt Larson, " Datum Principles: Flexible Parts: Applications for Automotive Body-in-White and Interior Trim (Dimensional Management Series Book 2)", Right Tech, Inc., Kindle Edition.

References:

1. Vukato Boljanovic, "Sheet Metal Forming Processes and Die Design", Industrial press Inc., Kindle Edition.
2. R. D. Cook, Concepts and Applications of Finite Element Analysis; John Wiley and Sons, second edition, 1981.
3. K.J. Bathe, Finite Element Method and Procedures; Prentice hall, 1996.
4. Ibrahim Zeid,"CAD/CAM Theory and Practice", Tata McGraw Hill Publication,
5. J. H. Dubois And W. I. Prebble, *Plastics Mold Engineering Handbook*, Van Nostr and Reihnhold, New York, 1987.
6. Geoffrey Boothroyd, Peter Dewhurst and Winston Knight, Product Design for Manufacturing and Assembly, 2nd Edition
7. C. Howard, *Modern Welding Technology*, Prentice Hall, 1979.
8. Jesper Christensen and Christophe Bastien, "Nonlinear Optimization of Vehicle Safety Structures: Modeling of Structures Subjected to Large Deformations, Butterworth-Heinemann, Kindle Edition
9. Grieves, Michael, Product Lifecycle Management, McGraw-Hill, 2006. ISBN 0071452303
10. Stark, John. Product Lifecycle Management: Paradigm for 21st Century Product Realization, Springer Verlag, 2004. ISBN 1852338105

E Vehicles

BTAPE603E	E Vehicles	PEC 3	3L-0T-0P	3 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

Course Contents:

Unit I: Introduction to EV: **[07 Hours]**

Past, Present & Feature of EV, Current Major Issues, Recent Development Trends, EV Concept, Key EV Technology, State-of-the Art EVs, Comparison of EV Vs IC Engine.

Unit II: EV System: **[07 Hours]**

EV Configuration: Fixed & variable gearing, single & multiple motor drive, In-wheel drives

EV Parameters:

Weight, size, force, energy & performance parameters.

Unit III: EV Propulsion: **[07 Hours]**

Electric Motor:

Choice of electric propulsion system, block diagram of EV propulsion system, concept of EV Motors, single motor and multi-motor configurations, fixed & variable geared transmission, In-wheel motor configuration, classification of EV motors, Electric motors used in current vehicle applications, Recent EV Motors, Comparison of Electric Motors for EV applications

Required Power Electronics & Control:

Comparison of EV power devices, introduction to power electronics converter, four quadrant DC chopper, three-phase full bridge voltage-fed inverter, soft-switching EV converters, comparison of hard-switching and soft-switching converter, three-phase voltage-fed resonance dc link inverter, Basics of Microcontroller & Control Strategies

Unit IV: EV Motor Drive: [07 Hours]

DC Motor: Type of wound-field DC Motor, Torque speed characteristics

DC-DC Converter, two quadrant DC Chopper, two quadrant zero voltage transition converter-fed dc motor drive, speed control of DC Motor

Induction Motor Drive: Three Phase Inverter Based Induction Motor Drive, Equal Area PWM, Three Phase Auxiliary resonant snubber (ARS) Inverter Type (ZVC & ZCS), Single Phase ARS Inverter Topology, Speed Control of Induction Motor, FOC, Adaptive Control, Model Reference Adaptive Control (MARS), Sliding mode Control,

Unit V: Energy Sources & Charging: [07 Hours]

Different Batteries and Ultracapacitors, Battery characteristics (Discharging &Charging) Battery Chargers: Conductive (Basic charger circuits, Microprocessor based charger circuit.

Arrangementof an off-board conductive charger, Standard power levels of conductive chargers, Inductive(Principle of inductive charging, Soft-switching power converter for inductive charging), Batteryindication methods

Charging Infrastructure: Domestic Charging Infrastructure, Public Charging Infrastructure, Normal Charging Station, Occasional Charging Station, Fast Charging Station, Battery Swapping Station, Move-and-charge zone.

References:

1. C.C Chan, K.T Chau: Modern Electric Vehicle Technology, Oxford University Press Inc., New York 2001
2. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2003.
3. Mehrdad Ehsani, Yimi Gao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.
4. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.

Process Equipment Design

BTMPE604A	PEC4	Process Equipment Design	3-0-0	Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the factors influencing design of pressure vessel
CO2	Calculate thickness and thickness variation for cylindrical storage tank
CO3	Estimation of thickness for thin and thick wall pressure vessels
CO4	Design of flange and gasket selection for cylindrical pressure vessels
CO5	Selection of various blade and baffle arrangement for agitators
CO6	Design of support for horizontal and vertical vessel

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1		1			1	1	1				1
CO2	2	2	1			1	1	1				1
CO3	2	2	2			1	1	1				1
CO4	2	2	2			1	1	1				1
CO5	2	2	1			1	1	1				1
CO6	2	2	2			1	1	1				1

Course Contents:

Unit 1: Design Considerations for Pressure Vessel **[07 Hours]**

Selection of type of vessel, Methods of fabrication, Effect of fabrication methods, various criteria in vessel design, Economic considerations, Types of process equipment, Constructional requirement and applications. Fabrication and testing, Inspection and non-destructive testing of equipment.

Unit 2: Storage Vessel **[07 Hours]**

Design methods of atmospheric storage vessel: storage of fluids, storage of non-volatile liquids, storage of volatile liquids, storage of gases, Optimum tank proportion, Bottom design, Shell design, Wind girder for open top tank, Rub curb angle, Self-supported roof, Design of rectangular tank,

Unit 3: Pressure Vessel **[07 Hours]**

Unfired process vessel with internal and external pressure, Operating condition, Selection of material, Design condition, Stresses, Design criteria, Design of shell subjected to internal and external pressure, cylindrical vessel under combined loading,

Design of heads and closures: flat head and formed heads for vessel. Design consideration for rectors and chemical process vessels. Flange facings, Gaskets, Design of flanged joint, Flange thickness, and Blind flanges.

Unit 4: High Pressure Vessel **[07 Hours]**

Design of thick-walled high-pressure vessel, Constructional features, Materials for high-pressure vessels, Multilayer vessel with shrink fit construction, Thermal expansion for shrink fitting, stress in multi shell or shrink fit construction, autofrettage, Pre-stressing. Tall vessels and their design, Stress in shell, Determinations of longitudinal stresses, Longitudinal bending stresses due to eccentric loads, Determination of resultant longitudinal stresses.

Unit 5: Agitated Vessel and Support for Pressure Vessel **[07 Hours]**

Type of agitators, Baffling, Power requirement for agitation, Design based on torque and bending moment, Design based on critical speed, Blade design, Hub and key design, Stuffing box and gland design, Turbine agitator design,

Support for Pressure Vessel

Bracket or lug support: Thickness of the base plate, Thickness of web (gusset) plate, Column support for bracket base plate for column or leg support. Skirt Support: Skirt design, Skirt bearing plate, and Anchor bolt design, Design of bolting chair. Saddle Support: Longitudinal bending moment, Stresses in shell at saddle.

Texts:

1. V. V. Mahajani, S. B. Umarji, “Process Equipment Design”, Macmillan Publisher India Ltd.
2. L. E. Brownell, E. H. Young, “Process equipment design”, John Wiley and Sons.
3. C. Bhattacharya, “Introduction to process Equipment Design”.

Reference Book:

1. Dennis Moss, “Pressure Vessel Design Manual”, Elsevier.
2. John F. Harvey, “Theory and Design of Pressure Vessels”, CBS Publication

Product Life Cycle Management

BTMPE604B	PEC4	Product Life Cycle Management	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Objectives: Establishing industry partnerships that guide, support, and validate PLM research and education activities assisting with the integration of PLM into College curricula and facilitating the PLM career opportunities.

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Outline the concept of PLM.
CO2	Illustrate the PDM system and its importance.
CO3	Illustrate the product design process.
CO4	Build the procedure for new product development.
CO5	Classify and compare various technology forecasting methods.
CO6	Outline the stages involved in PLM for a given product.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1				1						1	
CO2	1				1		1				1	
CO3	1		1		1							
CO4	1		1		1						1	

CO5	1				1		1					
CO6	1				1				1			1

Course Contents:

Unit 1: Introduction and strategies to PLM **[07 Hours]**

Need for PLM, opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study, PLM visioning, Industrial strategies, strategy elements, its identification, selection and implementation, change management for PLM.

Unit 2: Product Data Management (PDM) **[07 Hours]**

Human resources in product lifecycle, Information, Standards, Vendors of PLM Systems and Components, PDM systems and importance, reason for implementing a PDM system, financial Justification of PDM, barriers to PDM implementation

Unit 3: Product Design **[07 Hours]**

Engineering design, organization and decomposition in product design, product design process, methodical evolution in product design, concurrent engineering, design for 'X' and design central development model. Strategies for recovery at end of life, recycling, human factors in product design. Modeling and simulation in product design.

Unit 4: New Product Development **[07 Hours]**

Structuring new product development, building decision support system, Estimating market opportunities for new product, new product financial control, implementing new product development, market entry decision, launching and tracking new product program, Concept of redesign of product

Unit 5: Technology Forecasting and PLM Software and Tools **[07 Hours]**

Future mapping, invocating rates of technological change, methods of technology forecasting such as relevance trees, morphological methods and mission flow diagram, combining forecast of different technologies, uses in manufacture alternative.

PLM Software and Tools

Product data security. Product structure, workflow, Terminologies in workflow, The Link between Product Data and Product Workflow, PLM applications, PDM applications.

Texts/References:

1. Grieves, Michael, "Product Lifecycle Management", Tata McGraw-Hill, 2006, ISBN 007145230330.
2. Antti Saaksvuori, Anselmi Immonen, "Product Life Cycle Management", Springer, 1st edition, 2003.
3. Stark, John, "Product Lifecycle Management: Paradigm for 21st Century Product Realization", Springer-Verlag, 2004.
4. Fabio Giudice, Guido La Rosa, "Product Design for the environment-A life cycle approach", Taylor & Francis, 2006.
5. Robert J. Thomas, "NPD: Managing and forecasting for strategic processes".

Finite Element Method

BTMPE604C	PEC4	Finite Element Method	3-0-0	3Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the basic principle of Finite element methods and its applications
CO2	Use matrix algebra and mathematical techniques in FEA
CO3	Identify mathematical model for solution of common engineering problem
CO4	Solve structural, thermal problems using FEA
CO5	Derive the element stiffness matrix using different methods by applying basic mechanics laws
CO6	Understand formulation for two- and three-dimensional problems

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		1				1		1	1
CO2	2	3	2	1	2	1		1			2	1
CO3	3	2	2	1	1				1		2	1
CO4	3	3	2	1	2		1		1		2	1

CO5	3	1	1		1		1				2	1
CO6	1	1	1						1		1	1

Course Contents:

Unit 1: Introduction **[07 Hours]**
Finite element analysis and its need, Advantages and limitations of finite element analysis (FEA), FEA procedure.

Unit 2: Elements of Elasticity **[07 Hours]**
Stress at a point, Stress equation of equilibrium, 2-D state of stress, Strains and displacements, Stress-strain relationship for 2-D state of stress, Plane stress and plane strain approach.

Unit 3: Relevant Matrix Algebra **[07 Hours]**
Addition, subtraction and multiplication of matrices, Differentiation and integration of matrices, Inverse of a matrix, Eigen values and eigen vectors, Positive definite matrix, Gauss elimination.

Unit 4: One-Dimensional Problems **[07 Hours]**
Introduction, FE modeling, Bar element, Shape functions, Potential energy approach, Global stiffness matrix, Boundary conditions and their treatments, Examples.

Unit 5: Trusses and Frames and Two-dimensional Problems **[07 Hours]**
Introduction, Plane trusses, Element stiffness matrix, Stress calculations, Plane frames, examples.

Two-dimensional Problems
Introduction and scope of 2-D FEA, FE modeling of 2-D problem, Constant strain triangle, other finite elements (no mathematical treatment included), Boundary conditions.

Texts:

T. R. Chandrupatla, A.D. Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall of India Pvt. Ltd., 3rd edition, New Delhi, 2004.

P. Seshu, “A Textbook of Finite Element Analysis”, Prentice Hall of India Pvt. Ltd., New Delhi, 2003.

R. D. Cook, D. S. Malkus, M. E. Plesha, R. J. Witt, “Concepts and Applications of Finite Element Analysis”, John Wiley &Sons, Inc.

References:

K. J. Bathe, “Finite Element Procedures”, Prentice Hall of India Pvt. Ltd., 2006.

Robotics

BTMPE604D	PEC4	Robotics	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	List the various components of a typical Robot, grippers, sensors, drive system and describe their functions
CO2	Calculate the word to joint and joint to word coordinates using forward and reverse transformations
CO3	Calculate the gripper forces, drive sizes, etc.
CO4	Develop simple robot program for tasks such as pick and place, arc welding, etc. using some robotic language such as VAL-II, AL, AML, RAIL, RPL, VAL
CO5	Evaluate the application of robots in applications such as Material Handling, process operations and Assembly and inspection
CO6	Discuss the implementation issues and social aspects of robotics

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		1				3	1		
CO2	2	3	2	1	2	1			3	2		
CO3	3	2	2	1	1				3	2		

CO4	3	3	2	1	2		1		3	2		
CO5	3	1	1		1		1		3	2		
CO6	1	1	1						3	2		

Course Contents:

Unit 1: Introduction
Various basic components of a Robotic system, various configurations, work envelopes, Manipulators, Controllers, etc., Parameters **[07 Hours]**

Unit2: Mechanical Systemin Robotics
Motion conversion, Kinematic chains, position analysis, forward and reverse transformations, natural and joint space coordinates, homogeneous transformation and robot kinematics, Manipulator path control, Robot Dynamics.
[07 Hours]

Unit3: Drives for Robot
Electrical drives**,** Stepper motor, Servo motors,DC motors ,AC motors, hydraulic and pneumatic drives, hybrid drives, drive selection for robotic joints.
[07 Hours]

Unit4: Sensors and End Effectors in Robotics
Sensors:
Position sensor, velocity sensor, proximity sensors , touch sensors, force sensors, miscellaneous sensors etc. **[07 Hours]**
End Effectors:
Types of end effectors, Mechanical Grippers, Design of End Mechanical Grippers, and Other Principles of gripping, Tools and end effectors, Considerations in gripper selection and design.

Unit5: Robot Programming **[07 Hours]**
Path planning, Lead through (manual and powered) programming, teach pendant mode, programming languages, Simple statements from AL, AML, RAIL, RPL, VAL Languages

Artificial Intelligence for Robots: Knowledge Representation, Problem representation and problem solving, search techniques in problem solving
Application of robot in: Material handling, assembly and inspection, process operations, etc.Economic Analysis for robotic implementation

Texts:
1. M. P. Grover,“ Industrial Robotics: Technology, Programming andApplications ”,Tata Mc Graw Hill Publication.

References:
1. Saeed B. Niku, “Introduction to Robotics, Analysis, Systems, Applications ”,Pearson Education.

2. Richard D. Klafter, “Robotic Engineering :An Integrated Approach”, Prentice Hall of India.

Computational Fluid Dynamics

BTAPE604B	Fundamentals of Computational Fluid Dynamics	PEC 4	3L-0T-0P	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to

CO1	Identify applications of finite volume and finite element methods to solve Navier-Stoke equations.
CO2	Evaluate solution of aerodynamic flows. Appraise & compare current CFD software. Simplif flow problems and solve them exactly.
CO3	Design and setup flow problem properly within CFD context, performing solid modeling usin CAD package and producing grids via meshing tool
CO4	Interpret both flow physics and mathematical properties of governing Navier-Stokes equation and define proper boundary conditions for solution.
CO5	Use CFD software to model relevant engineering flow problems. Analyse the CFD results Compare with available data, and discuss the findings

Mapping of course outcomes with program outcomes

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1	1		1				3	1		

CO2	2	3	2	1	2	1			3	2		
CO3	3	2	2	1	1				3	2		
CO4	3	3	2	1	2		1		3	2		
CO5	3	1	1		1		1		3	2		
CO6	1	1	1						3	2		

Course Contents:

Unit-I: Introduction to CFD [07 Hours]

CFD – a research and design tool, CFD as third dimension of engineering supplementing theory and experiment, Steps in CFD solution procedure, strengths and weakness of CFD, Flow modeling using control volume - finite and infinitesimal control volumes, Concept of substantial derivative, divergence of velocity, Basic governing equations in integral and differential forms – conservation of mass, momentum and energy (No derivations), Physical interpretation of governing equations, Navier-Stoke's model and Euler's model of equations.

Unit- II: Basic Discretization Techniques [07 Hours]

Introduction to grid generation (Types of grids such as structured, unstructured, hybrid, multi-block, Cartesian, body fitted and polyhedral etc.), Need to discretize the domain and governing equations, Finite difference approximation using Taylor series, for first order (Forward Difference Approximation, Backward Difference Approximation, Central difference Approximation) and second order (based on 3 node, 4 node and 5 node points),explicit and Implicit approaches applied to 1D transient conduction equation, Counter flow equation () usingFTCS and Crank Nicholson's Method, Stability Criteria concept and physical interpretation,Thomas Tri-diagonal matrix solver.

Unit-III: Two Dimensional Steady and unsteady heat conduction [07 Hours]

Solution of two dimensional steady and unsteady heat conduction equation with Dirichlet, Neumann, Robbins and mixed boundary condition – solution by Explicit and Alternating Direction Implicit method (ADI Method), Approach for irregular boundary for 2D heat conduction problems.

Unit-IV: Application of Numerical Methods to Convection – Diffusion system [07 Hours]

Convection: first order wave equation solution with upwind, Lax–Wendroff, Mac Cormack scheme, Stability Criteria concept and physical interpretation **Convection –Diffusion:** 1D and 2D steady Convection Diffusion system – Central difference approach, Peclet Number, stability criteria, upwind difference approach, 1 D transient convection-diffusion system

Unit-V: Incompressible fluid flow [07 Hours]

Solution of Navier-Stoke's equation for incompressible flow using SIMPLE algorithms and its variation (SIMPLER), Application to flow through pipe, Introduction to finite volume method.

CFD as Practical approach

Introduction to any CFD tool, steps in pre-processing, geometry creation, mesh generation, selection of physics and material properties, specifying boundary condition, Physical Boundary condition types such as no slip, free slip, rotating wall, symmetry and periodic, wall roughness, initializing and solution control for the solver, Residuals, analyzing the plots of various parameters (Scalar and Vector contours such as streamlines, velocity vector plots and animation). Introduction to turbulence models. Reynolds Averaged Navier-Stokes equations (RANS), k-ϵ, k-. Simple problems like flow inside a 2-D square lid driven cavity flow through the nozzle

Texts/References:

1. "Computational Fluid Dynamics", John D Anderson: The Basics with Applications, McGraw-Hill
2. "Computational Fluid Dynamics", J. Tu, G.-H. Yeoh and C. Liu: A practical approach, Elsevier.
3. "Introduction to Computational Fluid Dynamics", A. W. Date: Cambridge University Press
4. "Computer Simulation of Fluid flow and heat transfer", P.S. Ghoshdastidar: Tata McGraw-Hill.
5. "Numerical Simulation of internal and external flows", Vol. 1, C. Hirsch, Wiley
6. Computational Fluid Mechanics and Heat transfer, Tannehill, Anderson, and Pletcher, CRC Press.

Open Elective-II

Quantitative Techniques in Project Management

BTMOE605A	OEC 2	Quantitative Techniques in Project Management	3-1-0	4Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: Engineering Mathematics-I/II/III

Course Outcomes: At the end of the course, students will be able to:

CO1	Define and formulate research models to solve real life problems for allocating limited resources by linear programming.
CO2	Apply transportation and assignment models to real life situations.
CO3	Apply queuing theory for performance evaluation of engineering and management systems.
CO4	Apply the mathematical tool for decision making regarding replacement of items in real life.
CO5	Determine the EOQ, ROP and safety stock for different inventory models.
CO6	Construct a project network and apply CPM and PERT method.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	1	3	2				3	1	3	1
CO2	3	1	1	3	2				3	2	3	1
CO3	3	1	1	3	2				3	2	3	1
CO4	3	1	1	3	2	1			3	2	3	1
CO5	3	1	1	3	2	1			3	2	3	1
CO6	3	1	1	3	2	2			3	2	3	1

Course Contents:

Unit 1: Introduction **[07 Hours]**

Introduction to Operations Research, Stages of Development of Operations Research, Applications of Operations Research, Limitations of Operations Research Linear programming problem, Formulation, graphical method, Simplex method, artificial variable techniques.

Unit 2: Assignment and Transportation Models **[07 Hours]**

Transportation Problem, North west corner method, Least cost method, VAM, Optimality check methods, Stepping stone, MODI method, Assignment Problem, Unbalanced assignment problems, Travelling salesman problem.

Unit 3: Waiting Line Models and Replacement Analysis **[07 Hours]**

Queuing Theory: Classification of queuing models, Model I (Birth and Death model) M/M/I (∞, FCFS), Model II - M/M/I (N/FCFS).

Replacement Theory, Economic Life of an Asset, Replacement of item that deteriorate with time, Replacement of items that failed suddenly.

Unit 4: Inventory Models **[07 Hours]**

Inventory Control, Introduction to Inventory Management, Basic Deterministic Models, Purchase Models and Manufacturing Models without Shortages and with Shortages, Reorder level and optimum buffer stock, EOQ problems with price breaks.

Unit 5: Project Management Techniques and Time and Cost Analysis **[07 Hours]**

Difference between project and other manufacturing systems. Defining scope of a project, Necessity of different planning techniques for project managements, Use of Networks for planning of a project, CPM and PERT.

Time and Cost Analysis

Time and Cost Estimates: Crashing the project duration and its relationship with cost of project, probabilistic treatment of project completion, Resource allocation and Resource leveling.

Texts:

1. P. K. Gupta, D. S. Hira, "Operations Research", S. Chand and Company Ltd., New Delhi, 1996.
2. L. C. Jhamb, "Quantitative Techniques for managerial Decisions", Vol. I and II, Everest Publishing House, Pune, 1994.
3. N. D. Vohra, "Operations Research", Tata McGraw Hill Co., New Delhi.

References:

1. H. Taha, "Operations Research–An Introduction", Maxwell Macmillan, New York.
2. J. K. Sharma, "Operations Research–An Introduction", Maxwell Macmillan, New Delhi.
3. Harvey M. Wagner, "Principles of Operations Research with Applications to Managerial Decisions", Prentice Hall of India Pvt. Ltd., New Delhi, 2nd edition, 2005.
4. Rubin and Lewin, "Quantitative Techniques for Managers", Prentice Hall of India Pvt. Ltd., New Delhi.

Nanotechnology

BTMOE605B	OEC2	Nanotechnology	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Demonstrate the understanding of length scales concepts, nanostructures and nanotechnology.
CO2	To impart basic knowledge on various synthesis and characterization techniques involved in Nanotechnology
CO3	To educate students about the interactions at molecular scale
CO4	Evaluate and analyze the mechanical properties of bulk nanostructured metals and alloys, Nano-composites and carbon nanotubes.
CO5	To make the students understand about the effects of using nanoparticles over conventional methods

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	1		3	3	2	1		3		1	3
CO2	3	2			3	3	2				1	3
CO3	1	1	1	3	2				2	1		1

CO4	1	1		3	3	2	1		3		1	3
CO5	1	1	1	3	2				2	1		1

Course Contents:

Unit 1: Scientific Revolutions **[07 Hours]**

Types of Nanotechnology and Nano machines: the Hybrid nanomaterial. Multiscale hierarchical structures built out of Nano sized building blocks (nano to macro). Nanomaterial's in Nature: Nacre, Gecko, Teeth. Periodic table, Atomic Structure, Molecules and phases, Energy, Molecular and atomic size, Surfaces and dimensional space: top down and bottom up.

Unit 2: Forces between Atoms and Molecules **[07 Hours]**

Particles and grain boundaries, strong Intermolecular forces, Electrostatic and Vander Waals forces between surfaces, similarities and differences between intermolecular and inter particle forces covalent and coulomb interactions, interaction polar molecules.
Thermodynamics of self-assembly.

Unit 3: Opportunity at the Nano Scale **[07 Hours]**

Length and time scale in structures, energy landscapes, Inter dynamic aspects of inter molecular forces, Evolution of band structure and Fermi surface.

Unit 4: Nano Shapes **[07 Hours]**

Quantum dots, Nano wires, Nano tubes, 2D and 3D films, Nano and mesopores, micelles, bilayer, vesicles, bio nano machines, biological membranes.

Unit 5: Influence of Nano Structuring and Nano Behavior **[07 Hours]**

Influence of Nano structuring on mechanical, optical, electronic, magnetic and chemical properties-gram size effects on strength of metals- optical properties of quantum dots.

Nano Behavior

Quantum wires, electronic transport in quantum wires and carbon nano-tubes, magnetic behavior of single domain particles and nanostructures, surface chemistry of Tailored monolayer, self-assembling.

Texts:

1. C. Koch, "Nanostructured materials: Processing, Properties and Potential Applications", Noyes Publications, 2002.

2. C. Koch, I. A. Ovidko, S. Seal and S. Veprek, "Structural Nano crystalline Materials: Fundamentals & Applications", Cambridge University Press, 2011.

References:

1. Bharat Bhushan, "Springer Handbook of Nanotechnology", Springer, 2nd edition, 2006.

2. Laurier L. Schramm, "Nano and Microtechnology from A-Z: From Nano-systems to Colloids and Interfaces", Wiley, 2014.

Energy Conservation and Management

BTMOE605C	OEC2	Energy Conservation and Management	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand energy problem and need of energy management
CO2	Carry out energy audit of simple units
CO3	Study various financial appraisal methods
CO4	Analyze cogeneration and waste heat recovery systems
CO5	Do simple calculations regarding thermal insulation and electrical energy conservation

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	3		2	3			2	2		2
CO2	1	1	3	1	2	3			2	2		2
CO3	2	1	1							1		2
CO4	3	3			2	3						1

CO5			3			2						1

Course Contents:

Unit1: Introduction [07 Hours]
General energy problem, Energy use patterns and scope of conservation. Energy Management Principles: Need, Organizing, Initiating and managing an energy management program.

Unit2: Energy Auditing [07 Hours]
Elements and concepts, Types of energy audits, Instruments uses in energy auditing . Economic Analysis: Cash flows, Time value of money, Formula are relating present and future cash flows-single amount, uniform series.

Unit3: Financial Appraisal Methods [07 Hours]
Payback period, Net present value , Benefit-cost ratio, Internal–rate of return,Lifecyclecosts/benefits.Thermodynamicsofenergyconservation,Energyconservationin Boilers and furnaces, Energy conservation in Steam and condensate system.

Unit4: Cogeneration and Insulation and Heating [07 Hours]
Concept, Types of cogeneration systems, performance evaluation of a cogeneration system. Waste Heat Recovery: Potential, benefits, waste heat recovery equipment's.
Space Heating, Ventilation Air Conditioning (HVAC) and water heating of building,Transfer of heat, Space heating methods, Ventilation and air conditioning, Heat pumps,Insulation, Cooling load, Electric water heating systems, Electric energy conservation methods.
Insulation and Heating Industrial Insulation: Insulation materials, Insulation selection, Economical thickness of insulation.Industrial Heating: Heating by indirect resistance, direct resistance heating (salt bath furnace),andHeat treatment by induction heating in the electric arc furnace industry.

Unit5: Energy Conservation in Electric Utility and Industry [07 Hours]
Energy costs and two part tariff, Energy conservation in utility by improving load factor, Load curve analysis, Energyefficient motors, Energy conservation in illumination systems, Importance of Power factor in energy conservation, Power factor improvement methods, Energyconservation in industries

Texts:

1. Callaghan, "Energy Conservation".
2. D.L. Reeg,"Industrial Energy Conservation", Pergamon Press.

References:

1. T.L. Boyen, "Thermal Energy Recovery", Wiley Eastern.
2. L.J. Nagrath ,"System Modeling and Analysis", Tata Mc Graw Hill Publications.
3. S.P. Sukhatme, "Solar Energy", Tata Mc Graw Hill Publications.

Wind Energy

BTMOE605D	OEC2	Wind Energy	3-1-0	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand historical applications of wind energy
CO2	Understand and explain wind measurements and wind data
CO3	Determine Wind Turbine Power, Energy and Torque
CO4	Understand and explain Wind Turbine Connected to the Electrical Network AC and DC
CO5	Understand economics of wind energy

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1							2	2	2	1		1

CO2		3	2	1	3	2	2	2	2			1
CO3	3	3	1	1	2	2	1					1
CO4	3	3		1								1
CO5	3	2	1									1

Course Contents:

Unit 1: Introduction and Wind Measurements **[07 Hours]**
Historical uses of wind, History of wind electric generations

Wind Characteristics: Metrology of wind, World distribution of wind, Atmospheric stability, Wind speed variation with height, Wind speed statistics, Weibull statistics, Weibull parameters, Rayleigh and normal distribution
Wind Measurements
Biological indicators, Rotational anemometers, other anemometers, Wind direction

Unit 2: Wind Turbine Power, Energy and Torque **[07 Hours]**
Power output from an ideal turbine, Aerodynamics, Power output from practical turbines, Transmission and generation efficiency, Energy production and capacity factor, Torque at constant speeds, Drive train oscillations, Turbine shaft power and torque at variable speeds.

Unit 3: Wind Turbine Connected to the Electrical Network **[07 Hours]**
Methods of generating synchronous power, AC circuits, the synchronous generator, per unit calculations, the induction machine, motor starting, Capacity credit features of electrical network

Unit 4: Wind Turbines with Asynchronous Electric Generators **07 Hours]**
Asynchronous systems, DC shunt generator with battery load, Per unit calculation, Self-excitation of the induction generators, Single phase operation the induction generator, Field modulated generators, Roesel generator.
Asynchronous Load: Piston water pumps, Centrifugal pumps, Paddle wheel heaters, Batteries, Hydrogen economy, and Electrolysis cells.

Unit 5: Economics of Wind Systems **[07 Hours]**
Capital costs, Economic concepts, Revenues requirements, Value of wind generated electricity

Texts:
1. S. Ahmad, “Wind Energy: Theory and Practice”, Prentice Hall of India Pvt. Ltd.

References:
1. Garg L. Johnson, “Wind Energy Systems” Prentice Hall Inc., New Jersey, 1985.

2. Desire Le Gouriers, “Wind Power Plants: Theory and Design” Pergamon Press, 1982.

Introduction to Probability Theory and Statistics

BTMOE605D	Introduction to Probability Theory and Statistics	OEC 2	3L-1T-0P	4 Credits

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial:1 hrs/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Objective

The objective of this course is

(i) To acquire the knowledge of mean, median, mode, dispersion, etc.
(ii) To develop the basics of Probability theory
(iii) To get the knowledge of random variables and their expectations
(iv) To establish acquaintance with various probability distributions
(v) To Acquire the knowledge of correlation and regression.

Course Outcome

At the end of the course, the student will be able to

(i) Apply the concepts to find the measure of the central tendency, dispersion and moments forgrouped data

(ii) Make use of the correlation, and regression analyses to find the correlation and regression Coefficients

(iii) Observe and analyze the behavior of various discrete and continuous probabilityDistributions

(iv)Investigate the properties such as mathematical expectation and variance of the random Variables.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	1	2	2	1			1	1		2
CO2	1	1		2	1		1					2
CO3	1	2		2	2	1				2		2
CO4	1	1	1	3	3	1			1			2

Course Contents:

Unit I: Probability **[07 Hours]**

Probability Theory: Definition of probability, Addition theorem of probability, Multiplication theorem of probability, Conditional probability, Bayes' theorem of inverse probability, Properties of probabilities with proofs.

Unit II: Theoretical Probability Distributions **[07 Hours]**

Theoretical Probability Distributions: Binomial distribution, Poisson distribution, Normal distribution, Fitting of binomial distributions, Properties of Binomial, Poisson and normal distributions, Relation between binomial and normal distributions, Relation between Poisson and normal distributions, Importance of normal distribution, Examples.

Unit III: Moments, Skewness and Kurtosis [07 Hours]

Moments about mean and an arbitrary point; Skewness: positive skewness, negative skewness, symmetric frequency distribution, Bowley's coefficient of skewness, Karl Pearson's coefficient of skewness,

Measures of skewness based on moments (β_1, γ_1); Concepts of kurtosis, leptokurtic, mesokurtic and platykurtic frequency distributions.

Unit IV: Correlation and Regression [07 Hours]

Correlation: Types of correlation, Karl Pearson's correlation coefficient (Covariance Method), Spearman's rank correlation method, Regression: lines of regression, fitting of lines of regression by the least squares method, interpretation of slope and intercept, properties of regression coefficients.

Unit V: Sampling Theory and Testing of Hypothesis[07 Hours]

Introduction to sampling distributions, Population and sample, Null hypothesis and Alternative hypothesis, Single and two tailed test, Testing of hypothesis, Level of significance, Critical region, Procedure for testing of hypothesis.

Text Books:

1. Fundamentals of Statistics by S. C. Gupta, Himalaya Publishing House Pvt. Ltd., New Delhi.
2. Probability and Statistics by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
3. Mathematical Statistics by P. Mukhopadhyay, New Central Book Agency, Kolkata.
4. Fundamentals of Mathematical Statistics by S. C. Gupta and V. K. Kapoor, S. Chand and Sons, New Delhi.
5. An Introduction to Probability and Statistics by V. K. Rohatgi and A. K. Md. Ehsanes Saleh, Wiley Intercedence Publication, New York.
6. Introduction to Probability and Statistical Applications by P. L. Meyer, Addison Wesley Publishing Co., Massachusetts.

Reference Books:

a. Probability, Statistics with Reliability, Queuing and Computer Science Applications by KishorS. Trivedi, Wiley India Pvt. Ltd., Mumbai.

b. Probability, Queuing Theory and Reliability Engineering by G. Hari baskaran,Laxmi

Publications, New Delhi.

c. Probability and Statistics by R. S. Murray, J. S. John, R. Alu Srinivasan and D. Goswami,

Schaum's Outlines series, McGraw Hill Publications, New Delhi.

d. Introduction to Theory of Statistics by A. M. Mood, F. A. Graybill and D. C. Boes, tata McGraw – Hill Publications, Pune.

Mechanical Engineering Lab – IV

BTMCL 606	PCC 18	Manufacturing Processes Lab - II+ +Machine Design Practice-II+ Applied	0-0-6	3 Credit

		Thermodynamics lab		

Practical Scheme:	Examination Scheme:
Practical: 6 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Group A (Manufacturing Processes Lab - II)

List of Practical's /Experiments/Assignments (Any Three from Group A)

1. Study of types of chips
2. Study of the effect of process parameters on cutting ratio and shear angle in oblique turning process
3. Study of the effect of process parameters on the surface roughness during oblique turning process
4. Study of the effect of cutting fluid on surface roughness during oblique turning process
5. Study of the effect of process parameters on tool wear during oblique turning process
6. Study of the effect of process parameters on cutting forces in oblique turning process
7. Study of the effect of process parameters on cutting forces in end milling process
8. To develop a manual part program of a given component on CNC Lathe using G and M codes.
9. To develop a manual part program of a given component on CNC Lathe usingstock removal cycle.
10. To develop a manual part program of a given component on CNC Lathe using canned cycle.
11. To develop a manual part program of a given component on CNC Milling machine using G and M code.
12. To develop a manual part program of a given component on CNC Milling machine using pocket milling cycle.
13. To develop a manual part program of a given component on CNC Milling machine using scanned cycle.
14. To examine the effect of parameters on MRR and TWR in Electro Discharge Machining (EDM).
15. To evaluate machining accuracy in EDM.
16. Demonstration on Wire-EDM
17. Industrial visit to study manufacturing practices.

Group B (Machine Design Practice - II)

List of Practical's/Experiments/Assignments

1. The term work shall consist of 01 design projects based on syllabus of Machine Design-II. Design project shall consist of 2 full imperial size sheets-one involving assembly drawings with apart list and Overall dimensions and other sheet involving drawing so find Individual Components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified, where ever necessary, so as to make it a working drawing
   Make the Project full on Auto-cad or on any 3D Design software print the full sheet on A3 size paper.
2. A design report giving all necessary calculations for the design of components and assembly should be submitted in a separate file. Sheets for one of the projects will be drawn using AutoCAD and computer printout using plotter of the same will be attached along with the design report.
3. At least two assignments based on topics of syllabus of Machine Design-II.

Group C (Elective - III)

Perform any FIVE Practical's/ Assignments

1. Determination of calorific value by Bomb calorimeter
2. Measurement of dryness fraction of steam using separating & throttling calorimeter.
3. Trial on boiler
4. Trial on convergent/convergent-divergent type nozzle
5. Performance evaluation of steam turbine (Reaction / Impulse).
6. Performance evaluation of surface condenser.
7. Flue gas analysis using emission measuring instruments
8. Study & trial on single stage/two-stage reciprocating air compressor
9. Trial on centrifugal blower
10. Visit to appropriate industry to study and experience some of the above listed systems

B. Tech Seminar

BTMS607	Seminar II	PROJ-3	0L-0T-2P	1 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: hrs/week	Continuous Assessment: 60 Marks Mid Semester Exam: -- End Semester Exam: 40 Marks

Objective:

- To expose and make students aware with latest research and research publications
- To understand the research and research publication, references, citation
- To enhance the presentation skill
- To enhance the report writing

- To make the student aware about research publication sites
  Students are expected to prepare a seminar report on the chosen topic/area

  selected with the discussion of chosen guide based on the available

  literature on the chosen topic.

Mini Project (TPCS)

BTAP608	Mini Project (TPCS)	PROJ-4	0L-0T-2P	1 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 2 hrs/week	Continuous Assessment: 60 Marks Mid Semester Exam: -- End Semester Exam: 40 Marks(Duration 03 hrs)

Students are expected to carry out a mini project under a project guide based on the chosen area. The project may be prototype/software based which may demonstrate Engineering application or community service. After completion the project work it is necessary that student should prepare a project report under the supervision of the assign guide and present before the committee.