Rayat Shikshan Sanstha's

Karmaveer Bhaurao Patil College of Engineering, Satara

Criterion 1 – Curricular Aspects

Key Indicator - 1.2 Academic Flexibility

1.2.2 Programmes in which Choice Based Credit System (CBCS) / Elective course system implemented at the affiliated College (if applicable) during the academic year

Course Structure

for Degree Programme

B. Tech. in Civil Engineering

with effect from AY 2018-19

Dr. Babasaheb Ambedkar Technological University

Lonere 402 103, Dist- Raigad, Maharashtra, INDIA

Program Objectives

Goal of the Civil engineering with a specialization in Structural Engineering (SE) 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 Structural 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.

In addition to above DBATU graduate is expected to be

1. Taking pride in their profession and have commitment to highest standards of ethical practices and related technical disciplines;
2. Able to design structural system 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;

Course Structure

Evaluation Scheme

Sr. No	Particulars of Evaluation	MSE	CA		ESE		Total
			CA1	CA2	Internal	External	
01	Theory courses	20	10	10	---	60	100
02	Audit courses	---	50	50	---	---	100
03	Studio Courses (Product Design Engg)	---	30	30	40	---	100
03	Laboratory (Practical) courses	---	15	15	10	10	50
04	Seminar / Min Project/ Project Stage 1	---	30		20	---	50
05	Field Training	---	---	---	50	---	50
06	Project Stage II	---	---	---	50	50	100

Semester- III

Sr. No.	Subject Code	Subject	Contact Hours			Credit
			L	T	P	
		Theory				
01	BTBSC301	Mathematics – III	3	1	-	4
02	BTCVC302	Mechanics of Solids	3	1	✓	4
03	BTCVC303	Hydraulics I	2	1	✓	3
04	BTCVC304	Surveying I	2	1	✓	3
05	BTCVC305	Building Construction	2	-	✓	2
06	BTCVC306	Engineering Geology	2	-	✓	2
07	BTHM303	Soft Skills Development	2	-	-	AU
		Practical / Drawing and/or Design				
08	BTCVL307	Hydraulics Laboratory I	-	-	2	1
09	BTCVL308	Surveying Laboratory I	-	-	2	1
10	BTCVL309	Building Construction - Drawings Laboratory	-	-	2	1
11	BTCVL310	Engineering Geology Lab	-	-	2	1
12	BTCVS311	Seminar on Topic of Field Visit to Foundation Work	-	-	1	AU
13	BTCVF312	Field Training / Internship/Industrial Training Evaluation (from semester II)	-	-	-	1
		Sub-Total	16	4	09	
		Total	**29**			**23**

Semester- IV

Sr. No.	Subject Code	Subject	Contact Hours			Credit
			L	T	P	
		Theory				
01	BTCVC401	Hydraulics II	2	1	✓	3
02	BTCVC402	Surveying – II	2	1	✓	3
03	BTCVC403	Structural Mechanics-I	3	1	-	4

04	BTID405	Product Design Engineering	1	2	-	3
05	CV E1	**Elective I**	3	-	-	3
06	BTCVC406	Engineering Management	1	-	-	AU
07	BTHM3401	Basic Human Rights	2	-	-	AU
Practical / Drawing and/or Design						
08	BTCVL407	Hydraulics Laboratory II	-	-	2	1
09	BTCVL408	Surveying Laboratory II	-	-	4	2
10	BTCVL409	Mechanics of Solids Laboratory	-	-	2	1
11	BTCVM410	Mini Project	-	-	2	1
12	BTCVF411	Seminar on Topic of Field Visit to works involving Superstructure Construction	-	-	1	1
		Sub-Total	**14**	**5**	11	
		Total	**31**			**22**
Elective I						
	BTCVE404A BTCVE404B BTCVE404C	Numerical Methods in Engineering Planning for Sustainable Development Instrumentation & Sensor Technologies for Civil Engineering Applications	3	-	-	3

Semester- V

Sr. No	Subject Code	Subject	Contact Hours L	T	P	Credit
Theory						
01	BTCVC 501	Design of Steel Structures	2	2	-	4
02	BTCVC 502	Structural Mechanics-II	2	1	-	3
03	BTCVC 503	Soil Mechanics	3	1	✓	4
04	BTCVC 504	Environmental Engineering	2	-	✓	2
05	BTCVC 505	Transportation Engineering	2	-	✓	2
06	CV E2	**Elective II**	3	-	-	3
07	BTHM507	Essence of Indian Traditional Knowledge	1	-	-	AU
Practical / Drawing and/or Design						
08	BTCVL508	Soil Mechanics Laboratory	-	-	2	1
09	BTCVL509	Environmental Engineering Laboratory	-	-	2	1
10	BTCVL510	Transportation Engineering Laboratory	-	-	2	1
11	BTCVS511	Seminar on Topic of Field Visit to works related to Building Services	-	-	1	AU
		Sub-Total	**15**	**4**	**7**	
		Total	**26**			**21**
	BTCVE506A BTCVE506B BTCVE506C BTCVE506D	**Elective II** Materials, Testing & Evaluation Computer Aided Drawing Development Engineering Business Communication & Presentation Skills	3	-		3

Semester- VI

$:Students should register for the CVF 705 in Semester VI to undergo training during vacation after semester VI and appear at examination in Semester VII. Result shall appear in Grade-sheet of Semester VII

Sr. No.	Subject Code	Subject Title	Contact hours			Credit
			L	T	P	
01	BTCVC601	Design of Concrete Structures I	3	1	-	3
02	BTCVC602	Foundation Engineering	2	1	-	3
03	BTCVC603	Concrete Technology	2	-	✓	2
04	BTCVC604	Project Management	2	1	-	2
05	CVE3	**Elective III**	3	-	-	3
06	BTCVC606	Building Planning and Design	2	-	✓	2
		Practical / Drawing and/or Design				
07	BTCVL607	Concrete Technology Laboratory	-	-	2	1
08	BTCVL608	Building Planning, Design and Drawing Laboratory	-	-	4	2
09	BTCVM609	Community Project (Mini Project)	-	-	2	1
10	BTCVS610	Seminar on Topic of Field Visit Road Construction	-	-	1	AU
11	BTCVF611	Industrial Training$	-	-	2	--
		Sub-Total	**14**	**3**	**11**	
		Total	**28**			**19**
		Elective III				
	BTCVE605A BTCVE605B BTCVE605C BTCVE605D BTCVE605E BTCVE605F	Air Pollution Control Operations Research Geographic Data Analysis and Applications Advanced Engineering Geology Advanced Soil Mechanics Design of Masonry and Timber Structures				

Semester – VII

Sr. No.	Subject Code	Subject Title	Contact hours			Credit
			L	T	P	
01	BTCVC 701	Design of Concrete Structures II	2	1	-	3
02	BTCVC 702	Infrastructure Engineering	3	-	-	3
03	BTCVC 703	Water Resources Engineering	2	1	-	3
04	BTCVC 704	Professional Practices	2	1	✓	3
05	CVE4	**Elective IV**	3	-	-	3
06	CVE5	**Elective V**	3	-	-	3
		Practical / Drawing and/or Design				
07	BTCVL707	Professional Practices Laboratory	-	-	2	1
08	BTCVL708	Design & Drawing of Steel Structures	-	-	4	2
09	BTCVP709	Project Stage-I	-	-	2	1
10	BTCVF710	Industrial Training	-	-	-	AU
		Sub-Total	**15**	**3**	**08**	
		Total	**26**			**22**
		Elective IV				
	BTCVE705A BTCVE705B	Plastic Analysis and Design Machine Foundations	-	-		-

	BTCVE705C BTCVE705D BTCVE705E	Modern Surveying Techniques Engineering Economics Ground Improvement Techniques			
Elective V					
	BTCVE706A BTCVE706B BTCVE706C BTCVE706D BTCVE706F BTCVE706F	Advanced Structural Mechanics Town and Urban Planning Construction Economics & Finance Intelligent Transportation Systems Waste Water Treatment Tunneling and Underground Excavations	-	-	--

Semester – VIII

Sr. No.	Subject Code	Subject Title	Contact hours			Credit
			L	T	P	
01	BTCVC 801	Introduction to Earthquake Engineering	2	1		3
02	CVE6	**Elective VI**	3	-		3
03	CVE7	**Elective VII**	3	-		3
04	CVE8	**Elective VIII**	3	-		3
Practical / Drawing and/or Design						
05	BTCVL805	Earthquake Engineering Laboratory	-	-	2	1
06	BTCVL806	Design and Drawing of RC Structures	-	-	4	2
07	BTCVF807	Self-Study Report based on field visit to Infrastructure Project Works	-	-	2	1
08	BTCVP808	Project Stage-II	-	-	8	4
		Sub-Total	**11**	1	16	
		Total	**28**			**20**
		Elective VI				
	BTCVE802A BTCVE802B BTCVE802C BTCVE802D BTCVE802E	Limit State Design of Steel Structures Construction Techniques Pavement Management System Composite Materials Disaster Preparedness & Planning Management	-	-		-
Elective VII						
	BTCVE803A BTCVE803B BTCVE803C BTCVE803D	Bridge Engineering Structural Audit Design of Hydraulic Structures Environmental Impact Assessment and Life Cycle Analyses	-	-		-
Elective VIII						
	BTCVE804A BTCVE804B BTCVE804C BTCVE804D BTCVE804E	Rock Mechanics Water Power Engineering Water Resources Economics Planning and Management Finite Element Method Repair & Rehabilitation of Structures	-	-		-
		Overall Total	**50+168 = 218**			**127**

Detailed Syllabus

Semester III

Sr. No.	Subject Code	Subject	Contact Hours			Credit
			L	T	P	
Theory						
01	BTBSC301	Mathematics – III	3	1	-	4
02	BTCVC302	Mechanics of Solids	3	1	✓	4
03	BTCVC303	Hydraulics I	2	1	✓	3
04	BTCVC304	Surveying I	2	1	✓	3
05	BTCVC305	Building Construction	2	-	✓	2
06	BTCVC306	Engineering Geology	2	-	✓	2
07	BTHM303	Soft Skills Development	2	-	-	AU
Practical / Drawing and/or Design						
08	BTCVL307	Hydraulics Laboratory I	-	-	2	1
09	BTCVL308	Surveying Laboratory I	-	-	2	1
10	BTCVL309	Building Construction - Drawings Laboratory	-	-	2	1
11	BTCVL310	Engineering Geology Lab	-	-	2	1
12	BTCVS311	Seminar on Topic of Field Visit to Foundation Work	-	-	1	AU
13	BTCVF312	Field Training / Internship/Industrial Training Evaluation (from semester II)	-	-	-	1
		Sub-Total	16	4	09	
		Total	**29**			**23**

BTBSC301Mathematics – III

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

Course Contents

Module 1: Laplace Transform (Lectures 08)

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 08)

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 05)

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 05)

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 $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$,and two dimensional heat flow equation (i.e. Laplace equation : $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$)

Module5: Functions of Complex Variables (Differential calculus)(Lectures 05)

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.

Module6: Functions of Complex Variables (Integral calculus)(Lectures 07)
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. VermaRajnish, "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", Pune VidyarthiGrihaPrakashan, 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", Tata Mcgraw-Hill 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 civil engineering phenomena in field of structures, survey, fluid mechanics and soil mechanics.

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BTCVC302Mechanics of Solids

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

Course Contents

Module 1: Stress and Strain
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 Beams
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: 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

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

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

Module 6: Theories of Failure: Concept of failure in strength and failure in deformation, statement and application of 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, "Strength of Materials", Harper Collins Publishers, Fourth Edition
- Junnarkar S.B. (2014), "Mechanics of Structures", Charotor Publishers, Anand, 31st edition,
- Khurmi R.S., "Strength of Material", S. Chand and Co., Edition revised 1968, New Delhi
- Sadhu Singh, "Strength of Materials", Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-048-7
- Prasad I.B, "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., "Elements of Strength of Materials", East West Press, 4th edition 1962, New Delhi
- Prasad I.B, "A text book of Strength of Materials", ISBN: 978-81-7409-069-X
- Dr. Sadhu Singh, "Strength of Materials", ISBN: 978-81-7409-048-7
- Ramamrutham S., "Strength of Materials", Dhanpatrai and Sons, Delhi

Reference Books

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

CO4: Visualize force deformation behavior of bodies.

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BTCVC303 Hydraulics I

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

Course Contents

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

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

Module 2: Fluid Statics **(Lectures 06)**

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

Module 3: Fluid Kinematics **(Lectures 06)**

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

Module 4: Laminar Flow **(Lectures 06)**

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

Module 5: Dimensional Analysis and Similitude **(Lectures 06)**

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

Module 6: Flow Measurement **(Lectures 06)**

Direct methods, restriction flow meters, linear flow meters, traversing methods, measurements in open channel flow

Flow Through Pipes: 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. andMc-Donald. A. T., "Introduction to Fluid Mechanics", John Wiley and Sons, Fifth Edition
- Modi and Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, Tenth Edition , 1991
- Kumar K. L., "Fluid Mechanics"
- Bansal R. K., "Fluid Mechanics"
- Jain A.K, "Fluid Mechanics including Hydraulic Machines" ISBN: 978-81-7409-194-7

Reference Books

- Streeter V. L., Bedford K. W. and Wylie E. B., "Fluid Dynamics", New York, McGraw-Hill, Ninth Edition, 1998
- Som S. K. & Biswas G., "Introduction to Fluid Mechanics & Fluid Machines", Tata McGraw-Hill, 2nd Edi., 2003

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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BTCVC304 Surveying – I

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

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 Surveying **(Lectures 08)**

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

Module 3: Plane Table Surveying **(Lectures 05)**

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

Module 4: Leveling and Applications **(Lectures 08)**

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 5: Theodolite Surveying **(Lectures 05)**

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 6: Engineering Surveys **(Lectures 05)**

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., "Surveying and Leveling", Vols. I, II and III, VidyarthiGruhPrakashan, Pune
- Punmia B.C., “Surveying”, Vols. I, II and III, Laxmi Publications, 16th edition, 2016

Reference Books

- Clark D., “Plane and Geodetic Surveying", Vol. I & II, C.B.S. Pub. &Distri., N. Delhi, 6th edi.
- Anderson J. M. and Mikhail E. M., “Introduction to Surveying”, McGraw Hill Book Company
- Bannister A. and Raymond S., “Surveying", ELBS, Sixth Edition, 1992
- KahmenHeribert and Faig Wolfgang, “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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BTCVC305 Building Construction

Teaching Scheme: (2 Lectures) hours/week

Course Contents

Module 1: Masonry Construction **(Lectures 06)**

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 08)**

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, various types, uses and limitations

Ramps: Requirements and types, planning aspects for physically handicapped persons

Elevators: Types and their Use

Module 5: Flooring Roofs and Types **(Lectures 06)**

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

Module 6: Precast and Pre-engineered Buildings **(Lectures 05)**

Principles- advantages and disadvantages, types of prefabricate, standardization, basic, nominal and actual dimensions, tolerances, joints production, transportation and erection

Text Books

- Punmia B.C., Jain A. K., “Building Construction", Laxmi Pub. Pvt. Ltd., 10th Edi, N. Delhi
- Arora S. P. and Bindra S. P., “Text Book of Building Construction”, DhanpatRai Publications
- Kumar Sushil, “Building Construction” Standard Publishers, 20th Edition, 2010.
- P. Purushothama Raj, “Building Construction Materials and Techniques”, Pearson Education
- Jain V.K., “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., "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., “A Course in Civil Engineering Drawing”, S. K. Kataria and Sons
- Catalogues. Information Brochures, Trade Literature by material or product manufacturers
- Mehta, Scarborough, Armpriest, “Building Construction”, Pearson Education
- Macay W.B, “Building Construction”, Vol. I, II, III, IV, Pearson Education
- Jain V.K., “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: Understand composition of concrete and effect of various parameters affecting strength.
CO3: Comprehend components of building and there purposes.
CO4: Comprehend the precast and pre-engineered building construction techniques.

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BTCVC306Engineering Geology

Teaching Scheme:(2 Lectures) 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 07)**

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 **(Lectures 05)**

Outcrop, Strike and Dip, Unconformity-Types, Outliers and Inliers, Overlap Fold and Fault: Parameters, Classification, Causes, Civil Engineering significance Joint: Types, Civil engineering considerations

Module 4: Building Stones **(Lectures 05)**

Properties of rocks, Requirement of good building stone, Building stones of India

Groundwater: Sources of groundwater, water table, Zones of groundwater, Porosity and permeability

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

Preliminary geological survey, Influence of geological conditions on location, alignment, Design and Type 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 reservoir site

Tunnels and Bridges: Influence of geological conditions on tunneling, difficulties during tunneling, tunnel lining, tunneling in folded strata, sedimentary rocks and Deccan traps, dependence of types of bridges on geological conditions

Module 6: Preliminary Geological Investigations **(Lectures 06)**

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

Text Books

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

Reference Books

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

- Read H. H., “Rultey’s Elements of Mineralogy”, CBS Publishers & Distributors, Delhi

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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BTHM303Soft Skills 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 02)**

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 02)**

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 02)**

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 02)**

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 Skills Development **(Lectures 02)**

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

Module 6: Effective Computing Skills **(Lectures 02)**

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

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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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BTCVL307Hydraulic Engineering Laboratory I

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 different diameters)
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.

BTCVL308Surveying Laboratory - I

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. Practical examination shall be based on above practical course.

Essential Practical

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 four 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

6) Study and use of Minor Instruments

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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BTCVL309Building Construction - Drawings Laboratory

Practical: 2 hours / week

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.

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

CO1: Draw plan, elevation and section of various structures.

CO2: Apply the principles of planning and by laws used for building planning.

CO3: Prepare detailed working drawing for doors and windows.

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BTCVL310 Engineering Geology Laboratory

Practical:2 hours / Week

List of Experiments

Practical Work 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 tour to the places of Engineering Geological importance

A Journal containing record of above practical work shall be examined as Term Work. Practical examination shall be based on above practical course.

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

CO1: Calculate the linear measurement on surface.

CO2: Find out engineering properties of various geological materials.

CO3: Draw subsurface lithologs.

CO4: Identify minerals and rocks by studying physical properties.

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BTCVS311Seminar on Topic of Field Visit to Foundation Work

Student shall visit to ongoing construction sites in field to witness and collect necessary information from works of foundation execution. It is desirable to collect basic information of geotechnical aspects of foundations, types and components of foundations, tools and plants, construction machinery, etc. Intention is to introduce students to process of collection and presentation of technical information. Report shall be submitted to cover above aspects as studied.

BTCVF312Field Training (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 report and power point presentation.

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Semester- IV

Sr. No.	Subject Code	Subject	Contact Hours			Credit
			L	T	P	
		Theory				
01	BTCVC401	Hydraulics II	2	1	✓	3
02	BTCVC402	Surveying – II	2	1	✓	3
03	BTCVC403	Structural Mechanics-I	3	1	-	4
04	BTID405	Product Design Engineering	1	2	-	3
05	CV E1	**Elective I**	3	-	-	3
06	BTCVC406	Engineering Management	1	-	-	AU
07	BTHM3401	Basic Human Rights	2	-	-	AU
		Practical / Drawing and/or Design				
08	BTCVL407	Hydraulics Laboratory II	-	-	2	1
09	BTCVL408	Surveying Laboratory II	-	-	4	2
10	BTCVL409	Mechanics of Solids Laboratory	-	-	2	1
11	BTCVM410	Mini Project	-	-	2	1
12	BTCVF411	Seminar on Topic of Field Visit to works involving Superstructure Construction	-	-	1	1
		Sub-Total	**14**	**5**	11	
		Total	**31**			**22**
		Elective I				
	BTCVE404A BTCVE404B BTCVE404C	Numerical Methods in Engineering Planning for Sustainable Development Instrumentation & Sensor Technologies for Civil Engineering Applications	3	-	-	3

BTCVC401Hydraulics 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 05)**

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 **(Lectures 07)**

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

Module 4: Impact of Jet **(Lectures 05)**

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: Hydraulic Machines **(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

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

Module6: Boundary Layer Theory **(Lectures 06)**

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

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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BTCVC402Surveying – II

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

Course Contents

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

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 **(Lectures 06)**

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 **(Lectures 06)**

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

Module 4: Curves **(Lectures 06)**

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 5: Photogrammetry **(Lectures 06)**

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

Module 6: Remote Sensing **(Lectures 06)**

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., “Surveying", ELBS, 6th Editon, 1992
- HeribertKahmen and Wolfgang Faig, “Surveying ", Walter de Gruyter, 1995
- Kanetkar T.P., "Surveying and Leveling", Vols. I, II and III, VidyarthiGruhPrakashan, 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”Vol 1 & 2, Tata Mcgraw Hill Publications, New Delhi

- 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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BTCVC403Structural Mechanics – I

Teaching Scheme:(3 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 05)**

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 07)**

Different structural systems, concept of analysis, basic assumptions, indeterminacy, choice of unknowns, Castiglano'stheorem

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 06)**

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 06)**

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

Module 6: Thin Cylinders **(Lectures 07)**

Thin cylinders subjected to internal fluid pressure, wire wound thin cylinders, thin cylindrical shells, circumferential and hoop stresses, longitudinal stresses, maximum shear stress, concept of stresses in thick cylinders

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” DhanpatRai 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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BTID405Product Design Engineering

Course Contents

Pre Requisites: Knowledge of Basic Sciences, Mathematics and Engineering Drawing

Design Studio:2 hr / week to develop designs through sketching,practical skills and learning digital tools

Continuous Assessment: Documentation of steps in the selected product design

Final Assessment: Product Design in Studio with final product specifications

Course Outcomes: At the end of the course, students will be able to

1. Create simple design of components or a system as whole
2. Create design documents for knowledge sharing
3. Manage own work to meet design requirements
4. Work effectively in a team

Subject refers to products in civil engineering. Product may an entity such as a building, bridge, road, railway, airport, tunnel, port, harbor, water supply or disposal schemes or components involved in such entities as tiles, doors, windows, walls, structural members, abutment, pier, etc., or even materials produced in industry such as cement, steel, composits, FRP, bricks or blocks etc. It is intended to refer to few of these products which may be chosen by student. Group activity is encouraged.

Module1:Introduction to Engineering Product Design: (Lectures 02)

Concept of a product, Problem solving approach for Product Design, Trigger for Product/ Process/ System, Disassembling existing Product(s) and understanding relationship of components with each other, Sketching of components, identifying materials and their processing for final product, fitting of components, understanding manufacturing as scale of the components, Reverse engineering concept, case studies of products in markets, (or in each discipline), underlying principles, Case studies of product failures, revival of failed products, Public/Society’s perception of products, and its input into product design.

Module 2: Ideation (Lectures 02)

Generation of ideas, Funnelling of ideas, Short-listing of ideas for product(s) as an individual or group of individuals, Sketching of products, Market research for need, competitions, scale and cost, Initial specifications of products

Module 3: Conceptualization (Lectures 02)

Computer operation principles and image editing through a graphical Composition; Computer aided 2D drafting and 3D Modeling through simple exercises.

Designing of components, Drawings of parts and synthesis of a product from its component parts, idea of rendering designs for 3-D visualization and to create a photo image, Parametric modelling of product, 3-D Visualization of mechanical products, Detail Engineering drawings of components

Module 4:Detailing **(Lectures 02)**

Managing assembling, Product specifications- data Sheet, Simple component designs, Workshop and erection safety and health issues, Create documents for knowledge sharing

Hands-on Activity Charts for Use of Digital Tools using software such as Autodesk Fusion 360 or similar freeware

Activity 1	Learn the basic vector sketching tools.	2
Activity 2	General understanding of shading for adding depth to objects. Understanding of editing vectors	2
Activity 3	Begin developing a thought process for using digital sketching.	3
Activity 4	Create a basic shape objects sphere, box cylinders	3
Activity 5	Create Automotive wheel concepts	3
Activity 6	Understanding Navigation and Data Panel Interface	2
Activity 7	Solid and Surface modelling, Rendering 3-D models	4
Activity 8	Product market and Product Specification Sheet	3
Activity 9	Documentation for the product	2

Reference Books

- Model Curriculum for "Product Design Engineer –Mechanical", NASSCOM (Ref. ID: SSC/Q4201, Ver 1.0, NSQF Level: 7)
- Eppinger, S., & Ulrich, K. (2015), "Product Design and Development". McGraw-Hill Higher Education.
- Green, W., & Jordan, P. W. (1999), "Human Factors in Product Design: Current Practice and Future Trends", CRC Press.
- Sanders, M. S., & McCormick, E. J. (1993), "Human Factors in Engineering and Design", McGraw-Hill Book Company
- Roozenburg, N. F., &Eekels, J. (1995), "Product Design: Fundamentals and Methods (Vol. 2)", John Wiley & Sons Inc.
- 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.

BTCVE404A Numerical Methods in Engineering

Teaching Scheme:(3 Lectures) hours/week

Pre Requisites: Mathematics - I and Mathematics – II

Course Contents

Module 1(Lectures 06)

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 06)**

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 RungaKutta Methods.

Module 3 **(Lectures 06)**

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 04)**

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

Module 6 **(Lectures 04)**

Implementation of above methods by algorithm development leading to programming in Spreadsheets / Fortran / C / C++

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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BTCVE404B 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, Environmental degradation and poverty Sustainable development: its main principles, the evolution of ideas about sustainability,

Module 2: **(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 3: **(Lectures 04)**

Innovation for sustainable development- Environmental management and innovation strategies.

Module 4: **(Lectures 04)**

Societal transformations. Institutional theory.

Module 5: **(Lectures 04)**

Governance for sustainable development. Policy responses to environmental degradation.

Module 6: **(Lectures 04)**

Capacity development for innovation. Research methods.

Text/Reference Books:

- Harris, J.M. (2204) Basic Principles for Sustainable Development, Global Development and Environment
- Institute, working paper 00-04, available at: http://ase.tufts.edu/gdae/publications/Working_Papers/Sustainable%20Development.PDF
- Robinson, J. (2004), "Squaring the circle? Some thoughts on idea of sustainable Development" Ecological Economics 48(4): 369-384.
- Hjorth, P. & A. Bagheri (2006), "Navigating towards Sustainable Development: A System Dynamics Approach", Futures 38: 74-92.

- 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 (PDF – 68 kb)
- 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.
- Douthwaite, B. (2002) Enabling Innovation. A practical guide to understanding & fostering innovation, London, Zed Books.

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BTCVC406Engineering Management

Teaching Scheme:(1 Lecture) hours/week

Course Contents

Module 1: Evolution of Management Thought **(Lectures 02)**

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, Maslow

Module 2: Functions of Management **(Lectures 02)**

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 02)**

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 **(Lectures 04)**

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

Module 5: Simulation Studies **(Lectures 02)**

Monte-Carlo simulation, queuing or waiting line theory (simple problems), dynamic programming, introduction to emerging optimization techniques

Module 6: Material Management **(Lectures 02)**

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., “Operation Research”
- Deshpande A. S., “A Text book of Management”
- Gopal Krishnan, “Material Management”, Sdueshan.
- Taha, “Operation Research”
- Banga and Sharma, “Engineering Managnment”

References

- Stoner, “Engineering Management”
- Davar, “Principles of Management”
- Koontz, Dounell and Weigrick, “Essentials of Management”
- Kast and Rosinweig, “Management and Organization”, Tata McGraw Hill Publication.

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- Wagner, "Operation Research", Wikey Easter Ltd., New Delhi
- Zhamb L.C., "Quantitative Techniques in Management", Vol. I,
- Miller and Stars, "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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BTHM3401Basic Human Rights

Teaching Scheme:(2 Lectures) hours/week

Course Contents

Module 1: Basic Concepts **(Lectures 04)**

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, Rights of working & exploited people

Module 2: Fundamental Rights and Economic Program **(Lectures 04)**

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 04)**

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

Module 4: NGOs and Human Rights in India **(Lectures 04)**

Land, Water, Forest issues.

Module 5: Human Rights in Indian Constitution and Law **(Lectures 04)**

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

Module 6: UDHR and Indian Constitution **(Lectures 04)**

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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BTCVL407Hydraulic 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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BTCVL408 Surveying Laboratory - II

Practical:4 hours / week

Practical Work consists of performing field practical from the list below and detailed reporting in form of journal. Practical examination shall be based on above.

1. Tacheometry

a) Determination of tachometric constants, b) Determination of grade of a line.

2. Use of subtense bar for distance measurement.

3. Setting out of curves

a) Simple circular curves, b) Transition curves

4. Study of topo sheets

5. Study of Aerial Photographs under Stereoscope

6. Traversing by Total Station.

Projects: 1) Road Project 2) Radial Contouring. 3) Block Contouring Project 4) Theodolite Traversing

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

CO1: Determine contour level of field.
CO2: Determine the tachometric constants and grade of a line.
CO3: Use sub tense bar for distance measurement.

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BTCVL409 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:

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

Determine the strength of coarse aggregates.

Find the compressive strength of concrete cubes and bricks.

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

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BTCVM410 Mini Project

Practical: 2 hours / week

Students shall take up work leading to product development. Needs of community around may be of prime concern. Work may target at easing out conventional construction operation by improvement of traditional devices / tools or development of altogether new approach.

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BTCVF411 Seminar on Topic of Field Visit to works involving Superstructure Construction

Student shall visit to ongoing construction sites in field to witness and collect necessary information from works of execution of superstructure of buildings or other. It is desirable to collect basic information on components of superstructure, tools and plants, construction machinery, etc. Intention of the work is to introduce the student to the chronological order of execution of works and generate data on vocabulary of terms in field.

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Semester- V

Sr. No	Subject Code	Subject	Contact Hours L	T	P	Credit
Theory						
01	BTCVC 501	Design of Steel Structures	2	2	-	4
02	BTCVC 502	Structural Mechanics-II	2	1	-	3
03	BTCVC 503	Soil Mechanics	3	1	✓	4
04	BTCVC 504	Environmental Engineering	2	-	✓	2
05	BTCVC 505	Transportation Engineering	2	-	✓	2
06	CV E2	**Elective II**	3	-	-	3
07	BTHM507	Essence of Indian Traditional Knowledge	1	-	-	AU
Practical / Drawing and/or Design						
08	BTCVL508	Soil Mechanics Laboratory	-	-	2	1
09	BTCVL509	Environmental Engineering Laboratory	-	-	2	1
10	BTCVL510	Transportation Engineering Laboratory	-	-	2	1
11	BTCVS511	Seminar on Topic of Field Visit to works related to Building Services	-	-	1	AU
		Sub-Total	**15**	**4**	**7**	
		Total	**26**			**21**
		Elective II				
	BTCVE506A	Materials, Testing & Evaluation	3	-		3
	BTCVE506B	Computer Aided Drawing				
	BTCVE506C	Development Engineering				
	BTCVE506D	Business Communication & Presentation Skills				

BTCVC 501 Design of Steel Structures

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

Course Contents

Module 1: Introduction and Connections **(8 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 **(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 3: 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 4: 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

Module 5: 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

Module 6: Introduction to Plastic Analysis and Limit State method (4 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.

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BTCVC 502 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

Module 2: Moving Loads and Influence Lines **(6 Lectures)**

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 3: Cables, Suspension Bridges and Arches **(6 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 4: Analysis of Indeterminate Structures by direct Flexibility Method **(6 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 5: Analysis of Indeterminate Structures by direct Stiffness Method **(6 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 6: 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
- Wang C.K., "Statically Indeterminate Structures", McGraw Hill
- Vazirani V.N., Ratwani M.M and Duggal S.K., "Analysis of Structures - Vol. II" Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-205-6
- Sadhu Singh, "Theory and Solved Problems in Adv. Strength of Materials", Khanna Publishers, N. Dehli, ISBN No. 978-81-7409-212-7
- Ramamrutham S. and Narayanan R., "Theory of Structures" Dhanpat Rai 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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BTCVC 503 Soil Mechanics

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

Course Contents

Module 1: Introduction (2 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 (6 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 (8 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 (8 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

Module 6: Earth Pressure Theories (5 Lectures)

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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BTCVC 504 Environmental Engineering

Teaching Scheme: (2 Lectures) hours/week

Course Contents

Module 1: Introduction **(4 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 **(4 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 of Waste Water **(2 Lectures)**

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

Module 5: Treatment of Solid Waste **(3 Lectures)**

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 6: Air Pollution **(3 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 505 Transportation Engineering

Teaching Scheme: (2 Lectures) hours/week

Course Contents

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

Importance of various modes of transportation, Highway Engineering, Road Classification, Developments in Road Construction, 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: **(4 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 **(6 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 **(6 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

Module 6: Other modes of Transport **(4 Lectures)**
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

Course Outcomes: 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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BTHM3507 Essence of Indian Traditional Knowledge

Teaching Scheme: 1 Lecture / week

Course Contents

Module I **(03 Lectures)**
Ancient Education System in India, History of Indian Knowledge System, Sources of knowledge transmission and

preservation, Indian Artistic Tradition: Chitrakala, Moorthikala,Vasthukala, Sthapthya, Sangeetha, Nruthya, Sahithya

Module II **(02 Lectures)**
Indian Linguistic Tradition (Phonology, morphology, syntax & semantics), Yoga & Holistic Health care

Module III **(01 Lectures)**
Philosophical Traditions in ancient India, Relevance in today's life

Module IV **(03 Lectures)**
Glimpses of ancient Indian science and technology, Ancient structures in India, Traditional materials, Construction styles and Techniques, Developments in construction materials, living styles and habitation, Town Planning, Case Studies

Module V **(02 Lectures)**
Developments in water supply, sanitation, irrigation and agriculture, Case Studies

Module VI **(01 Lectures)**
Developments in transportation and communication, Case Studies

Text / Reference Books

- V. Sivaramakrishna, "Cultural Heritage of India", Course Material, Bharatiya Vidya Bhavan, Mumbai, 5th Edi., 2014
- Swami Jitatmanand, "Modern Physics and Vedant", Bharatiya Vidya Bhavan
- Fritzof Capra, "Tao of Physics"
- Fritzof Capra, "The wave of Life"
- 5Jha V. N. (English Trans,), "Tarkasangraha of Annam Bhatta", Inernational Chinmay Foundation, Velliarnad, Arnakulam
- "Yoga Sutra of Patanjali", Ramakrishna Mission, Kolkatta
- Jha GN (English Trans.), R N Jha, "Yoga-darshanam with Vyasa Bhashya", Vidyanidhi Prakasham, Delhi, 2016
- Jha RN, "Science of Consciousness Psychotherapy and Yoga Practices", Vidyanidhi Prakasham, Delhi, 2016
- P R Sharma (English translation), "Shodashang Hridayam"
- Indian Journal of Traditional Knowledge: https://www.niscair.res.in/sciencecommunication/researchjournals/rejour/ijtk/ijtk0.asp
- Swayam Course by Prof. D. P. Mishra, IIT Kanpur: https://swayam.gov.in/nd1_noc19_ae07/preview

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BTCVL508 Soil Mechanics Laboratory

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 Attergerg'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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BTCVL509Environmental 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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BTCVL510Transportation Engineering Laboratory

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

6) Penetration Test
7) Softening Point Test
8) Flash and Fire Point Test
9) Ductility Test
10) Viscosity Test
11) Specific Gravity Test
12) Demonstration of Marshall Test
13) Pavement design exercise based on flexible pavement consisting of bituminous concrete.
14) 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.

Perform CBR tests on local soils to determine subgrade properties needed for roadways.

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BTCVF511Seminar on Topic of Field Visit to works related to Building Services

Student shall visit to ongoing construction sites in field to witness and collect necessary information from works of execution of building services such as electrification, plumbing, air-conditioning, acoustics, etc. It is desirable to collect basic information on components, tools and plants, construction equipment, safety precautions, etc. Intention of the work is to introduce the student to the chronological order of execution of works and generate data on vocabulary of terms in field.

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BTCVE506A Materials, Testing &Evaluation

Course Objectives:

1. To provide an overview to the students about various types of civil engineering materials used in constructions along with their properties.
2. To enable students to know details of various tests to be performed on civil engineering materials to evaluate their quality to know their suitability for use in construction.

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: **(4 Lectures)**

Composite Materials: RCC, FRC, steel/concrete composite bridge decks, fibre reinforced plastics structural insulated panels.

Module4: **(4 Lectures)**

Comparison of Different Materials, Introduction, comparison of strengths of various materials, comparison for environmental impact, health and safety.

Module 5: **(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 6: **(6 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:

- S.V. Deodhar. (1990),Civil Engineering Materials', Allied Publishers, N. Delhi.
- S.C Rangwala. (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

1. To develop skill among students to construct strong and durable structures by applying knowledge of material science.
2. To make the students aware of quality assurance and control in their real life as a professional.

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BTCVE506C Development Engineering

Course Objectives:

The main objectives of the course are:

1. To provide an overview to the students of the various fields within planning, such ascommunity development, urban planning and sustainability, challenges at rural level, rural development.
2. To enable students to develop professional capabilities through field and design workin real world problems in the field of planning and development of urban and ruralareas.

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

Module2: **(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;

Module3: **(6 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

Module4: **(6 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.

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Module5: **(6 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.

Module6: **(6 Lectures)**

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

1. To develop multi scaled perspective about decisions in the built environment,
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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BTCVE506D Business Communication & Presentation Skills

Teaching Scheme: (3 Lectures) hours / Week

Course Contents

Module 1: Language for Technical Purpose and Presentation Tools

Technical vocabulary, Sentence structures, Computer Aids, Graphical presentations **(03 Lectures)**

Module 2: Formal Written Communication

Drafting Letters, e-Mails, Memos, Notices, Circulars, Schedules. **(03 Lectures)**

Module 3: Project Proposals and Reports

Abstract, Aims, Background & significance, Design & methods, writing a sample proposal, Project Report: Types of reports, Planning a report, Collection & organization of information, Structure & style, Proofreading etc. **(06 Lectures)**

Module 4: Leadership Skill and Team Building, Working.

Leadership Skills**:** Leadership quality and styles, Emotional intelligence, Diplomacy and Tact and effective communication, Case studies. Need of team, Effective teams, Group development **(06 Lectures)**

Module 5: Business Meetings

Understanding role of meetings, planning meetings, developing meeting agendas, scheduling meetings, Taking notes and publishing minutes **(06 Lectures)**

Module 6: Presentation Skills

Use of presentation tools, Presentation, nonverbal techniques, handling questions **(04 Lectures)**

References:

- S. Hariharan, et.al. Soft Skills; MJP Publishers, 2010.
- John Seely, Oxford Guide to Effective Writing and Speaking; Oxford University Press, 2009.
- Thomas N. Huckin and Leslie A. Olsen, Technical Writing and Professional Communication for Nonnative Speakers of English; Tata McGraw Hills, International Edition, 1991.
- Ann Masters & Harold R. W., Personal Development for Life & Work,10e,Cengage, Learning India Private Limited,2011.

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Semester- VI

$:Students should register for the CVF 705 in Semester VI to undergo training during vacation after semester VI and appear at examination in Semester VII. Result shall appear in Grade-sheet of Semester VII

Sr. No.	Subject Code	Subject Title	Contact hours			Credit
			L	T	P	
01	BTCVC601	Design of Concrete Structures I	3	1	-	3
02	BTCVC602	Foundation Engineering	2	1	-	3
03	BTCVC603	Concrete Technology	2	-	✓	2
04	BTCVC604	Project Management	2	1	-	2
05	CVE3	**Elective III**	3	-	-	3
06	BTCVC606	Building Planning and Design	2	-	✓	2
		Practical / Drawing and/or Design				
07	BTCVL607	Concrete Technology Laboratory	-	-	2	1
08	BTCVL608	Building Planning, Design and Drawing Laboratory	-	-	4	2
09	BTCVM609	Community Project (Mini Project)	-	-	2	1
10	BTCVS610	Seminar on Topic of Field Visit Road Construction	-	-	1	AU
11	BTCVF611	Industrial Training$	-	-	2	--
		Sub-Total	**14**	**3**	**11**	
		Total	**28**			**19**
		Elective III				
	BTCVE605A	Waste Water Treatment				
	BTCVE605B	Operations Research				
	BTCVE605C	Geographic Data Analysis and Applications				
	BTCVE605D	Advanced Engineering Geology				
	BTCVE605E	Advanced Soil Mechanics				
	BTCVE605F	Design of Masonry and Timber Structures				

BTCVC601Design of Concrete Structures - I

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

Course Contents

Module 1: **(5 Lectures)**

Basic Aspects of Structural Design, Introduction to Design Philosophies, Stress Strain behaviour of Materials, Permissible stresses, Comparison of Different Philosophies, Estimation of Loads

Working Stress Method

Module 2: **(5 Lectures)**

Stress block parameters, Balanced, under reinforced and over reinforced section: Modes of failure, properties of singly and doubly reinforced rectangular section beams, Analysis and Design of Singly and Doubly Reinforced Beams

One Way and Two Way Slab: Behavior of slabs, types, support conditions, analysis and design with various conditions

Module 3: **(4 Lectures)**

Analysis and Design of Axially and Eccentrically Loaded Columns, Isolated Column Footings, Staircases, Design of dog-legged and open well stair case, effective span and load distribution

Limit State Method

Module 4: Introduction to Limit State Approach **(5 Lectures)**

Introduction to Limit State Approach, Types and Classification of Limit States, Characteristics Strength and Characteristics Load, Load Factor, Partial Safety Factors

Module 5: Limit State of Collapse (Flexure) **(7 Lectures)**

Limit State of Collapse (Flexure): Analysis and Design of Singly and Doubly Reinforced Rectangular Beam Sections, properties of Flanged (L and T) sections, Analysis and Design of Flanged Beams

Module 6: Limit States of Collapse (Shear and Bond) **(7 Lectures)**

Limit States of Collapse (Shear and Bond): Shear Failure, Types of Shear Reinforcement, Design of Shear Reinforcement, Bond – Types, Factors Affecting, Resistance, Check for Development Length, detailing of reinforcement

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"
- 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

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 to the various design philosophies used for design of reinforced concrete.

Analyze and design the reinforced concrete slab using limit state and working state method.

Analyze and design the reinforced concrete beam using limit state and working state method.

Analyze and design the reinforced concrete column using limit state and working state method.

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BTCVC602Foundation Engineering

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

Course Contents

Module 1: **(6 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: **(7Lectures)**

Bearing Capacity Analysis - Failure Modes, Terzaghi'sAnalysis,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: **(5Lectures)**

Foundationsfor 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, Modification of Expansive Soils, Design of Foundation on Swelling Soils, Ground Improvement Methods: for general considerations, for Cohesive Soils, for Cohesionless Soils,

Module 4: **(5 Lectures)**

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

Module 5: **(7 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 6: **(6 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 andGraphical 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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BTCVC603Concrete 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 (3 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 (4 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

Module 5 (4 Lectures)

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 6 (6 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.

BTCVC604Project Management

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

Course Contents

Module 1: **(6 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: **(4 Lectures)**

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

Module 3: **(4 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: **(5 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: **(5 Lectures)**

Linear break even analysis – problems, quality control – concept, statistical methods – control charts

Module 6: **(5 Lectures)**

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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BTCVC606Building Planning and Design

Teaching Scheme:2 Lectures hours/week

Course Contents

Planning of Buildings

Module 1: **(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: **(6 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

Module3: **(6 Lectures)**

Traditional constructions using stone, brick, timber, bamboo, mud, lime, etc. low cost housing-materials & methods (conceptual introduction only), maintenance, repairs, rehabilitation

Building Services

Module 4:Plumbing Systems **(10Lectures)**

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 rain water 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

Module 5: Ventilation **(10 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

Module6: Introduction to Acoustics **(10 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

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

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

To plan buildings considering various principles of planning and bye laws of governing body.

Comprehend various utility requirements in buildings

Understand various techniques for good acoustics.

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BTCVL607Concrete 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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BTCVL608Building Planning Design and Drawing Laboratory

Practical:4 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.
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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BTCVM 609Community Project (Mini Project)

Student shall choose a topic of his interest in consultation with faculty in the department. The topic for community project may be related to 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. It is desirable to obtain industry or community sponsorship. Simplified tools or devices may be presented in form of working model and a brief report stating development. A power point presentation shall also be submitted.

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BTCVS610Seminar on Topic of Field Visit Road Construction

Student shall visit to ongoing construction sites in field to witness and collect information from works of execution of roads. It is desirable to collect basic information on components of roads, construction machinery, etc. Intention of the work is to introduce the student to the sequential order of execution of road works, preparation of road alignment and various surveys

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BTCVF611Industrial 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 VI and appear at examination in Semester VII.

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Elective III

BTCVE605AWaste Water Treatments

Teaching Scheme:(3 Lectures) hours/week

Pre Requisites: Environmental Engineering

Course Contents

Module 1: Wastewater Treatment **(5 Lectures)**

Introduction of wastewater, its types and various sources, Concept of sewage, sullageand storm water, Necessity of treatment of waste water

Preliminary treatment: screening and grit removal units, oil and grease removal, Primary treatment,

Secondary treatment: Activated sludge process, trickling filter, sludge digestion, drying bed. Stabilization pond, septic tank, soakage system, Imhoff Tank, recent trends and advanced wastewater treatment: nutrient removal, solids removal

Module 2: Low cost wastewater treatment methods **(7 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 3: Industrial Waste Water Treatment Management **(6 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 4: Waste Water Treatment Methods **(7 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 5: Environmental Sanitation **(6 Lectures)**

Communicable diseases, Methods of communication, Diseases communicated by discharges of intestines, nose and throat, other communicable diseases and their control

Insects and Rodent Control-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

Module 6:Rural Sanitation **(5 Lectures)**

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

- Manual on sewerage and sewage Treatment-Government of India Publication
- Masters G.M., “Introduction to Environmental Engineering and Science”
- Metcalf & Eddy, “Waste Water Engineering Treatment & Disposal”, Tata McGraw Hill, 1982
- Garg S.K., “Sewage Disposal and Air Pollution Engineering”, Khanna Publishers
- Rao M.N.&Datta, Waste water treatment
- EhalersVictor& Earnest W Steel, Municipal and Rural sanitation

Reference Books

- Peavey, Rowe D.R. and Tchobanoglous, “Environmental Engineering”, McGraw-Hill Book Co.
- Viessman and Hammer, “Water Supply and Pollution Control”, Harper Collins College Pub.
- Hammer M.J., “Water and Waste water Technology”, Prentice-Hall of India Private Limited
- Canter, “Environmental Impact Assessment”, Tata McGraw Hill Publication
- Bhatia H. S., Environmental Pollution and Control, Galgotia Publication Pvt. Ltd., New Delhi

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

Determine the sewage characteristics and design various sewage treatment plants.

Understand municipal water and wastewater treatment system design and operation.

Apply environmental treatment technologies and design processes for treatment of industrial waste water.

Understand the rural sanitation schemes.

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BTCVE605CGeographic Data Analysis and Applications

Teaching Scheme: (3 Lectures) hours / Week

Pre Requisites: Mathematics - I and Mathematics – II

Course Contents

Module 1: **(6 Lectures)**

Basic concepts of GIS- Information systems, spatial and non-spatial information, geographical concepts and terminology, advantages of GIS, basic components of GIS, commercially available GIS hardware and software, organization of data in GIS.

Module 2: **(6 Lectures)**

GIS data- Field data, statistical data, Maps, aerial photographs, satellite data, points, lines and areas features, vector and raster data, advantages and disadvantages, data entry through keyboard, digitizers and scanners, digital data, preprocessing of data rectification and registration, interpolation techniques.

Module 3: **(6 Lectures)**

Data management- DBMS, various data models, run-length encoding, quadtrees, data analysis-data layers, analysis of spatial and non-spatial data, data overlay and modeling, data processing: raster based and vector based, data presentation –hardcopy devices, softcopy devices.

Module 4: **(6 Lectures)**

Remote sensing and GIS integration- Principles of electromagnetic remote sensing, imaging characteristics of remote sensing systems, extraction of metric and descriptive information from remotely sensed images, integration of remote sensing &GIS.

Module 5: **(6 Lectures)**

Digitizing, Editing and Structuring of map data: Digitizing: manual, semiautomatic and automatic, editing: error detection and correction, tolerances, topology creation, Attribute map generation.

Digital Elevation Model: Need of DEM, Various structures of DEM: line,

Module 6: **(6 Lectures)**

Applications of GIS- Map revision, land use, agriculture, forestry, archaeology, municipal geology, water resources, soil erosion, land suitability analysis, change detection

Term Work:

Each student to appear for at least one written test during the semester. At least 10 assignments based on above syllabus and the graded answer paper for the semester test to be submitted.

Text/Reference Books:

1.Lo C P, Yeung A K W, Concepts and Techniques of Geographic Information Systems, Prentice Hall. India.

2.Kang-tsung Chang, Introduction to Geographic Information Systems, Tata McGraw Hill

3.Deepankar Chakrabarti, Suchandra Choudhury Sujit Choudhury, "Introduction to Geographic Information Technology", Kindle Edition

4.ChakrabortyDebashis, "Fundamentals of Geographic Information Systems"

5.Sabins F F, "Remote Sensing Principles and Interpretation"

6. KataraPratibha,"Remote Sensing and GIS Technology"

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BTCVE605DAdvanced Engineering Geology

Teaching Scheme: (3Lectures) hours/week

Pre Requisites: Engineering Geology

Course Contents

Module 1 **(6 Lectures)**

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

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

Engineering geology of Deccan traps: 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 **(6 Lectures)**

Geology of soil formations: 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

Module 5 **(6 Lectures)**

Geophysics: Various methods: magnetic, gravitational and electrical resistivity methods, applications of electrical resistivity method using Wennerconfiguration 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,

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

Module 6 **(6 Lectures)**

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 VidyarthiGrihaPrakashan, 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.
- Reddy, “Engineering Geology for Civil Engineering”, Oxfard& IBH Publishing Co. N. Delhi.
- SathyaNarayanSwamiB. S., “Engineering Geology”, DhanpatRai& Co.(P) Ltd, Delhi

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

1) Understand geological time scale and physiographic division of India and their geological characteristics and different geological formation in India.
2) Perform sub surface exploration and interpret core log.
3) Solve numerical problem based on core drilling and seismic data.
4) Familiar with origin of earthquake, seismic wave and landslide in Deccan trap.

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BTCVE 605E Advanced Soil Mechanics

Teaching Scheme: (3Lectures) hours/week

Pre Requisites: Soil Mechanics

Course Contents

Module 1: Introduction to Clay Minerals (6 Lectures)

Introduction to Clay minerology;Gravity forces, surface forces and their dependency on particle size; Primary and Secondary valence bonds; Structural units of clay minerals; Electrical charges on clay minerals; Structural composition and behavior of the minerals like Kaolinite, Montmorillonite, Illite, Halloysite etc.

Module 2: Stress Distribution in Soil (8 Lectures)

Boussinesq's equation for point load, vertical pressure under loaded circular area and uniformly loaded rectangular area. Newmark's method for uniformly distributed loads, preparation and use of Newmark's chart.

Module 3: Earth work and Earth moving Equipments (4 Lectures)

Planning of Earth work, Earth moving equipment: dozers, scrapers, loader-backhoe, excavators; compaction equipments: static and drum rollers, vibratory rollers, sheep-foot rollers, pneumatic tyre rollers, small compactors; selection of equipments.

Module 4: Ground Improvement and Modifications (6 Lectures)

Improvement by excavating and replacing, mixing additives, applications, in-situ ground improvement- compaction piles, compaction with dynamics loads, pre-loading using sand drains, grouting, replacing existing soils with stronger soil in bore hole, response of sands and clays to externally applied stress, impact compaction of sands, vibratory compaction in sands, types of drains.

Module 5: Reinforced Soils (6 Lectures)

Soil reinforcement and its applications, Mechanism of soil reinforcement; Geosynthetics: Introduction; Geotextile, Geojute, Geomembrane, Geogrid, Applications of Geosynthetics in Civil Engineering, testing of geotextile, using Geogrids as a reinforcements, design with geo-synthetics.

Module 6: Grouting and injection methods (6 Lectures)

Principles, design methods, selection of methods and requirements. Aspects of grouts, types of grouts and chemical applications, seepage control, solidification and stabilization – equipment and accessories used – quality control – specifications for achieving satisfactory results.

Text Books

- Murthy V.N.S., "Soil Mechanics & Foundation Engineering", U.B.S. Pub. And Distri. N. Delhi
- Punmia B.S., "Soil Mechanics & Foundation Engineering", Laxmi Publications
- Arora K. R., "Soil Mechanics" Standard Publishers, N. Delhi
- Shashi K Gulathi and ManojDatta, "Geotechnical Engineering", Mc-Graw Hill Publications (India) Pvt. Ltd.

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
- Donald P. Coduto, Man-Chu Ronald Yeung, William A. Kitch, “ Geotechnical Engineering”, Pearson Publications

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

CO1: Behavior of soil based on its particle size and mineral content

CO2: Ability to understand the Earth work equipment

CO3: Ability to understand the necessity of ground improvement and potential of a ground for improvement

CO4: Understand the soil reinforcement mechanisms

CO5: Understand the grouting and injection methods.

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Semester – VII

Sr. No.	Subject Code	Subject Title	Contact hours			Credit
			L	T	P	
01	BTCVC 701	Design of Concrete Structures II	2	1	-	3
02	BTCVC 702	Infrastructure Engineering	3	-	-	3
03	BTCVC 703	Water Resources Engineering	2	1	-	3
04	BTCVC 704	Professional Practices	2	1	✓	3
05	CVE4	**Elective IV**	3	-	-	3
06	CVE5	**Elective V**	3	-	-	3
		Practical / Drawing and/or Design				
07	BTCVL707	Professional Practices Laboratory	-	-	2	1
08	BTCVL708	Design & Drawing of Steel Structures	-	-	4	2
09	BTCVP709	Project Stage-I	-	-	2	1
10	BTCVF710	Industrial Training	-	-	-	AU
		Sub-Total	**15**	**3**	**08**	
		Total	**26**			**22**
		Elective IV				
	BTCVE705A BTCVE705B BTCVE705C BTCVE705D BTCVE705E	Plastic Analysis and Design Machine Foundations Modern Surveying Techniques Engineering Economics Ground Improvement Techniques	-	-		-
		Elective V				
	BTCVE706A BTCVE706B BTCVE706C BTCVE706D BTCVE706F BTCVE706F	Advanced Structural Mechanics Town and Urban Planning Construction Economics & Finance Intelligent Transportation Systems Waste Water Treatment Tunneling and Underground Excavations	-	-		--

BTCVC 701 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

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: **(4 Lectures)**

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

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.

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BTCVC 702Infrastructure Engineering

Teaching Scheme:(3 Lectures) hours/week

Course Contents

Module 1: **(5Lectures)**

Railway Engineering: Permanent Way, gauges, rails, sleepers, ballast, subgrade 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: **(5 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 4: **(6 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 Equipments

Module 5: **(6 Lectures)**

Bridge Engineering: Determination of design discharge, Linear Water Way, Economical Span, Location of Piers and Abutments, Afflux, Scour, Depth, Standard Specification For Bridges: Indian Road Congress Bridge Code, Aesthetics in Bridge Design, Bridge Foundations, Types, Components, Foundations in Special Conditions, Foundation Failures, Piers For Viaducts, Construction Aspects of Various Types of Bridges: Launching, erection and performance of Bridges, Bridge bearings

Module 6: **(5 Lectures)**

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

- Antia K. F., "Railway Engineering", New Book Company Pvt. Ltd
- Saxena and Arora, "A Course in Railway Engineering," DhanpatRai& Sons Delhi
- Quinn, "Planning and Construction of Docks and Harbours", Tata McGraw Hill, Latest Edition
- Oza, "Dock and Harbour Engineering", Chartor Publishing House, Anand
- Shrinivasan, Rangawala, "Dock, Harbour and Tunnel Engineering", Chartor Publishing House
- Arora N. L., "Transportation Engineering", IPH New Delhi
- Bindra S. P., "Bridge Engineering", Dhanpatrai and Sons
- Khanna and Arora, "Airport Engineering" 6th Edition, Nemchand& Bros., 1999
- Rangawala, "Airport Engineering", Charotar Publishing House Pvt. Limited
- Hariharan K. V., "Multimodal Transport & Infrastructure Development in India", Shroff Publishers, Mumbai

References

- Publications of Bureau of Indian Standards, New Delhi, Relevant To the SylLaboratoryus
- Cormick H. F., "Dock and HarbourEngineering"Giffin Publisher
- Raina V K, "Handbook for Concrete Bridges" Vol. 1 and 2, Shroff Publishers, Mumbai
- Horonjeff, "Planning and Design of Airports",Fifth edition

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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BTCVC 703Water Resources Engineering

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

Course Contents

Module 1: Introduction **(6 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 **(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

Gravity Dams – Estimation of Loading, Design Criteria, Causes of Failure of Gravity Dam, Precaution against Failure, Theoretical and Practical Profile, Stability Calculations, Galleries, Joints, 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 **(6 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

- Varshney R. S., Gupta & Gupta, "Theory and Design of Irrigation Structures", Vol. I & II
- Punamia B. C. Pandey B. B. and Lal, "Irrigation and Water Power Engineering", Standard Publishers, New Delhi
- Garg S. K., "Irrigation Engineering & Hydraulic Structures",Khanna Publishers, N. Delhi, ISBN NO: 978-81-7409-047-9
- Priyani, "Irrigation and Water Power", Charotar Publishing House, Anand
- Bharat Singh, "Irrigation", Nemchand Brothers, Roorkee
- Subramanya K., "Engineering Hydrology", Tata Mc-Graw Hill Company Limited, N. Delhi

References Books

- USBR, "Design of Small Dam", OXFORD & IBH, Publishing Company
- Justinn, "Engineering for Dam" Vol. I, II, III, Creager and Hinds
- Leliavsky, "Design of Hydraulic Structures" Vol. I & II,
- C B I & P "River Behaviour, Management and Training"
- 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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BTCVC 704Professional Practices

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

Pre Requisites: Building Construction

Course Contents

Module 1: Quantity Surveying **(4 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 2: Costing **(6 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 3: 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 4: Contracts **(4Lectures)**

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 5: Valuation **(4 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

Module 6: **(6 Lectures)**

Valuation from yield and from life, gross yield and net yield, sinking fund, depreciation, different methods of calculating depreciation, depreciated cost, obsolescence

Text Books

- Dutta B. N., "Estimating and Costing", UBS Publishers Distributors
- NanavatiRoshan, "Professional Practice Estimating and Valuation", Laksmi book Depot
- Patil B. S., "Civil Engineering Contracts and Estimates", Universities Press, 3rd edition
- Bhasin P. L., "Quantity Surveying", S.Chand and Co. Ltd Revised 3rd edition
- Rangwala S. C., "Elements of Estimating and Costing", Charotar Publication 8th edition
- Birdi, "Estimating and Costing", DhanpatRai Publication 1988 28th edition
- Chakroborty M., "Estimating, Costing & Specification in Civil Engineering", M.Chakraborty Publication
- Rangwala S. C., "Valuation of real Properties", Charotar Publication,2011

References

- Govt. of Maharashtra P.W.andHousing DepartmentPublication edition 1979 and 1981
- P. W. D. Maharashtra, "Standard Specifications", Volumes I & II
- C.P.W.D. Specifications
- C.P.W.D. Schedule of Rates
- P.W.D. Maharashtra Schedule of Rates
- 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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Elective IV

BTCVE705APlastic 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 Contents

Module 1: **(5Lectures)**

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: **(7 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: **(7 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: **(6 Lectures)**

Design of portal frames, design of corner connection with and without haunches

Module 6: **(5 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:

Understand modes of structural collapse

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

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Elective V

BTCVE706B Town and Urban Planning

Teaching Scheme: Lectures: 4 Hours / Week

Course Contents

Module 1: 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: 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: 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: 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: Town Planning works with reference to M.R.T.P. Act, Land Acquisition Act, Necessity and procedure of acquisition

Module 6: Village Planning, Multilevel Planning, Decentralization Concepts, Rural Developments, Planning Methodology, Growth Centre Approach, Area Development Approach, Integrated Rural Development Approach

Text Books

- Gandhi N.K., "Town and Country Planning",
- Hiraskar G.K., "Town and country Planning"
- RangawalaS.C., "Town Planning", Charotar Publications, Anand
- Sundaram K.V., "Urban and Regional Planning in India", Vikash Publishing House Pvt. Ltd.
- MRTP Act 1966
- Land Acquisition Act - 1894
- Misra S.N., "Rural Development Planning-Design and Method", Satvahan Publications, N. Delhi

Reference Books

- Lewis Kuble, "Town and Country Planning"
- Gallion, "The Urban Pattern", Eisner

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BTCVL707 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 fourof 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.

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BTCVL708 Design & Drawing of Steel Structures

Practical:4 Hours / Week **Term Work:** 50 Marks

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, 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 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.

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BTCVP709Project Phase I

Term work shall consist of detailed report for chosen topic and final working proposed in next semester. Report shall summarise the literature survey, spell out the scope of work, proposed methodology and expected results. It is desirable to have a topic sponsored by Industry or research organization or community.

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BTCVF710Industrial 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 VI and appear at examination in Semester VII.

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Semester – VIII

Sr. No.	Subject Code	Subject Title	Contact hours			Credit
			L	T	P	
01	BTCVC 801	Introduction to Earthquake Engineering	2	1		3
02	CVE6	**Elective VI**	3	-		3
03	CVE7	**Elective VII**	3	-		3
04	CVE8	**Elective VIII**	3	-		3
		Practical / Drawing and/or Design				
05	BTCVL805	Earthquake Engineering Laboratory	-	-	2	1
06	BTCVL806	Design and Drawing of RC Structures	-	-	4	2
07	BTCVF807	Self-Study Report based on field visit to Infrastructure Project Works	-	-	2	1
08	BTCVP808	Project Stage-II	-	-	8	4
		Sub-Total	**11**	1	16	
		Total	**28**			**20**
		Elective VI				
	BTCVE802A BTCVE802B BTCVE802C BTCVE802D BTCVE802E	Limit State Design of Steel Structures Construction Techniques Pavement Management System Composite Materials Disaster Preparedness & Planning Management	-	-		-
		Elective VII				
	BTCVE803A BTCVE803B BTCVE803C BTCVE803D	Bridge Engineering Structural Audit Design of Hydraulic Structures Environmental Impact Assessment and Life Cycle Analyses	-	-		-
		Elective VIII				
	BTCVE804A BTCVE804B BTCVE804C BTCVE804D BTCVE804E	Rock Mechanics Water Power Engineering Water Resources Economics Planning and Management Finite Element Method Repair & Rehabilitation of Structures	-	-		-
		Overall Total	**50+168 = 218**			**127**

BTCVC 801Introduction to Earthquake Engineering

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

Course Contents

Module 1: **(5 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: **(5 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

62

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

- IS 456, IS 1498, IS 1893, IS 1905, IS 2131, IS 13920, IS 4326 of recent editions, Bureau of Indian Standards, New Delhi.
- Chopra A.K. (2001), "Dynamics of Structures", 2nd Edi, Pearson Education Pvt. Ltd., India, ISBN 81-7808-472-4.
- Mario Paz, "Structural Dynamics", CBS Publication.
- Arya A.S., "Elements of Earthquake Engineering", South Asian Pub., New Delhi.

Reference Books

- Clough R.W. and Penzien J.(1993), "Dynamics of Structures", McGraw Hill New York
- Humar J. L., "Dynamics of Structures", 2nd Edition (2002), Swets and Zeitlinger, Netherlands.
- FarzadNaiem, "The Seismic Design Handbook", Kluwer Academic Pub. (2001), Massachusetts, ISBN: 0-7923-7301-4.
- Dowrick D. J., "Earthquake Resistant Design for Engineers & Architects", John Wiley and Sons Ltd. ISBN: 0-471-91503-3.
- Pauley T. and Priestley M.J.N., "Seismic Design of Reinforced Concrete and Masonry Buildings", (1992) John Wiley & Sons Inc., USA, ISBN 0-471-54915-0.
- Nayak N. V., "Foundation Design Manual", Dhanpatrai and Sons, Delhi.
- Housner G.W. & Hudson D. E., "Applied Mechanics- Dynamics", East-West Edition, N. Delhi.
- Kramer S. L., "Geotechnical Earthquake Engineering", Pearson Education

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

Capture complexities in earthquake resistant design of structures

Grasp Nature of earthquake vibration and associated forces on structures

Understand importance of designing the building to targeted seismic performance.

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BTCVL805Earthquake Engineering Laboratory

Practical:2 Hours / Week

Term work includes detailed study and working on minimum 03 of following set of assignments:

1) Planning of earthquake resistant building
2) Construction of design response spectra
3) Evaluation of lateral loads on multi-storeyed building as per IS 1893
4) Ductile detailing of members as per IS 13920
5) Detailing of masonry structures

Laboratory Work:

The students are expected to perform **any 03** experimentsout of list given below and submit report of same;

- Dynamics of a three-storied building frame subjected to harmonic base motion
- Dynamics of a three-storied building frame subjected to periodic (non harmonic) base motion
- Vibration isolation of a secondary system.
- Dynamics of a vibration absorber.
- Dynamics of beams.
- Dynamics of free-standing rigid bodies under base motions.

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BTCVL806 Design and Drawing of RC Structures

Practical:4 Hours / Week

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

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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BTCVF807Self-Study Report based on field visit to Infrastructure Project Works

Student shall visit to any one ongoing construction site in field to witness and collect necessary information from works of execution of infrastructure works such as bridges, railways, airports, docks, harbors, tunnels, industrial establishments, planned cities, etc. It is desirable to collect basic information on aspects of planning, operation, various specializations involved, etc. Intention of the work is to introduce the student to data on vocabulary of terms in field.

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BTCVP808 Project Phase II

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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Elective VI

BTCVE802BConstruction Techniques

Teaching Scheme: 3 Lectures hours/week

Pre Requisites: Project Management

Course Contents

Module 1: **(6 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

Module2: **(6 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

Module3: **(6Lectures)**

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: **(6 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: **(6 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

Module6: **(6 Lectures)**

Diaphragm walls: purpose and construction methods, safety measures in construction, prevention of accidents and introduction to disaster management

Text Books

- Peurifoy R.L. “Construction, Planning, Equipment & Methods”, McGraw hill Book Co. N.Delhi
- VermaMahesh, “Construction Equipment”, Metropolitan book Co.,New York
- Singh J., “Heavy Construction - Planning, Equipment & Methods”, Oxford & IBH Pub., N.Delhi
- Taylors, “Reinforced Concrete Bridges”,

Reference Books

- Quin, “Planning and Construction of Docks and Harbors”,Mc-Graw Hill Company, New York.
- Stubbs, “Hand Book of Heavy Construction”,Mc-Graw Hill Inc,US 2nd edition.
- Boyes R.G.H, “Structural & cut off Diaphragm Walls”, Applied Science Publishers Ltd. London.
- Ataev S. S., “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 thevarious 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.

BTCVE802C Pavement Management System

Teaching Scheme: (3 Lectures) hours/week

Pre Requisites: Transportation Engineering I, Transportation Engineering II

Course Contents

Module 1: **(6 Lectures)**

Need of pavement management system, Pavement distresses in flexible/rigid pavements causes and remedies. Visual Surface distress survey procedures and techniques. Serviceability Indicators for roads. Measurement of Serviceability Indicators using various equipments like Bump Indicator, Skid tester, Distress surveys & Benkelman Beam.

Module 2: **(6 Lectures)**

Functional evaluation of pavements- Serviceability Concepts, Visual Rating, Pavement Serviceability Index, Riding Quality, Roughness Measurements, Skid Resistance, Roughness, and Safety Aspects. Inventory System.Classification of maintenance operations, Routine, Periodic, Special. Common types of maintenance: Potholes, Cracked surface, Ruts & undulations, Reasons for repetitive occurrence,

Module 3: **(6 Lectures)**

Maintenance Methodology - Resurfacing, Interface treatments, Bituminous Thin Surface Courses- Seal Coat, Surface Dressing, Premixed carpet, Mixed seal surfacing, Micro asphalt concrete (MAC), Bituminous Surface Courses: Semi-Dense Bituminous Concrete, Bituminous Concrete, and Bitumen Mastic. Road maintenance in high rainfall areas. Choice of materials. Modified bitumen & geo-fabrics. Maintenance alternatives including recycling.

Module 4: **(6 Lectures)**

Pavement Management/ Maintenance Management System-Components of PMS and their Activities, Major Steps in Implementing PMS, Inputs, Design, Construction and Maintenance, Rehabilitation and Feedback Systems, Examples of HDM package, Highway Financing, Fund Generation, Evaluating Alternate Strategies and Decision Criteria.

Module 5: **(6 Lectures)**

Prediction Deterioration Models- Factors affecting performance, Types of prediction models, Prediction deterioration model development, Method to assess the precision and accuracy of the developed model.

Module 6: **(6 Lectures)**

Pavement Structural Design and Economic Analysis; Emerging Technology in Pavement Management Systems.

Text/Reference Books:

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BTCVE802E Disaster Preparedness & Planning Management

Teaching Scheme: Lectures: 3 Hours/Week

Pre Requisites: Mathematics - I and Mathematics – II

Course Contents

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

Concepts and definitions: disaster, hazard, vulnerability, risk, capacity, impact, prevention, mitigation).

Module 2:NaturalDisasters **(6 Lectures)**

Disasters classification; natural disasters (floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.); hazard and vulnerability profile of India.

Module 3: ManmadeDisasters **(6 Lectures)**

Manmade disasters (industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills etc); hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

Module 4:Disaster Impacts **(6 Lectures)**

Disaster impacts (environmental, physical, social, ecological, economical, political, etc.); health, psycho-social issues; demographic aspects(gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

Module 5:Disaster Risk Reduction(DRR) **(6 Lectures)**

Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and nonstructural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control); Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Module 6: Disasters, Environment and Development **(6 Lectures)**

Factors affecting vulnerability such as impact of developmental projects and environmental modifications (including of dams, land-use changes, urbanization etc.), sustainable and environmental friendly recovery; reconstruction and development methods.

Text/Reference Books:

- http://ndma.gov.in/ (Home page of National Disaster Management Authority).
- http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
- Pradeep Sahni, 2004, Disaster Risk Reduction in South Asia, Prentice Hall.
- Singh B.K., 2008, Handbook of Disaster Management: techniques & Guidelines, Rajat Publication.
- Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation.

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BTCVE803ABridge Engineering

Teaching Scheme: (3 Lectures) hours/week

Pre Requisites: Transportation Engineering, Infrastructure Engineering, Hydraulic Engineering I & II

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), 4th Edition, Shroff Publishers, Mumbai
- Raina V. K., Concrete Bridge Practice, (Construction, Maintenance, Rehabilitation),, 2nd Edition, Shroff Publishers,
- Raina V. K., Field Manual for Highway and Bridge Engineers", 3rd 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.

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BTCVE803B Structural Audit

Teaching Scheme: (3 Lectures) hours/week

Pre Requisites: All subjects related to Structural analysis and Foundation Engineering

Course Contents

Module 1: Introduction to Structural Audit **(06 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: Causes and types of deterioration in Structures **(06 Lectures)**

Causes 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: Elementary aspects of Non Destructive Testing **(06 Lectures)**

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: Strength Evaluation of Existing Structures **(06 Lectures)**

Reserve strength, identification of critical sections, structural system and its validation, evaluation of damage in RC structures

Module 5: Approach to conduct Structural Audits **(06 Lectures)**

Guidelines of Statutory Bodies, Legal aspects, Responsibility of calling Structural Audit, Scope of Investigation

Module 6: Structural Audit Report **(06 Lectures)**

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.

BTCVE804ARock Mechanics

Teaching Scheme: Lectures: 3 hours/week

Pre Requisites: Engineering Geology

Course Contents

Module 1 **(6 Lectures)**

Introduction, Development of Rock Mechanics, Applications of Rock Mechanics

Module 2 **(8 Lectures)**

Rock sampling, Determination of Density, Porosity, Water Absorption, Uni-axial Compressive Strength, Tensile Strength, Shear Strength, Flexural Strength, Swelling and Slake Durability, Permeability and Point Load Strength, Tri-axial Compressive Test. Factors affecting Strength and Deformation of Rocks, In-situ Determination of Strength, Geophysical Methods

Module 3 **(6 Lectures)**

Classification, Rock Mass Classification, Rock Quality Designation, Rock Structure Rating, Geo-mechanics and NGI Classification Systems

Module 4 **(4 Lectures)**

Methods of Improving Rock Properties, Rock Reinforcement & Rock Bolting

Module 5 **(6 Lectures)**

Stability of Rock Slopes, Modes of Failure, Methods of Analysis, Prevention and Control of Rock Slope Failure, Monitoring and Maintenance

Module 6 **(6 Lectures)**
Foundations on Rocks, Shallow Foundations, Pile and Well Foundations, Basement Excavation, Foundation Construction, Allowable Bearing Pressure, Tunnels: Rock Stresses and Deformations, Rock Support Interaction, Design of Tunnel Lining

Text Books
- Vulukuri and Lama, "Hand Book on Mechanical Properties of Rocks", Vol. I to IV
- Central Board of Irrigation and Power , "Manual on Rock Mechanics"
- Varma B. P., "Rock Mechanics for Engineers", Khanna Publications
- Stag and Zienkiewec, "Rock Mechanics in Engineering Practice", John Wiley and Sons, India
- SubinoyGangopadhyay , "Engineering Geology ",oxford university

References
- Goodman R. E., "Introduction to Rock Mechanics", John Wiley and Sons, India
- Obert and Duvall, "Rock Mechanics and Hydraulic Structures", John Wiley and Sons, India
- Winterkorn and Fang, "Foundation Engineering Hand Book"
- Relevant Indian Standards.

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

CO1: Understand the mechanism of rock under various conditions.

CO2: Able to determine the engineering properties of rocks and sub-surface conditions

CO3: Identify various cause of slope failure and suggest some preventive measures for them.

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BTCVE804BWater Power Engineering

Teaching Schemes: Lectures: 3 Hours/Week

Course Contents

Module 1 **(06 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 **(06 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

- 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”

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BTCVE804DFinite Element Method

Teaching Schemes: Lectures: 3 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 in FEM.

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(06 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: Computer Implementation of FEM(06 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 softwares, elementary problem solving using freeware

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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 consecutiveModules.

References:

- M. Mukhopdhyay, Concept and Application of Finite Element Analysis, Oxford and IBH Publishing Co. Pvt. Ltd.
- O.C.Zienkiewicz&R.L.Taylor, The Finite Element Method Vol.I& II, Tata McGraw Hill
- J.N.Reddy, An introduction to the Finite Element Method , Tata McGraw Hill Pub.
- R. D. Cook, Concept and Application of Finite Element Analysis, John Wiley & sons
- Hutton D.V., Fundamentals of Finite Element Analysis, Tata McGraw Hill Pub.
- C. S. Desai & J. F. Abel, Introduction to the Finite Element Method, CBS Pub.
- C. S .Krishnamoorthy, Programming in the Finite Element Method, Tata McGraw Hill
- T.R.Chandrupatla and Belegundu, Introduction to the Finite Element in Engineering Pearson Education
- Bathe K.J., Finite Element Procedures, PHI learning pvt.ltd
- Y.M.Desai, T.I Eldho, Finite Element Method with application in Engineering, Pearson , Delhi
- S. S. Bhavikatti., Finite Element Analysis, New Age International Publication.

Outcomes:

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

- Understand the different energy methods in structural analysis and basic concepts of finite element method.
- Analyze 1-D problems related to structural analysis like Bars, Trusses, Beams and Frames using finite element approach.
- Find solution to problems using direct approach methods like Rayleigh – Ritz or Galerkin's Method.
- Solve 2-D problems using knowledge of theory of elasticity.
- 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.
- Analyze 1D, 2D, and 3D structures using different software packages based on FEM.

BTCVE804ERepair & Rehabilitation of Structures

Teaching Schemes: Lectures: 3 hours/week

Course Contents

Module 1: Serviceability and Durability (06 Lectures)

Quality Assurance for Concrete Construction, Permeability, Thermal Properties and Cracking, Distress Monitoring, Causes for Distress, Effects of Climate, Temperature, Chemicals, Wear and Erosion, Corrosion Mechanism, Effects of Cover Thickness

Non Destructive Testing: Ultrasonic and Sonic Test, Rebound Hammer Test, Strength Evaluation of Existing Structures

Module 2:Cracks in Structures(06 Lectures)

Causes, Thermal and Shrinkage cracks, Cracks due to Vegetation and Trees, Foundation Movements, Types and their Fatality, Diagnosis Techniques for Repair.

Moisture Penetration

Sources of Dampness, Moisture Movement from Ground, Reasons for Ineffective Damping, Leakage in Concrete Slabs, Pitched Roofs, Dampness in Solid Walls, Condensation, Remedial treatments, Chemical Coatings.

Module 3: Steel Structures and Masonry(06 Lectures)

Types and Causes of Deterioration, Preventive Measures, Repair Procedure, Brittle Failure, Defects in Connections, Welded Joints: Test for Defects; Mechanism of Corrosion, Methods of Corrosion Protection, Corrosion Inhibitors, Corrosion Resistant Steels, Coatings, Cathodic Protection.

Masonry Structures

Discoloration and Weakening of Stones, Preservation, Chemical Preservatives, Brick Masonry Structures, Distress and Remedial Measures.

Module 4: Materials for Repairs(06 Lectures)

Essential Parameters for Repair Material, Premixed Cement Concrete and Mortar, Sulphur Infiltrated Concrete, Fiber Reinforced Concrete, Special Elements for Accelerated Strength Gain, Expansive Cement, Polyester Resin.

Polymer Concrete: Physical and Mechanical Properties, General Guidelines and Precautions for Use, Field Application

Polymer Modified Concrete: Physical and Mechanical Properties, General Guidelines and Precautions for Use, Field Application, Epoxy Concrete and Mortar: Epoxies, Physical and Mechanical Properties, General Guidelines

Surface Coatings: Essential Parameters, Types, Characteristics.

Module 5: Maintenance and repair strategies(06 Lectures)

Definitions: Maintenance, Repair and Rehabilitation, Facets of Maintenance, Importance of Maintenance, Preventive Measures on Various Aspects Inspection, Assessment Procedure for Evaluating a Damaged Structure, Causes of Deterioration,

Techniques for Repairs

Repairs using Mortars and Dry Packs**,** ConcreteReplacement, Surface Impregnation, Rust Eliminators and Polymers Coating for Rebar During Repair Foamed Concrete, Vacuum Concrete, Gunite and Shotcrete, Injection: Epoxy, Resin, Polymer Modified Cement Slurry; Shoring and Underpinning. Propping and Supporting: False Work,

Module 6: Strengthening of Existing Structures(06 Lectures)

General Principle, Relieving Loads, Stress Reduction, Strengthening of Super Structures (Beam, Column, Slab including Joints) for Tension, Compression, Flexural, and Shear respectively, Jacketing (RCC, Plate, Fiber ,Wrap), Bonded Overlays, Reinforcement Addition, Strengthening of Masonry Structure.

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 Modules.

References:

- Johnson. S.M., “Deterioration, maintenance and repair of structures”, McGraw-Hill book company, New York, 1965.
- R. T. Allen and S. C. Edwards, “Repair of concrete structures”, Blakie and Sons, UK, 1987.
- Denison Campbell, Allen and Harold Roper, “Concrete structures”, Materials, Maintenance and Repair, Longman Scientific and technical UK, 1991.
- SP25-84, “Hand book on causes and prevention of cracks on buildings”, Indian standards.
- M. S. Shetty, “Concrete Technology- Theory and Practice”, S. Chand and Company, New Delhi, 1992.
- Gambhir, “Concrete Technology”.
- Santhakumar, A.R., " Training Course notes on Damage Assessment and repair in Low Cost Housing "," RHDC–NBO " Anna University, July, 1992.
- Raikar, R.N., “Learning from failures – Deficiencies in Design ", Construction and Service – R & D Centre (SDCPL), RaikarBhavan, Bombay, 1987.

Outcomes:

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

- Understand factors of Serviceability and Durability of Structures.
- Determine crack width, effect of crack on materials, effect of moisture on structures.
- Understand methods for protection of steel structures and masonry structures.
- Understand various materials and methodologies used for repairing of structures.
- Understand and implement techniques used for repairing and maintenance of structure.
- Understand procedure to strengthen the existing structures and structural elements.

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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Detailed Syllabus

for

Second Year

B. Tech program in Computer Engineering/ Computer Science/ Computer Science & Engineering

With effective from

Academic year July 2018-19

Approved in the 11th meeting of Academic Council 8th June 2018

Teaching and Evaluation Scheme Second Year B. Tech. (Computer Engineering)

Sr. No.	**Code**	**Course title**	**Weekly Teaching hours**			**Evaluation Scheme**			**Credit**
			L	T	P	MSE	CA	ESE	
		Semester III							
1	BTBSC301	Engineering Mathematics -III	3	1	-	20	20	60	4
2	BTCOC302	Discrete Mathematics	2	1	-	20	20	60	3
3	BTCOC303	Data Structures	2	1	-	20	20	60	3
4	BTCOC304	Computer Architecture & Organization	2	1	-	20	20	60	3
5	BTCOC305	Digital Electronics & Microprocessors	2	1	-	20	20	60	3
6	BTHMC306	Basic Human Rights	2	-	-	-	50	-	Audit
7	BTCOL307	Python Programming	1	-	2	-	60	40	2
8	BTCOL308	HTML and Javascript	1		2		60	40	2
8	BTCOL309	Data Structures Lab	-	-	2	-	60	40	1
9	BTCOL310	Digital Electronics & Microprocessor Lab	-	-	2	-	60	40	1
10	BTCOF311	Field Training / Internship/Industrial Training Evaluations	-	-	-	-	-	100	1
		Total	**15**	**5**	**8**	**100**	**390**	**560**	**23**
		Semester IV							
1	BTCOC401	Design & Analysis of Algorithms	2	1	-	20	20	60	3
2	BTCOC402	Probability & Statistics	2	1	-	20	20	60	3
3	BTCOC403	Operating System	2	1	-	20	20	60	3
4	BTCOE404	**Elective-I** A) Object Oriented Programming in C++ B) Object Oriented Programming in Java	2	1	-	20	20	60	3
5	BTCOE405	**Elective-II** A) Numerical Methods B) Physics of Engineering Materials C) Soft Skills and Personality Development	2	1	-	20	20	60	3
6	BTXXC406	Product Design Engineering	2	-	-	20	20	60	2
7	BTCOL407	Design & Analysis of Algorithms Lab	-	-	2	-	60	40	1
8	BTCOL408	Introduction to Data Science with R	1	-	2	-	60	40	2
9	BTCOL409	Object Oriented Programming Lab	-	-	2	-	60	40	1
10	BTCOL410	Operating System Lab	-	-	2		60	40	1
11	BTCOF411	Field Training / Internship/Industrial Training (minimum 4 weeks which can be completed partially in first semester and second Semester or in at one time.)						100	Credits to be evaluated at in V Sem.
		Total	**13**	**5**	**8**	**120**	**360**	**620**	**22**

(BTBSC301) Engineering Mathematics III

Unit 1: Laplace Transform

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. **[07 Hours]**

Unit 2: Inverse Laplace Transform

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. **[07 Hours]**

Unit 3: Fourier Transform

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. **[07 Hours]**

Unit 4: Partial Differential Equations and Their Applications

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 $\left(\frac{\partial u}{\partial t}=c^2\frac{\partial^2 u}{\partial x^2}\right)$, and two dimensional heat flow equation (i.e. Laplace equation : $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=0$). **[07 Hours]**

Unit 5: Functions of Complex Variables (Differential calculus)

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. **[07 Hours]**

Unit 6: Functions of Complex Variables (Integral calculus)

Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs). **[07 Hours]**

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3. A Course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
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 **6 hrs**

Fundamental Structures and Basic Logic: 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 **6 hrs**

Functions and Relations: Subjective, Injective, Bijective and inverse functions, Composition of function, Reflexivity, Symmetry, Transitivity and equivalence relations.

Unit 3 **6 hrs**

Combinatorics: Counting, Recurrence relations, generating functions.

Unit 4 **6 hrs**

Graph Theory: 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 Coloring.

Unit 5 **6 hrs**

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 6 **6 hrs**

Algebraic Structures and Morphism: Algebraic Structures with one Binary Operation, Semi Groups, Monoids, Groups, Congruence Relation and Quotient79 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.

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.

Text Books:

1. C. L. Liu, *Elements of Discrete Mathematics*, McGraw-Hill Publication, 3rd Edition, 2008.
2. Kenneth H. Rosen, *Discrete Mathematics and its Applications*, McGraw-Hill Publication, 6th Edition, 2010.
3. Y. N. Singh, *Discrete Mathematical Structures*, Wiley Publication, 1st Edition, 2010.
4. Dr. Sukhendu Dey, *Graph Theory with Applications*, SPD Publication, 1st Edition, 2012.

BTCOC303 Data Structures

Unit 1 **6 hrs**

Introduction: Data, Data types, Data structure, Abstract Data Type (ADT), representation of Information, characteristics of algorithm, program, analyzing programs.

Unit 2 **6 hrs**

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 3 **6 hrs**

Searching and Sorting: 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.

Unit 4 **6 hrs**

Linked Lists: 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 5 **6 hrs**

Stacks and Queues: 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 6 **6 hrs**

Trees and Graphs: 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.

Reference Books:

1. E. Horowitz, S. Sahani, *Fundamentals of Data Structures*, Galgotia Publication, 1st Edition, 1983.
2. Thomas Cormen, *Introduction to Algorithms*, PHI Publication, 2nd Edition, 2002.
3. Venkatesan & Rose, *Data Structures*, Wiley Publication, 1st Edition, 2015.
4. Goodrich & Tamassia, *Data Structure & Algorithm in C++*, Wiley Publication, 2nd Edition, 2011.
5. R. G. Dromey, *"How to Solve it by Computer"*, 2nd Impression, Pearson Education.
6. Kyle Loudon, *Mastering Algorithms with C: Useful Techniques from Sorting to Encryption*, O'Reilly Media, 1st Edition, 1999.

Text Books:

1. Mark Allen Weiss, *Data structures and algorithms analysis in C++*, Pearson Education, 4th Edition, 2013.
2. S. Lipschutz, *Data Structures*, McGraw-Hill Publication, Revised 1st Edition, 2014.
3. Y. Langsm, M. Augenstin, A. Tanenbaum, *Data Structure using C and C++*, Prentice Hall India Learning Private Limited, 2nd Edition, 1998.
4. Trembley and Sorenson, *Introduction to Data Structures*, PHI Publication, 2nd Revised Edition, 1983.
5. Vishal Goyal, Lalit Goyal, *A Simplified Approach To Data Structure*, SPD Publication, 1st Edition, 2014.

BTCOC304 Computer Architecture and Organization

Unit 1 **6 hrs**

Introduction: Concept of computer organization and architecture, Fundamental unit, Computer function and interconnection, CPU structure and function.

Unit 2 **6 hrs**

Instruction Sets: 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 **6 hrs**

Computer Arithmetic: The arithmetic and logic Unit, Integer representation, Integer arithmetic, Floating point representation, Floating point arithmetic, Introduction of arithmetic co-processor.

Unit 4 **6 hrs**

Memory Organization: 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 **6 hrs**

Control Unit: 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.

Unit 6 **6 hrs**

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.

Reference Books:

- Hennessy and Patterson, *Computer Architecture: A Quantitative Approach*, Morgan and Kaufman Publication, 4th Edition, 2007.
- Morris Mano, *Computer System Architecture*, Pearson Education India, 3rd Edition, 2007.
- Mostafa Abd-El-Barr, Hesham El-Rewini, *Fundamentals of Computer Organization and Architecture*, Wiley Publication, 1st Edition, 2004.
- Miles J. Murdocca, Vincent P. Heuring, *Computer Architecture and Organization: An Integrated Approach*, Wiley Publication, 1st Edition, 2007.
- Sajjan G. Shiva, *Computer Organization, Design, and Architecture*, CRC Press, 5th Edition, 2013.

Text Books:

- William Stalling, *Computer Organization and Architecture: Designing for Performance*, Prentice Hall Publication, 8th Edition, 2009.
- Hayes, *Computer Architecture and Organization*, McGraw-Hill Publication, 3rd Edition, 2012.
- Zaky, *Computer Organization*, McGraw-Hill Publication, 5th Edition, 2011.

BTCOC305 Digital Electronics & Microprocessor

Unit 1 **6 hrs**

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples ofICgates, **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 **6 hrs**

Combinational Digital Circuits:
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 **6 hrs**

Sequential circuits and systems:
A 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 **6 hrs**

Fundamentals of Microprocessors:
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 **6 hrs**

Memory Interfacing. I/O Interfacing. Direct Memory Access. (DMA). Interrupts in 8086.

Unit 6 **6 hrs**

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 Books:

1. R. P. Jain, "Modern Digital Electronics", McGraw Hill Education, 2009.
2. M. M. Mano, "Digital logic and Computer design", Pearson Education India, 2016.
3. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
4. Douglas Hall, *Microprocessors and Interfacing*, McGraw-Hill Publication, Revised 2nd Edition, 2006.

BTHMC306-Basic Human Rights

Unit 1 **6 hrs**

The Basic Concepts:
Individual, Group, Civil Society, State, Equality, Justice, Human Values: - Humanity, Virtues, Compassion.

Unit 2 **6 hrs**

Human Rights and Human Duties:
Origin, Civil and Political Rights, Contribution of American Bill of Rights, French Revolution, Declaration of Independence, Rights of Citizen, Rights of working and Exploited people, Fundamental Rights and Economic program, India's Charter of freedom.

Unit 3 **6 hrs**

Society, Religion, Culture, and their Inter-Relationship:
Impact of Social Structure on Human behaviour, Roll of Socialization in Human Values, Science and Technology, Modernization, Globalization, and Dehumanization.

Unit 4 **6 hrs**

Social Structure and Social Problems:
Social and Communal Conflicts and Social Harmony, Rural Poverty, Unemployment, Bonded Labour, Migrant workers and Human Rights Violations, Human Rights of mentally and physically challenged.

Unit 5 **6 hrs**

State, Individual Liberty, Freedom and Democracy:
The changing of state with special reference to developing countries, Concept of development under development and Social action, need for Collective action in developing societies and methods of Social action, NGOs and Human Rights in India: - Land, Water, Forest issues.

Unit 6 **6 hrs**

Human Rights in Indian Constitution and Law:
The constitution of India:
(i) Preamble
(ii) Fundamental Rights
(iii) Directive principles of state policy
(iv) Fundamental Duties
(v) Some other provisions
Universal declaration of Human Rights and Provisions of India, Constitution and Law, National Human Rights Commission and State Human Rights Commission.

Text / 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.

BTCOL307 Python Programming

One hour per week is for program demonstration and instruction which can be conducted as a classroom session or lab session.

Module 1: **2 Hrs.**
Informal introduction to programming, algorithms and data structures, Downloading and installing Python, run a simple program on Python interpreter.

Module 2: **2 Hrs.**
Variables, operations, control flow – assignments, conditionals, loops, functions: optional arguments, default values, Passing functions as arguments.

Module 3: **2 Hrs.**
Statements, Expressions, Strings: String processing. Exception handling, Basic input/output, Handling files.

Module 4: **2 Hrs.**
Class and Object, Data Structure: List, Tuple and Sequences, Set, Dictionaries.

Module 5: **4 Hrs.**
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.**

Reference Books:

1. Mark Lutz, *Learning Python*, O'Reilly Media, 5th Edition, 2013.
2. Mark Pilgrim, *Dive into Python 3*, Apress Publication, 2nd Edition, 2009.
3. Allen B. Downey, *Think Python*, O'Reilly Media, 2nd Edition, 2012.
4. Jon Kleinberg and Eva Tardos, *Algorithm Design*, Pearson Education, 1st Edition, 2006.

Text Books:

1. Michael Urban and Joel Murach, *Murach's Python Programming*, Murach's Publication, 2016.
2. Charles Severance, *Python for Informatics: Exploring Information*, University of Michigan, Version 2.7.0, 2014.
3. Dr. R. Nageswara Rao, *Core Python Programming*, Dreamtech Press, 1st Edition, 2016.

BTCOL308 HTML and JavaScript

Unit 1 **2 hrs**

Web Site development Essentials: Overview of Web Design Concepts, Web Development Teams, Web Project Management Fundamentals, Web Site Development Process, Web Page Layout and Elements, Web Site Usability and Accessibility, Configure Browsers Setting, Navigation Concepts, Web Graphics, Multimedia and the Web.

Unit 2 **2 hrs**

Hyper Text Markup Language (HTML): HTML and the Evolution of Markup languages, Create Hyperlinks, Create Tables, Create Web Forms, Image Inserting Techniques, Create Frames, GUI HTML Editors, Site Content and Metadata.

Unit 3 **2 hrs**

Introduction to Client-Server Model: Features of Dreamweaver Interface, Setting Up a Site with Dreamweaver, FTP -Site Upload Feature of Dreamweaver, Create various types of Links, Insert multimedia including text, image, animation & video, Finding a Home for your WordPress Site, Installing WordPress on Your Site, Content Management using WordPress, Selecting the Right Tools, Image Formats, Fonts and Colors, Designing Your WordPress Site, The WordPress Default Layout, Creating a Custom Site.

Unit 4 **2 hrs**

Cascading Style Sheets: Cascading Style Sheets for Web page design, Creating CSS rules in Dreamweaver, 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 5 **4 hrs**

JavaScript first steps; JavaScript first steps overview; What is JavaScript?; A first splash into JavaScript; What went wrong? Troubleshooting JavaScript; Storing the information you need — Variables; Basic in JavaScript — Numbers and operators; Handling text — Strings in JavaScript; Useful string methods; Arrays; Making decisions in your code — Conditionals; Looping code; Functions — Reusable blocks of code; Build your own function; Function return values; Introduction to events

***Programming assignments are mandatory.**

Reference Books:

J. N. Robbins, *Learning Web Design*, O'Reilly Media, 4th Edition, 2012.
Steven M. Schafer, *HTML, XHTML, and CSS Bible*, Wiley India, 5th Edition, 2010.
John Duckett, *Beginning HTML, XHTML, CSS, and JavaScript*, Wiley India, 3rd Edition, 2009.
Hal Stern, David Damstra, Brad Williams, Professional WordPress: Design and Development, Wrox Publication, 3rd Edition, 2015.
E. Robson, E. Freeman, *Head First HTML & CSS*, O'Reilly Media, 2nd Edition, 2012.

BTCOL309 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 the enqueue 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

BTCOL310 Digital Electronics and Microprocessor Laboratory

List of Experiments:

1. Simplification, realization of Boolean expressions using logic gates/universal gates.
2. Realization of half/full adder & half/full subtractors using logic gates.
3. Realization of parallel adder/subtractors using 7483 chip, BCD to Excess-3code conversion & vice versa.
4. Realization of binary to gray code conversion & vice versa.
5. MUX/DEMUX – use of 74153, 74139 for arithmetic circuits & code converter.
6. Realization of one/two bit comparator and study of 7485 magnitude comparator.
7. Use of a) Decoder chip to drive LED display & b) Priority encoder.
8. Truth table verification of flip-flops: i) JK Master Slave ii) T type iii) D type.
9. Realization of 3-bit counters as a sequential circuit & MOD-N counter design (7476, 7490, 74192, 74193).
10. Writing & testing of sequence generator.
11. Design of FSM: Moore machine, Mealy machine.

BTCOC401 Design and Analysis of Algorithms

Unit 1 6 hrs

Introduction to Algorithms: Definition of Algorithms, 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 6 hrs

Divide and Conquer: Introduction to Divide and Conquer Technique, Binary Search, Merge Sort, Quick Sort, Strassen's Matrix Multiplication.

Unit 3 6 hrs

Greedy Algorithms: 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 4 6 hrs

Dynamic Programming: 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.

Unit 5 6 hrs

Backtracking: Backtracking Concept, N–Queens Problem, Four–Queens Problem, Eight–Queen Problem, Hamiltonian Cycle, Sum of Subsets Problem, Graph Coloring Problem.

Branch and Bound: Introduction, Traveling Salesperson Problem, 15-Puzzle Problem, Comparisons between Backtracking and Branch and Bound.

Unit 6 6 hrs

Tree: Introduction, B-tree, Red-Black Tree (RBT): Insertion, Deletion.
NP Completeness: Introduction, The Complexity Class P, The Complexity Class NP, Polynomial-Time Reduction, The Complexity Class NP-Complete.

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.

Text Books:

1. Cormen, *Introduction to Algorithms*, PHI Publication, 2nd Edition, 2002.
2. Ellise Horowitz, Sartaj Sahni, S. Rajasekaran, *Fundamentals of Computer Algorithms*, University Press (India) Private Ltd, 2nd Edition, 2008.
3. Sara Base, *Computer algorithms: Introduction to Design and Analysis*, Addison-Wesley Publication, 2nd Edition, 1988.

BTCOC402 Probability and Statistics

Unit 1 **6 hrs**

Probability Theory: 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 **6 hrs**

Random Variable and Mathematical Expectation: Random variables, Probability distributions, Probability mass function, Probability density function, Mathematical expectation, Join and marginal probability distributions, Properties of expectation and variance with proofs.

Unit 3 **6 hrs**

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 4 **6 hrs**

Correlation: 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 5 **6 hrs**

Linear Regression Analysis: 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 6 **6 hrs**

Applied Statistics: Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

Reference Books:

1. Kishor S. Trivedi, *Probability, Statistics with Reliability, Queuing and Computer Science Applications*, Wiley India Pvt. Ltd, 2nd Edition, 2001.
2. Vijay K. Rohatgi, A. K. Md. Ehsanes Saleh, *An Introduction To Probability And Statistics*, Wiley Publication, 2nd Edition, 2001.

Text Books:

1. S. C. Gupta, *Fundamentals of Statistics*, Himalaya Publishing House, 7th Revied and Enlarged Edition, 2016.
2. G. V. Kumbhojkar, *Probability and Random Processes*, C. Jamnadas and Co., 14th Edition, 2010.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. Veerarajan T., Engineering Mathematics (for semester III), Tata McGraw-Hill, New Delhi, 2010.
5. G. Haribaskaran, *Probability, Queuing Theory and Reliability Engineering*, Laxmi Publications, 2nd Edition, 2009.
6. Murray Spiegel, John Schiller, R. ALU Srinivasan, *Probability And Statistics*, Schaum's Outlines, 4th Edition, 2013.

BTCOC403 Operating System

Unit 1 **6 hrs**

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 **6 hrs**

Processes and CPU Scheduling: Process Concept, Process Scheduling, Operation on process, Cooperating processes. Threads, Inter-process Communication, Scheduling criteria, scheduling Algorithms, Multiple-Processor Scheduling, Real-Time Scheduling, Scheduling Algorithms and performance evaluation.

Unit 3 **6 hrs**

Process Synchronization The critical-section problem, Critical regions, Synchronization Hardware, Semaphores, Classical Problems of synchronization, and Monitors Synchronizations in Solaris.

Unit 4 **6 hrs**

Deadlocks: Systems Model, Deadlock characterization, Methods for handling Deadlocks, Deadlock Prevention, Deadlock Avoidance, Deadlock Detection, Recovery from Deadlock, Combined approach to deadlock Handling.

Unit 5 **6 hrs.**

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.
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 6 **6 hrs.**

I/O Hardware: I/O devices, Device controllers, Direct memory access Principles of I/O Software: Goals of Interrupt handlers, Device drivers, sDevice independent I/O software, Secondary-Storage Structure: Disk structure, Disk scheduling algorithms.

File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed), Free-space management (bit vector, linked list, grouping), directory implementation (linear list, hash table), efficiency and performance.

Reference Books:

1. D. M. Dhamdhere, *Systems Programming and Operating Systems*, McGraw-Hill, 2nd Edition, 1996.
2. Garry Nutt, *Operating Systems Concepts*, Pearson Publication, 3rd Edition, 2003.
3. Harvey M. Deitel, *An Introduction to Operating Systems*, Addison-Wesley Publication, 2nd Edition, 1990.
4. Thomas W. Doeppner, *Operating System in Depth: Design and Programming*, Wiley Publication, 2011.

Text Books:

1. Abraham Silberschatz, Peter B. Galvin and Greg Gagne, *Operating System Concepts*, Wiley Publication, 8th Edition, 2008.
2. Andrew S. Tanenbaum, *Modern Operating System*, PHI Publication, 4th Edition, 2015.

BTCOE404(A) Object-Oriented Programming using C++ (Elective I)

Unit 1 **6 hrs**

Introduction to Object Oriented Programming and Objects and Classes: Need of object oriented programming, The object oriented approach, Characteristics of object oriented languages. A class, Objects as data types, Constructors, Objects as function arguments, Returning objects.

Unit 2 **6 hrs**

Operator Overloading and Inheritance: Overloading unary and binary operators, Data conversion. Derived and base class, Public and private inheritance, Levels of inheritance, Multiple inheritance Examples.

Unit 3 **6 hrs**

Polymorphism: Virtual functions, Dynamic binding, Abstract classes and pure virtual functions, Friend functions, this pointer.

Unit 4 **6 hrs**

Streams and Files: Streams, Stream output and input, Stream manipulators, Files and streams, Creating, Reading, Updating sequential and random files.

Unit 5 **6 hrs**

Templates and Exception Handling: Function templates, Overloading function templates, Class templates, Exception handling overview, Need of exceptions, An exception example, Multiple exceptions, Exception specifications.

Unit 6 **6 hrs**

Standard Template Library (STL): Introduction to STL-Containers, Iterators, Algorithms, Sequence containers, Associative containers, Container adapters.

Reference Books:

1. Bjarne Stroustrup, The C++ Programming Language, Addison-Wesley Publication, 4th Edition, 2013.
2. P. J. Deitel, H. M. Deitel, *C++ How to Program*, PHI Publication, 9th Edition, 2012.
3. John Hubbard, *Programming with C++*, Schaum's Outlines, McGraw-Hill Publication, 2nd Edition, 2000.
4. Nicolai M. Josuttis, *Object-Oriented Programming in C++*, Wiley Publication, 1st Edition, 2002.

Text Books:

1. E. Balagurusamy, *Object Oriented Programming with C++*, McGraw-Hill Publication, 6th Edition, 2013.
2. Robert Lafore, *Object Oriented Programming in C++*, Sams Publishing, 4th Edition, 2001.
3. Dr. B. B. Meshram, *Object Oriented Paradigms with C++ Beginners Guide for C and C++*, SPD Publication, 1st Edition, 2016.
4. Rajesh R. Shukla, *Object-Oriented Programming in C++*, Wiley India Publication, 1st Edition, 2008.

BTCOE404(B) Object-Oriented Programming using Java (Elective I)

Unit 1 **6 hrs**

Introduction to Computers and Java: Computers: Hardware and Software, Data Hierarchy, Computer Organization, Machine Languages, Assembly Languages and High-Level Languages, Introduction to Object Technology, Operating Systems, Programming Languages, Java and a Typical Java Development Environment, Your First Program in Java: Printing a Line of Text, Modifying Your First Java Program, Displaying Text with printf, Another Application: Adding Integers, Memory Concepts, Arithmetic, Decision Making: Equality and Relational Operators.

Unit 2 **6 hrs**

Introduction to Classes, Objects, Methods and Strings: Introduction, Declaring a Class with a Method and Instantiating an Object of a Class, Declaring a Method with a Parameter, Instance Variables, set Methods and get Methods, Primitive Types vs. Reference Types, Initializing Objects with Constructors Floating-Point Numbers and Type double.

Unit 3 **6 hrs**

Control Statements: Algorithms, Pseudocode, Control Structures, if Single-Selection Statement, if...else Double-Selection Statement, while Repetition Statement, Formulating Algorithms: Counter-Controlled Repetition, Formulating Algorithms: Sentinel-Controlled Repetition, Formulating Algorithms: Nested Control Statements, Compound Assignment Operators, Increment and Decrement Operators, Primitive Types, Essentials of Counter-Controlled Repetition, for Repetition Statement, Examples Using for Statement, do...while Repetition Statement, switch Multiple-Selection Statement, break and continue Statements, Logical Operators.

Unit 4 **6 hrs**

Array: Introduction, Declaring and Creating Arrays, Examples Using Arrays, Case Study: Card Shuffling and Dealing Simulation, Enhanced for Statement, Passing Arrays to Methods, Case Study: Class GradeBook Using an Array to Store Grades, Multidimensional Arrays, ase Study: Class GradeBook Using a Two-Dimensional Array, Variable-Length Argument Lists, Using Command-Line Arguments, Class Arrays.

Unit 5 **6 hrs**

Classes and Objects: Introduction, Controlling Access to Members, Referring to the Current Object's Members with the this Reference, Time Class Case Study: Overloaded Constructors, Time, Default and No-Argument Constructors, Notes on Set and Get Methods, Composition, Enumerations, Garbage Collection and Method finalize, static Class Members, static Import, final Instance Variables, Time Class Case Study: Creating Packages, Package Access.

Unit 6 **6 hrs**

Inheritance: Introduction, Superclasses and Subclasses, protected Members, Relationship between Superclasses and Subclasses, Hierarchy Using private Instance Variables, Constructors in Subclasses Software Engineering with Inheritance, Class Object.
Polymorphism: Introduction, Polymorphism Examples, Demonstrating Polymorphic Behavior, Abstract Classes and Methods, Case Study: Payroll System Using Polymorphism, final Methods and Classes, Case Study: Creating and Using Interfaces.

Reference Book:

1. Paul Deitel and Harvey Detail, *Java: How to Program*, Pearson's Publication, 9th Edition,
2. Joel Murach and Michael Urban, *Murach's Beginning Java with Eclipse*, Murach's Publication, 1st Edition, 2016.
3. Doug Lowe, *Java All-in-One For Dummies*, Wiley Publication, 4th Edition, 2014.
4. Herbert Schildt, *Java The Complete Reference*, McGraw-Hill Publication, 9th Edition,
5. Patrick Niemeyer, Daniel Leuck, *Learning Java*, O'Reilly Media, 4th Edition, 2013.

BTCOE405(A) Numerical Methods (Elective-II)

This course preferably offered as a SWAYAM course

Unit 1 [5 Hrs.]
Solution of Algebraic and Transcendental Equation: Bisection method, Method of false position, Newton's method and Newton-Raphson method.

Unit 2 [5 Hrs.]
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 [5 Hrs.]
Finite Differences: Forward difference operator, Backward difference operator, Central difference operator, Newton's interpolation formulae, Newton's forward–backward-central interpolation formulae.

Unit 4 [5 Hrs.]
Differentiation and Integration: Newton-Cortes formula, Trapezoidal rule, Simpson one–third rule, Simpson three- eighth rule.

Unit 5 Numerical Solution of ODE: Picard's methods, Taylor series method, Euler's method, Modified Euler's method, Runge - Kutta method. [5 Hrs.]

Text Books:

1. B.S Grewal, Higher Engineering Mathematics, 40 th edition, Khanna publication.
2. S. S. Shastri, Introduction to Numerical Methods, PHI publication.
3. V. Rajaraman, Computer Oriented Methods, 3 rd edition, PHI publication.

Reference Books:

1. Conte and De boor, Elementary Numerical Analysis, BPB publication.
2. E. Kreyszig, Advanced Engineering Mathematics, BPB publication.
3. Steven C Chapra, Numerical Methods for Engineers, 5 th edition, McGraw Hill publication.

Equivalent SWAYAM/NPTEL Course

BTCOE405(B) Physics of Engineering Material (Elective-II)

Unit I Magnetic Materials: **5hrs**

Magnetic Materials: Origin of magnetization using atomic theory, classification of magnetic materials and properties, Langevin's theory of Dia, Para and ferromagnetism, Soft and Hard magnetic materials and their uses, Domain theory of ferromagnetism, Hysteresis loss, Ant ferromagnetic and Ferromagnetic materials, Ferrites and Garnets, magnetic bubbles, magnetic recording.

Unit II Conducting and Superconducting Materials: Band theory of solids, Classical free electron theory of metals, Quantum free electron theory, Density of energy states and carrier concentration, Fermi energy, Temperature and Fermi energy distribution, Superconductivity, Factor affecting Superconductivity, Meissner effect, Type-I and Type-II superconductors, BCS theory, Josephson effect, High temperature superconductors, Application of superconductors (Cryotron, magnetic levitation) **5hrs**

Unit III Semiconducting Materials: Band structure of semiconductor, Charge carrier concentration, Fermi level and temperature, Electrical conductivity, Hall effect in semiconductors, P-N junction diode, Preparation of single crystals, LED, Photovoltaic Cell **5hrs**

Unit IV Dielectric Materials: Dielectric constant and polarizability, types of polarization, temperature and frequency dependences of Dielectric parameter, internal fields in solids, Clausius-Mosotti equation, dielectric loss, dielectric breakdown, ferroelectric, pyroelectric and piezoelectric materials, applications of dielectric materials **5hrs**

Unit V Nano Materials: Nanomaterials : Introduction and properties, synthesis of nanomaterials, Carbon Nano Tubes, Characterization techniques of nanomaterials- SEM, TEM, EDAX, FMR, XRD. Applications of nanomaterials. **5hrs**

Text Books:

1. C. Kittle ,"***Introduction to Solid state Physics***".
2. C. M. Srivastava , C. Srinivasan , "***Science of Engineering Materials and Carbon Nanotubes***".
3. A. J. Dekker, "***Solid State Physics***".

Reference Books:

1. V. Raghavan, "***Material Science and Engineering***".
2. A. J. Dekker, "***Electrical Engineering Materials***".

BTCOE405(C) Soft Skills and Persnolity Development (Elective-II)

This course preferably offered as a SWAYAM course

UNIT I

Self Management:
Self Management, 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

UNIT II

Time Management Techniques
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.

UNIT III

Motivation/ Inspiration
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

Unit IV

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

Unit V

Effective Computing 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 and 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***".

BTXXC406 Product Design Engineering

Unit 1 **6 hrs**

Creating Simple Products and Modules.

Unit 2 **6 hrs**

Document Creation and Knowledge Sharing.

Unit 3 **6 hrs**

Self and Work Management.

Unit 4 **6 hrs**

Team Work and Communication.

Unit 5 **6 hrs**

Managing Health and Safety.

Unit 6 **6 hrs**

Data and Information Management.

Text / Reference Books:

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- HILL book company.
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.

BTCOL407 Design and Analysis of Algorithm Laboratory

List of Experiments:

1. Divide and conquer method (quick sort, merge sort, Strassen's matrix multiplication).
2. Greedy method (knapsack problem, job sequencing, optimal merge patterns, minimal spanning trees).
3. Dynamic programming (multistage graphs, OBST, 0/1 knapsack, traveling sales person problem).
4. Obtain the Topological ordering of vertices in a given digraph.
5. Back tracking (n-queens problem, graph coloring problem, Hamiltonian cycles).
6. Selection: Minimum/ Maximum, K^{th} smallest element.
7. Find optimal ordering of matrix multiplication. (Use Dynamic programming method).
8. Use dynamic programming algorithm to solve optimal binary search tree problem.
9. Compute the transitive closure of a given directed graph using Warshall's algorithm.
10. Write programs to find out a minimum spanning tree of a simple connected undirected graph by applying: (a) Prim's algorithm (b) Kruskal's algorithm.
11. Write a program to implement Dijkstra's algorithm for solving single source shortest path problem using priority queue.
12. Write a program to implement Floyd-Warshall algorithm for solving all pairs shortest path problem.

BTCOL408 Introduction to data science with R

Unit 1: Introduction to Basics **2 hrs**

The basic data types in R. Variables.

Module 2 Vectors and Matrices **4hrs**

Vectors. Create, name and select elements from vectors. Learn how to work with matrices in R. Do basic computations with them and demonstrate your knowledge by analyzing the Star Wars box office figures.

Module 3: Factors & Data Frames **2 hrs**

Storeing Categorical data in factors. Learn how to create, subset and compare categorical data. When working R, you'll probably deal with Data Frames all the time. Therefore, you need to know how to create one, select the most interesting parts of it, and order them.

Module 4: Lists **2 hrs**

Create, name and select elements from Lists

Module 5: Basic Graphics **2 hrs**

Discover R's packages to do graphics and create your own data visualizations.

***Programming assignments are mandatory.**

Reference Books:

1. Joel Grus, *Data Science from Scratch: First Principles with Python*, O'Reilly Media, 1st Edition, 2015.
2. Hadley Wickham, Garrett Grolemund, *R for Data Science Import, Tidy, Transform, Visualize, and Model Data*, O'Reilly Media, 1st Edition, 2017.
3. Nina Zumel, John Mount,"Practical Data Science with R", Manning, 2014.

Text Books:

1. Rajendra Patil, Hiren dand, Rupali Dahake, *A practical approach to R Tool*, SPD Publication, 1st Edition, 2017.

BTCOL409 Object Oriented Programming Laboratory

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.

BTCOL410 Operating Systems Laboratory

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.
15. Writing utilities and OS performance tuning.

Dr. Babasaheb Ambedkar Technological University, Lonere.

Dr. Babasaheb Ambedkar Technological University
(Established as a University of Technology in the State of Maharashtra)
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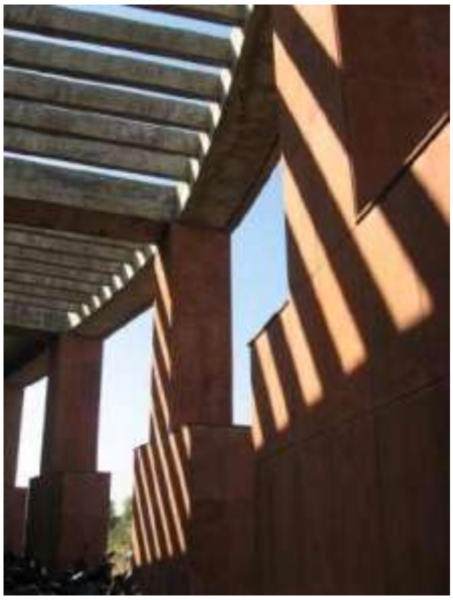
COURSE STRUCTURE AND SYLLABUS

For

B. Tech. Electronics Engineering Programme

With effect from the Academic Year

2017-2018 (First Year), 2018-2019 (Second Year),
2019-2020 (Third Year), 2019-2021 (Final Year).



B. Tech (Electronics & Telecommunication Engineering) / B. Tech (Electronics Engineering)

Curriculum for Semester III [Second Year]

Sr. No.	Course Code	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
			L	T	P	MSE	CA	ESE		
1	BTBSC301	Engineering Mathematics-III	3	1	0	20	20	60	100	4
2	BTEXC302	Analog Circuits	2	1	0	20	20	60	100	3
3	BTEXC303	Electronic Devices & Circuits	2	1	0	20	20	60	100	3
4	BTEXC304	Network Analysis	2	1	0	20	20	60	100	3
5	BTEXC305	Digital Logic Design	2	1	0	20	20	60	100	3
6	BTHM3401	Basic Human Rights	2	0	0	--	50	--	50	(Audit)
7	BTEXL307	Analog Circuits Lab	0	0	2	--	60	40	100	1
8	BTEXL308	Electronic Devices & Circuits Lab	0	0	2	--	60	40	100	1
9	BTEXL309	Network Analysis Lab	0	0	2	--	60	40	100	1
10	BTEXL310	Digital Logic Design Lab	0	0	2	--	60	40	100	1
11	BTEXW311	Electronics Workshop	0	0	2	--	60	40	100	1
12	BTES211P	Field Training/ Internship/Industrial Training Evaluation	--	--	--	--	--	50	50	1
		Total	**13**	**05**	**10**	**100**	**450**	**550**	**1100**	**22**

B. Tech (Electronics & Telecommunication Engineering) / B. Tech (Electronics Engineering)

Curriculum for Semester IV [Second Year]

Sr. No	Course Code	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
			L	T	P	MSE	CA	ESE		
1	BTEXC401	Electrical Machines and Instruments	2	1	0	20	20	60	100	3
2	BTEXC402	Analog Communication Engineering	2	1	0	20	20	60	100	3
3	BTEXC403	Microprocessor	2	1	0	20	20	60	100	3
4	BTEXC404	Signals and Systems	2	1	0	20	20	60	100	3
5	BTID405	Product Design Engineering	1	0	2	30	30	40	100	2
6	BTBSC406	Numerical Methods and Computer Programming	2	1	0	20	20	60	100	3
7	BTEXL407	Electrical Machines and Instruments Lab	0	0	2	--	60	40	100	1
8	BTEXL408	Analog Communication Engineering Lab	0	0	2	--	60	40	100	1
9	BTEXL409	Microprocessor Lab	0	0	2	--	60	40	100	1
10	BTEXL410	Signals and Systems Lab	0	0	2	--	60	40	100	1
11	BTHML411	Soft-Skill Development	0	0	2	--	60	40	100	1

12	BTEXF412	Field Training/ Internship/Industrial Training (Minimum 4 weeks which can be completed partially in third semester or fourth semester or in at one time)	--	--	--	--	--	--	--	1 (To be evaluated in V^{th} Semester)
		Total	**11**	**05**	**12**	**130**	**430**	**540**	**1100**	**22**

B. Tech (Electronics Engineering)

Proposed Curriculum for Semester V [Third Year]

S. N.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEXC501	Professional Core Course 1	Electromagnetic Field Theory	2	1	0	20	20	60	100	3
2	BTEXC502	Professional Core Course 2	Control System Engineering	2	1	0	20	20	60	100	3
3	BTEXC503	Professional Core Course 3	Microelectronics	3	0	0	20	20	60	100	3
4	BTEXC504	Professional Core Course 4	Digital Signal Processing	2	1	0	20	20	60	100	3
5	BTEXC505	Professional Core Course 5	Microcontroller and its Applications	3	0	0	20	20	60	100	3
6	BTEXPE506A	Program Elective Course 1	Probability Theory and Random Processes	3	0	0	20	20	60	100	3
	BTEXPE506B		NSQF (Level 7 Course)								
	BTEXPE506C		Data Structures and Algorithms Using Java Programming								
	BTEXPE506D		Introduction to MEMS								

	BTEXPE506E		Audio and Video Processing							
7	BTEXL507	Control System Engineering Lab		0	0	2	--	30	20	50	1
8	BTEXL508	Digital Signal Processing Lab		0	0	2	--	30	20	50	1
9	BTEXL509	Microcontroller and its Applications Lab		0	0	2	--	30	20	50	1
10	BTEXP510	Mini Project		0	0	2	--	30	20	50	1
11	BTEXS511	Seminar		0	0	2	--	30	20	50	1
12	BTEXF412	Field Training/ Internship/Industrial Training Evaluation		--	--	--	--	--	50	50	1
			Total	**15**	**03**	**10**	**120**	**270**	**510**	**900**	**24**

B. Tech (Electronics Engineering)

Proposed Curriculum for Semester VI [Third Year]

S.N.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEXC601	Professional Core Course 1	Computer Architecture	3	0	0	20	20	60	100	3
2	BTEXC602	Professional Core Course 2	Power Electronics	3	0	0	20	20	60	100	3
3	BTEXPE603A	Program Elective Course 2	Digital Communication	3	0	0	20	20	60	100	3
	BTEXPE603B		Computer Network and Cloud Computing								
	BTEXPE603C		Nano Electronics								
	BTEXPE603D		Web Development and Design								
4	BTEXOE604A	Open Elective Course 1	Digital System Design	3	0	0	20	20	60	100	3
	BTEXOE604B		Neural Networks and Fuzzy Systems								
	BTEXOE604C		NSQF (Level 7 Course)								
	BTEXOE604D		Analog Integrated Circuit Design								
5	BTEXOE605A	Open Elective Course 2	Embedded System Design	2	0	0	20	20	60	100	2
	BTEXOE605B		Electronics System Design								

	BTEXOE605C		Project Management and Operation Research								
	BTEXOE605D		Android Programming								
6	BTHM606	Humanities & Social Science including Management Courses	Employability & Skill Development	2	0	0	--	50	0	50	2
7	BTEXL607	Power Electronics Lab		0	0	2	--	30	20	50	1
8	BTEXL608	Program Elective Course 2 Lab		0	0	2	--	30	20	50	1
9	BTEXL609	Open Elective Course 1 Lab		0	0	2	--	30	20	50	1
10	BTEXP610	Community Project		0	0	2	--	30	20	50	1
11	BTEXS611	Seminar		0	0	2	--	30	20	50	1
12	BTEXF612	Field Training/ Internship/Industrial Training (Minimum 4 weeks)		--	--	--	--	--	--	--	1*
			Total	**16**	**0**	**10**	**100**	**300**	**400**	**800**	**21**

Program Elective 2	**Open Elective 1**	**Open Elective 2**
(A) Digital Communication	(A) Digital System Design	(A) Embedded System Design
(B) Computer Network and Cloud Computing	(B) Neural Networks and Fuzzy Systems	(B) Electronics System Design
(C) Nano Electronics	(C) NSQF (Level 7 Course)	(C) Project Management and Operation Research
(D) Web Development and Design	(D) Analog Integrated Circuit Design	(D) Android Programming

* To be evaluated in VIIth Semester

B. Tech (Electronics Engineering)

Proposed Curriculum for Semester VII [Final Year]

S.N.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEXC701	Professional Core Course 1	Antennas and Wave Propagation	3	0	0	20	20	60	100	3
2	BTEXPE702	Program Elective 3	Group A	3	0	0	20	20	60	100	3
3	BTEXPE703	Program Elective 4	Group B	3	0	0	20	20	60	100	3
4	BTEXPE704	Program Elective 5	Group C	3	0	0	20	20	60	100	3
5	BTHM705	Humanities & Social Science including Management Courses	Financial management	2	0	0	--	50	--	50	2
6	BTEXL706	Program Elective 3 Lab		0	0	2	--	30	20	50	1
7	BTEXL707	Program Elective 4 Lab		0	0	2	--	30	20	50	1
8	BTEXL708	Program Elective 5 Lab		0	0	2	--	30	20	50	1
9	BTEXP709	Project Part-I		0	0	8	--	50	50	100	4
10	BTEXS710	Seminar		0	0	2	--	30	20	50	1
11	BTEXF612	Field Training/ Internship/Industrial Training Evaluation		--	--	--	--	--	50	50	1
			Total	**14**	**0**	**16**	**80**	**300**	**420**	**800**	**23**

Program Elective 3 (Group A)	Program Elective 4 (Group B)	Program Elective 5 (Group C)
(A) Digital Image Processing	(A) IOT 4.0	(A) Microwave Theory & Techniques
(B) Data Compression and Encryption /Cryptography	(B) Wireless Sensor Networks	(B) Satellite Communication
(C) NSQF (Level 7 Course)	(C) CMOS Design	(C) Fiber Optic Communication
(D) Parallel Processing	(D) Process Instrumentation	(D) Wireless Communication

B. Tech (Electronics Engineering)

Proposed Curriculum for Semester VIII [Final Year]

(Students doing the Project at Institute Level)

Sr. No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEXPE801	Program Elective 6	Group A	3	0	0	20	20	60	100	3
2	BTEXPE802	Program Elective 7	Group B	3	0	0	20	20	60	100	3
3	BTEXOE803	Open Elective 3	Group C	3	0	0	20	20	60	100	3
4	BTEXL804	Program Elective 6 Lab		0	0	2	--	40	60	100	1
5	BTEXL805	Program Elective 7 Lab		0	0	2	--	40	60	100	1
6	BTEXP806	Project Part-II		0	0	16	--	100	50	150	8
			Total	**9**	**0**	**20**	**60**	**240**	**350**	**650**	**19**

OR

B. Tech (Electronics Engineering)

Proposed Curriculum for Semester VIII [Final Year]

(Students doing the Project at Industry)

Sr. No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEXPE801	Program Elective 6	Group A	3	0	0	20	20	60	100	3*
2	BTEXPE802	Program Elective 7	Group B	3	0	0	20	20	60	100	3*
3	BTEXOE803	Open Elective 3	Group C	3	0	0	20	20	60	100	3*
4	BTEXP804	Project Part-II		0	0	20	--	200	150	350	10
			Total	**9**	**0**	**20**	**60**	**260**	**330**	**650**	**19**

* Students should complete the certification credit course using SWAYAM, MOOC, NPTEL, Corusera platform and submit the certificate. University will transfer these credits accordingly.

OR

B. Tech (Electronics Engineering)

Proposed Curriculum for Semester VIII [Final Year]

(Students doing the In-plant training and completing the Project sponsored / promoted by Industry)

Sr. No.	Course Code	Type of Course	Course Title	Hours Per Week			Evaluation Scheme			Total Marks	Credits
				L	T	P	MSE	CA	ESE		
1	BTEXPE801	Program Elective 6	Group A	--	--	--	--	60*	40*	--	Audit *
2	BTEXPE802	Program Elective 7	Group B	--	--	--	--	60*	40*	--	Audit *
3	BTEXOE803	Open Elective 3	Group C	--	--	--	--	60*	40*	--	Audit *
4	BTEXP804I	In-Plant Training and Project Part-II		--	--	30	--	450	200	--	19
			Total	--	--	**30**	--	**450**	**200**	**650**	**19**

* Students should complete the certification course using SWAYAM, MOOC, NPTEL Platform or self -study mode.

Program Elective 6 (Group A)	**Program Elective 7 (Group B)**	**Open Elective 3 (Group C)**
(A) Surface Mounting Technology	(A) e-Yantra	(A) Advanced Industrial Automation
(B) Mixed Signal Design	(B) Mobile Communication & Networks	(B) Electronics in Smart City
(C) Bio-medical Signal Processing	(C) Geo-informatics and Spatial Computing	(C) Industrial Drives and Control
(D) Multirate Digital Signal Processing	(D) Software Defined Radio	(D) Robotics Design
(E) Wavelet Theory	(E) Entrepreneurship Development	(E) Block Chain Technology

BTBSC301	Engineering Mathematics-III	4 Credits

Second Year B. Tech Classes (Common to all Branches) Semester: III

Prerequisites: Differential and Integral Calculus, Taylor series and Infinite series, Differential equations of first order and first degree, Fourier series, Vector algebra, Algebra of complex numbers.

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 Electromagnetics 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:

1. Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
2. Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. 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.
4. Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.
5. Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

UNIT - 1	07 Hours

Laplace Transform

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	07 Hours

Inverse Laplace Transform

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	07 Hours

Fourier Transform

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	07 Hours

Partial Differential Equations and Their Applications

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 $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$, and two dimensional heat flow equation (i.e. Laplace equation : $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$).

UNIT - 5	07 Hours

Functions of Complex Variables (Differential calculus)

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.

UNIT - 6	07 Hours

Functions of Complex Variables (Integral calculus)

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. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3. A Course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

REFERENCE BOOKS

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
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 batch wise. 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.

BTEXC302	Analog Circuits	3 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.
6. To understand functionalities of PLL.

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 for Op-Amp.
4. Comply and 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.
9. Understand and apply the functionalities of PLL.

UNIT - 1	06 Hours

OP-AMP Basics

Block diagram of OP-AMP, Differential Amplifier configurations, Differential amplifier analysis for dual-input balanced-output configurations, Need and types of level shifter, current mirror circuits. Feedback topologies: Voltage series and voltage shunt feedback amplifier and its effect on R_i, R_o, bandwidth and voltage gain.

UNIT - 2	06 Hours

Linear Applications of OP-AMP

Inverting and non-inverting amplifier configurations, voltage follower, summing, averaging scaling amplifier, difference amplifier, integrator, differentiator, and instrumentation amplifiers.

UNIT - 3	06 Hours

Non-linear Applications of OP-AMP

Introduction to comparator, characteristics and applications of comparator, Schmitt trigger, clippers and clampers, voltage limiters, square wave generator, triangular wave generator, Need of precision rectifiers, Half wave and Full wave precision rectifiers.

UNIT - 4	06 Hours

Converters using OP-AMP

V-F, I-V and V-I converter, Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistor string etc. Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash type.

UNIT - 5	06 Hours

Oscillators

Principle of Oscillators, Barkhausen criterion, Oscillator types: RC oscillators (design of phase shift, Wien bridge etc.), LC oscillators (design of Hartley, Colpitts, Clapp etc.), non-sinusoidal oscillators, and voltage controlled oscillators.

UNIT - 6	06 Hours

Active filters and PLL

Design guidelines of Active filters: Low pass, high pass, band pass and band stop filters, block diagram of PLL and its function.

TEXT/REFERENCE BOOKS

1. Ramakant A. Gaikwad, "Op Amps and Linear Integrated Circuits", Pearson Education 2000.
2. Salivahanan and Kanchana Bhaskaran, "Linear Integrated Circuits", Tata McGraw Hill, India 2008.
3. George Clayton and Steve Winder, "Operational Amplifiers", 5th Edition Newnes.
4. Sergio Franco, "Design with Operational Amplifiers and Analog Integrated Circuits", Tata McGraw Hill.
5. Bali, "Linear Integrated Circuits", McGraw Hill 2008.
6. Gray, Hurst, Lewise, Meyer, "Analysis & Design of Analog Integrated Circuits", Wiley Publications on Education.

BTEXC303	Electronic Devices & Circuits	3 Credits

Prerequisites:

Basic knowledge of Semiconductor Physics.

Course Objectives:

1. To introduce semiconductor devices FET and MOSFET, their characteristics, operations, circuits and applications
2. To introduce concepts of both positive and negative feedback in electronic circuits
3. To analyze and interpret 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
5. To study the different types of voltage regulators.

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 small signal model of FET and MOSFET.
4. Explain behavior of FET at low frequency.
5. Design an adjustable voltage regulator circuits.

UNIT - 1	06 Hours

JFET

Introduction to JFET, Types, Construction, Operation, Static Characteristics, Pinch off voltage, FET Volt-Ampere characteristics, FET Configurations (CS/CD/CG) and their Comparison. Biasing of FET (Self).FET as an amplifier and its analysis (CS) and its frequency response, Small signal model, FET as High Impedance circuits

UNIT - 2	06 Hours

MOSFET& its DC Analysis

Basics of MOS Transistor operation, Construction of n-channel E-MOSFET, E-MOSFET characteristics & parameters, non-ideal voltage current characteristics viz. Finite output resistance, body effect, sub-threshold conduction, breakdown effects and temperature effects. Common source circuit, Load Line & Modes of operation, common MOSFET configurations: DC Analysis, constant current source biasing, MOSFET as switch, diode/active resistor, Current sink and source, current mirror, Voltage references, Basic principle of band gap reference, CMOS Inverter as amplifier: Active load, Current source and Push pull configurations.

UNIT - 3	06 Hours

Electronics Amplifiers

Classification of amplifiers, Fundamentals of Low noise and Power amplifiers. Feedback amplifiers: Feedback concept and topologies, Effect of feedback on terminal characteristics of amplifiers, feedback amplifier analysis, cascade amplifiers, DC Amplifiers.

UNIT - 4	06 Hours

Oscillators

Barkhausen criterion, stability with feedback. Classification of oscillators, RC Oscillators: FET RC Phase Shift oscillator, Wein bridge oscillator, LC Oscillators: Hartley and Colpitts oscillators, Crystal oscillators, UJT Relaxation oscillator.

UNIT - 5	06 Hours

Multivibrators

IC555 Block diagram, Types of Multivibrators: Astable, Monostable and Bistable, Operation of Multivibrators using FETs and IC555. Applications of IC555 in Engineering.

UNIT - 6	06 Hours

Voltage Regulator

Block diagram of an adjustable three terminal positive and negative regulators (317,337) typical connection diagram, current boosting, Low drop out voltage regulators, Introduction to Switch Mode Power supply (SMPS), Block diagram of SMPS, Types of SMPS. Comparison of Linear Power supply and SMPS.

TEXT/REFERENCE BOOKS

1. Millman Halkias, "Integrated Electronics-Analog and Digital Circuits and Systems", Tata McGraw Hill, 2000
2. Donald Neaman, "Electronic Circuit Analysis and Design", 3rd Edition, Tata McGraw Hill
3. Brijesh Iyer, S. L. Nalbalwar, R. Dudhe, "Electronics Devices & Circuits", Synergy Knowledgeware Mumbai, 2017. ISBN:9789383352616
4. David A. Bell, "Electronic Devices and Circuits",5th Edition, Oxford Press
5. R. L. Boylstad, L. Nashlesky, "Electronic Devices and circuits Theory", 9thEdition, Prentice Hall of India, 2006.

BTEXC304	Network Analysis	3 Credits

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 the same.
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	06 Hours

Basic Circuit Analysis and Simplification Techniques

Basic circuit elements, Simplification of networks, Equivalent 'T' and 'Π' networks of any complicated network, Voltage and Current laws (KVL/KCL), Network Analysis: Mesh, Super mesh, Node and Super Node analysis. Principle of duality, Source transformation and source shifting, Network Theorems such as Superposition, Thevenin's, Norton's and Maximum Power Transfer Theorems.

***Note**: Above circuit analysis, mentioned in this Unit-1, is for AC network only.*

UNIT - 2	06 Hours

Frequency Selective Networks

Significance of Quality factor, Series Resonance: Resonating frequency, Reactance curves, Variation of circuit parameters such as impedance, phase angle, voltage and current with frequency; Bandwidth, Selectivity, Magnification factor, Parallel resonance: Resonant frequency, Variation circuit parameters such as admittance, phase angle, voltage and current with frequency; Bandwidth and selectivity. Analysis of parallel resonating circuit with resistance present in both branches (inductive and capacitive branches) and tank circuit, Effect of generator resistance on BW & Selectivity, Comparison and applications of series and parallel resonant circuits.

UNIT - 3	06 Hours

Electrical Network Parameters and Passive Filters

Classifications: Symmetrical and Asymmetrical networks. Properties of two port Network :(i) Symmetrical Networks (T and Π only): Characteristics impedance and propagation constant in terms of circuit components, open and short circuit parameters (ii) Asymmetrical

Networks: Image Impedance and Iterative Impedance. Passive Filters: Filter fundamentals, Introduction to Neper and Decibel, Relation between Neper and Decibel, Constant K-LPF, HPF, BPF and BSF, m-derived LPF and HPF, Terminating half sections, Concept of composite filters. Attenuators: Symmetrical T and Π type attenuators, Ladder attenuator.

UNIT - 4	06 Hours

Steady State and Transient Response

DC and AC response of R-L, R-C and RLC circuits, Analysis of electrical circuits using Laplace Transform.

UNIT - 5	06 Hours

Two Port Network Parameters and Functions

Terminal characteristics of network: Z, Y, h, ABCD Parameters; Reciprocity and Symmetry conditions, Applications of the parameters. Network functions for one port and two port networks, Pole-zeros of network functions and network stability.

UNIT - 6	06 Hours

Transmission Line Theory

Types of Transmission lines, Transmission Line Equation, Equivalent circuits, Primary and Secondary line constants, Terminations of transmission lines, VSWR and Reflection Coefficient, Impedance matching, Transmission line measurements using Smith chart.

TEXT/REFERENCE BOOKS

1. D Roy Choudary, “Network and Systems” 1st edition, New Age International, 1988
2. John D. Ryder, “Network Lines and Fields” 2nd edition, PHI, 1955
3. C. P. Kuriakose, “Circuit Theory Continuous and Discrete Time System, Elements of Network Synthesis” PHI
4. W.H. Hayt Kemmerly, “Engineering Circuit Analysis”, 5th Edition, Tata McGraw Hill Publications, 1993.
5. M. E. Van Valkenburg, “Network Analysis”, 3rd Edition, Pearson, 2004. 6. Boylestead, “Introductory Circuit Analysis”, 4th edition, Charles & Merrill, 1982. 7. Royal Signal Handbook on Line Communication.

BTEXC305	Digital Logic Design	3 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	06 Hours

Combinational Logic Design

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	06 Hours

Sequential Logic Design

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, 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	06 Hours

State Machines

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	06 Hours

Digital Logic Families

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	06 Hours

Programmable Logic Devices and Semiconductor Memories

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.

UNIT - 6	06 Hours

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.

BTHM3401	Basic Human Rights	Audit

Course Objectives:

1. To work for ensuring that basic human rights are respected everywhere.
2. To cooperate to avoid compromising on human rights for economic or political expediency
3. To recognize democratic institutions as a fundamental human right
4. To work towards the sovereignty and self-determination of entities with historical, cultural and ecological identity.
5. To actively engage with the Government of India and other countries to promote human rights education.
6. To bring diplomatic and commercial pressures on regimes that violates human rights, to ensure that they respect the basic rights of their citizens.
7. To keep the interests of disempowered communities foremost in all dealings with countries in which human rights violations occur
8. To develop a more distinctive and effective role for the International Court of Justice in the field of human rights
9. To promote a culture for educating the citizenry that cultivation and promotion of human rights culture is the sine qua non for the smooth functioning of the organs of a democratic State and for the kind of development that results into overall development of the society.
10. To train the young men and women for 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
11. To study the effects of draconian laws and unlawful use of State's machinery and force by the enforcement agencies.

Course Outcomes:

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

1. Simply put, human rights education is all learning that develops the knowledge, skills, and values of human rights.
2. Strengthen the respect for human rights and fundamental freedoms.
3. Enable all persons to participate effectively in a free society.
4. Learn about human rights principles, such as the universality, indivisibility, and interdependence of human rights.
5. Learn about regional, national, state, and local law that reinforces international human rights law.
6. Learn and know about and being able to use global, regional, national, and local human rights instruments and mechanisms for the protection of human rights.

UNIT - 1	06 Hours

The Basic Concepts

Individual, Group, Civil Society, State, Equality, Justice, Human Values: - Humanity, Virtues, Compassion.

UNIT - 2	06 Hours

Human Rights and Human Duties

Origin, Civil and Political Rights, Contribution of American Bill of Rights, French Revolution, Declaration of Independence, Rights of Citizen, Rights of working and Exploited people, Fundamental Rights and Economic program, India’s Charter of freedom

UNIT - 3	06 Hours

Society, Religion, Culture, and their Inter-Relationship

Impact of Social Structure on Human behavior, Roll of Socialization in Human Values, Science and Technology, Modernization, Globalization, and Dehumanization.

UNIT - 4	06 Hours

Social Structure and Social Problems

Social and Communal Conflicts and Social Harmony, Rural Poverty, Unemployment, Bonded Labour, Migrant workers and Human Rights Violations, Human Rights of mentally and physically challenged

UNIT - 5	06 Hours

State, Individual Liberty, Freedom and Democracy

The changing of state with special reference to developing countries, Concept of development under development and Social action, need for Collective action in developing societies and methods of Social action, NGOs and Human Rights in India: - Land, Water, Forest issues.

UNIT - 6	06 Hours

Human Rights in Indian Constitution and Law

The constitution of India:

(i) Preamble

(ii) Fundamental Rights

(iii) Directive principles of state policy

(iv) Fundamental Duties

(v) Some other provisions

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

TEXT/REFERENCE BOOKS

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

BTEXC401	Electrical Machines and Instruments	3 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	06 Hours

DC Machines

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	06 Hours

Induction Motor and Synchronous Motor

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	06 Hours

Special Purpose Machines

Construction, working and application of steeper motor, variable reluctance motor, servo motor, FHP motor, hysteresis, repulsion, linear IM.

UNIT - 4	06 Hours

Sensors and Transducers

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	06 Hours

Industrial Measurement and Industrial Applications

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.

UNIT - 6	06 Hours

I/O Devices

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 McGraw Hill)
3. Electrical Machines by Ashfaqu Husain, Dhanpatrai and publication
4. Instrumentation Devices System edition C. S. Rajan, G. R. sharma
5. Abhijit Chakrabarti & Sudipta Debnath, “Electrical Machines”, Tata McGraw-hill Publication.
6. William H Hayt, Jack E Kimmerly and Steven M. Durbin, “Engineering Circuit Analysis”, Tata McGraw Hill.
7. A.E. Fitzgerald, Charles Kingsley & Jr. Stephen D. Umans, “Electrical Machinery”, Tata McGraw-hill Publication 6th Edition.
8. I.J Nagarath & D.P Kothari, “Electrical Machines”, Tata McGraw-hill Publication 4th 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.

BTEXC402	**Analog Communication Engineering**	**3 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 demodulation techniques.
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 noise performance.
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	**06 Hours**

Introduction to Communication System

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	06 Hours

Amplitude Modulation

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	06 Hours

Angle Modulation

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	06 Hours

Radio Receivers and Demodulators

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	06 Hours

AM and FM Detectors

AM Detectors: Envelop detector and practical diode detector.

FM Detectors: Slope detector, phase discriminator and ratio detector.

UNIT - 6	06 Hours

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, 4th 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 Graw Hill
5. Beasley & Miller, "Modern Electronic Communication", Prentice-Hall India-2006, 8th Edition.
6. Wayne Tomasi, "Electronic Communication Systems", Pearson Education-2005, 5th Edition.
7. R. G. Gupta, "Audio & Video Systems" Tata McGraw-Hill New Delhi-2008.

BTEXC403	Microprocessor	3 Credits

Course Objectives:

1. Objective of this course is to introduce to the students the fundamentals of microprocessor.
2. After learning Microprocessor course, students will get advantage to pursue higher studies in Embedded Systems or employment in core industries.
3. The learner can design microprocessor based systems and thus can become successful entrepreneur and meet needs of Indian and multinational industries.
4. The students can design and develop processor which can be used in Robotics, Automobiles, Space and many research areas.
5. The learners will acquaint optimization skills and undergo concepts design metrics for embedded systems.
6. The students will get acquainted with recent trends in microprocessor like pipelining, cache memory etc.
7. To understand the applications of Microprocessors.
8. To learn interfacing of real world input and output devices.
9. To study various hardware and software tools for developing applications.

Course Outcomes:

1. Learner gains ability to apply knowledge of engineering in designing different case studies.

2. Students get ability to conduct experiments based on interfacing of devices to or interfacing to real world applications.
3. Students get ability to interface mechanical system to function in multidisciplinary system like in robotics, Automobiles.
4. Students can identify and formulate control and monitoring systems using microprocessors.
5. Students will design cost effective real time system to serve engineering solution for Global, social and economic context.
6. This course understanding will enforce students to acquire knowledge of recent trends like superscalar and pipelining and thus finds recognition of continuous updation.
7. Learn use of hardware and software tools.
8. Develop interfacing to real world devices.

UNIT - 1	07 Hours

Fundamentals of Microprocessor

Basic 8085 microprocessor architecture and its functional blocks, 8085 microprocessor IC pin outs and signals.

UNIT - 2	07 Hours

Programming with 8085

Assembly Language Programming Basics, Addressing Modes, Instruction set of microprocessor, Instruction timing diagram. Writing, Assembling & Executing Assembly Language Programs.

UNIT - 3	07 Hours

Interrupts

Interrupt structure of 8085 microprocessor, processing of vectored and non-vectored interrupts, latency time and response time; Handling multiple interrupts.

UNIT - 4	07 Hours

Interfacing

Memory Interfacing, Interfacing with 8255 Programmable Peripheral Interface, 8254 Programmable Interval Timer, 8279 Display controller, Interrupt controller 8259.

UNIT - 5	07 Hours

Introduction of 8086 Microprocessor

Detail Architecture of 8086, Addressing Modes, Assembler directives, Co-Processor

TEXT/REFERENCE BOOKS

1. Microprocessor and interfacing 8085, Douglas V Hall, Tata Mc Gram Hill.
2. Microprocessor-Architecture, programming and application with 8085, gaonkar, penram international.
3. Short K. L., "Microprocessors and Programmed Logic", 2nd Ed.,Pearson Education, 2008..
4. D V kodavade, S. Narvadkar, 8085-86 microprocessors Architecture progg and interfaces, wiley.
5. Rout 8085 microcontroller-architecture, programming and application, 2nd edi, penram international.

BTEXC404	Signals and Systems	3 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.
5. To develop basis of probability and random variables.

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.
5. Understand the basic concept of probability, random variables & random signals and develop the ability to find correlation, CDF, PDF and probability of a given event.

UNIT - 1	06 Hours

Introduction to Signals and Systems

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	06 Hours

Time domain representation of LTI System

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	06 Hours

Fourier Series

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	06 Hours

Fourier transform

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 bandpass signals.

UNIT - 5	06 Hours

Laplace and Z-transform

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.

UNIT - 6	06 Hours

Probability and Random Signals

Probability: Experiment, sample space, event, probability, conditional probability and statistical independence, Bayes theorem, Random variables: Continuous and Discrete random variables, cumulative distributive function, Probability density function, properties of CDF and PDF. Definitions: Statistical averages, mean, moments and expectations, standard deviation and variance, Introduction to Correlation: Autocorrelation, Cross correlation, and their properties.

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, Wiley India.
4. Shaila Apte, "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. Nagoor Kanni "Signals and Systems", 2nd edition, McGraw Hill.
8. NPTEL video lectures on Signals and Systems.

BTID405	Product Design Engineering	2 Credits

Teaching Scheme:	Examination Scheme:
Lecture-cum-demonstration: 1 hr/week Design Studio: 2 hr/week	Continuous Assessment 1: 30 Marks Continuous Assessment 2: 30 Marks Final Assessment: 40 Marks

- Pre-requisites: Knowledge of Basic Sciences, Mathematics and Engineering Drawing
- Design Studio : 2 hr/week to develop design sketching and practical skills, learning digital tools
- Continuous Assessment: Progress through a product design and documentation of steps in the selected product design
- Final Assessment: Product Design in Studio with final product specifications

Course Outcomes: At the end of the course, students will be able to

1. Create simple mechanical or other designs
2. Create design documents for knowledge sharing
3. Manage own work to meet design requirements
4. Work effectively with colleagues.

UNIT - 1	04 Hours

Introduction to Engineering Product Design:

Trigger for Product/ Process/ System, Problem solving approach for Product Design, Disassembling existing Product(s) and understanding relationship of components with each other, Sketching of components, identifying materials and their processing for final product, fitting of components, understanding manufacturing as scale of the components, Reverse engineering concept, case studies of products in markets, (or in each discipline), underlying principles, Case studies of product failures, revival of failed products, Public/Society's perception of products, and its input into product design.

UNIT - 2	04 Hours

Ideation:

Generation of ideas, Funnelling of ideas, Short-listing of ideas for product(s) as an individual or group of individuals, Sketching of products, Market research for need, competitions, scale and cost, Initial specifications of products.

UNIT - 3	04 Hours

Conceptualisation:

Computer operation principles and image editing through a graphical Composition; Computer aided 2D drafting and 3D Modeling through simple exercises.

Designing of components, Drawings of parts and synthesis of a product from its component parts, Rendering the designs for 3-D visualization and to create a photo realistic image, Parametric modelling of product, 3-D Visualization of mechanical products, Detail Engineering drawings of components.

UNIT - 4	04 Hours

Detailing:

Managing assembling, Product specifications- data Sheet, Simple mechanical designs, Workshop safety and health issues, Create documents for knowledge sharing.

Hands-on Activity Charts for Use of Digital Tools

Activity 1	Learn the basic vector sketching tools.	2
Activity 2	General understanding of shading for adding depth to objects. Understanding of editing vectors	2
Activity 3	Begin developing a thought process for using digital sketching.	3
Activity 4	Create a basic shape objects sphere, box cylinders	3
Activity 5	Create Automotive wheel concepts	3
Activity 6	Understanding Navigation and Data Panel Interface	2
Activity 7	Solid and Surface modelling, Rendering 3-D models	4
Activity 8	Product market and Product Specification Sheet	3
Activity 9	Documentation for the product	2

TEXT/REFERENCE BOOKS

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- HILL book company.

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.

BTBSC406	Numerical Methods and Computer Programming	3 Credits

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	06 Hours

Introduction to Computational Methods and Errors

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	06 Hours

Solution of Transcendental / Polynomial Equations and System of Linear Equation

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	06 Hours

Interpolation and Polynomial Approximation

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's interpolation polynomials, Spline interpolation, Least square approximation.

UNIT - 4	06 Hours

Numerical Integration and Differentiation

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, Runge Kutta $2^{nd}$and 4^{th} order, Stability analysis of above methods.

UNIT - 5	06 Hours

Object Oriented Programming

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.

UNIT - 6	06 Hours

Operator Overloading and Type Conversions

Defining operator overloading, Overloading unary operators, Overloading binary operators, Manipulation of strings operators, Rules for overloading operators. Inheritance: Extending Classes: Defining derived classes, Single inheritance, multilevel inheritance, multiple inheritance, Hierarchical inheritance, Hybrid inheritance, Virtual base classes, Abstract classes, Member classes: Nesting of classes Pointers Virtual Functions and Polymorphism: Pointers to objects, Pointers to derived classes, Virtual functions, pure virtual functions Managing Console I/O Operations C++ Streams, C++ Stream Classes, Unformatted I/O Operations, Managing output with manipulators.

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, 2001,2ndEdition

6. Yeshwant Kanetkar, "Let us C++, BPB Pub.", Delhi, 2002, 4^{th}Edition.
7. Stroupstrup Bjarne, "C++ Programming Language", Addison Wesley, 1997, 3rd Edition.
8. Horton, "Beginning C++: The Complete Language", Shroff Pub., Navi Mumbai, 1998.

BTEXC501	Electromagnetic Field Theory	3 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
7. Understand principle of radiation and radiation characteristics of an antenna.

UNIT - 1

Maxwell's Equations

Basics of Vectors, Vector calculus, Basic laws of Electromagnetics, Maxwell's Equations, Boundary conditions at Media Interface.

UNIT - 2

Uniform Plane Wave

Uniform plane wave, Propagation of wave, Wave polarization, Poincare's Sphere, Wave propagation in conducting medium, phase and group velocity, Power flow and Poynting vector, Surface current and power loss in a conductor

UNIT - 3

Transmission Lines

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 - 4

Plane Waves at a Media Interface

Plane wave in arbitrary direction, Reflection and refraction at dielectric interface, Total internal reflection, wave polarization at media interface, Reflection from a conducting boundary.

UNIT - 5

Wave propagation

Wave propagation in parallel plane waveguide, Analysis of waveguide general approach, Rectangular waveguide, Modal propagation in rectangular waveguide, Surface currents on the waveguide walls, Field visualization, Attenuation in waveguide

UNIT - 6

Radiation

Solution for potential function, Radiation from the Hertz dipole, Power radiated by hertz dipole, Radiation Parameters of antenna, receiving antenna, Monopole and Dipole antenna

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", Prentice Hall.
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", Wiley Eastern.

BTEXC502	Control Systems Engineering	3 Credits

Course Objectives:

- To introduce the elements of control system and their modeling using various Techniques.
- To introduce methods for analyzing the time response, the frequency response and the stability of systems.
- To introduce the concept of root locus, Bode plots, Nyquist plots.
- To introduce the state variable analysis method.
- To introduce concepts of PID controllers and digital and control systems.
- 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

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

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

UNIT - 3

Stability Analysis

Concept of Stability, Routh-Hurwitz Criteria, Relative Stability analysis, Root-Locus technique. Construction of Root-loci, Dominant Poles, Application of Root Locus Diagram,

UNIT - 4

Frequency-response analysis

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 - 5

Introduction to Controller Design

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 Bode Plot.

UNIT - 6

State variable Analysis

Concepts of state variables, State space model. Diagonalization of State Matrix, Solution of state equations, Eigenvalues 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, 7th Edition,1995.
3. M. Gopal, "Control System – Principles and Design", Tata McGraw Hill, 4th Edition, 2012.
4. Schaum's Outline Series, "Feedback and Control Systems" Tata McGraw-Hill, 2007.
5. John J. D'Azzo& Constantine H. Houpis, "Linear Control System Analysis and Design", Tata McGraw-Hill, Inc., 1995.
6. Richard C. Dorf and Robert H. Bishop, "Modern Control Systems", Addison – Wesley, 1999.

BTEXC503	**Microelectronics**	**3 Credits**

Course Objectives: As part of this course, students:

- Will understand the physical, electrical, and optical properties of semiconductor materials and their use in microelectronic.
- Relate the atomic and physical properties of semiconductor materials to device and circuit performance issues.
- Develop an understanding of the connection between device-level and circuit-level performance of microelectronic systems.

Course Outcomes: After successfully completing the course students will be able to upon successful completion of this course, students should be able to:

1. Compute carrier concentrations for semiconductor materials under a variety of doping conditions.
2. Compute conductivity and resistivity of semiconductor materials under a variety of condition.
3. Silicon wafer processing and formation of P N junction using diffusion and Ion Implantation technique
4. Wet and Dry oxidation process required for photolithography process.
5. Manufacturing process for P N junction, BJT, MOS, and IC fabrication.

UNIT - 1

MOSFETS:

Device Structure and Physical Operation, V-I Characteristics, MOSFET Circuits at DC, Biasing in MOS amplifier Circuits, Small Signal Operation and Models, MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, small signal operation modes, single stage MOS amplifiers. MOSFET internal capacitances and high frequency modes, Frequency response of CS amplifiers, CMOS digital logic inverter, and detection type MOSFET.

UNIT - 2

Single Stage IC Amplifier:

IC Design philosophy, Comparison of MOSFET and BJT, Current sources, Current mirrors and Current steering circuits, high frequency response.

UNIT - 3

Single Stage IC amplifiers:

CS and CF amplifiers with loads, high frequency response of CS and CF amplifiers, CG and CB amplifiers with active loads, high frequency response of CG and CB amplifiers, Cascade amplifiers. CS and CE amplifiers with source (emitter) degeneration source and emitter followers, some useful transfer parings, current mirrors with improved performance. SPICE examples.

UNIT - 4

Differences and Multistage Amplifiers:

The MOS differential pair, small signal operation of MOS differential pair, the BJT differences pair, other non-ideal characteristics and differential pair, Differential amplifier with active loads, frequency response and differential amplifiers. Multistage amplifier. SPICE examples.

UNIT - 5

Feedback

General Feedback structure, Properties of negative feedback. Four basic feedback topologies. Series-Shunt feedback. Determining the loop gain. Stability problem. Effect of feedback on amplifier poles. Stability study using Bode plots. Frequency compensation. SPICE examples.

UNIT - 6

Digital CMOS circuits

Overview, Design and performance analysis of CMOS inverter, Logic Gate Circuits, Pass-transistor logic, Dynamic Logic Circuits, SPICE examples

TEXT/REFERENCE BOOKS

1. "Microelectronic Circuits", Adel Sedra and K.C. Smith, 5th Edition, Oxford University Press, International Version, 2009.
2. "Fundamentals of Microelectronics", Behzad Razavi, John Wiley India Pvt. Ltd, 2008.
3. "Microelectronics – Analysis and Design", Sundaram Natarajan, Tata McGraw-Hill, 2007.

BTEXC504	Digital Signal Processing	3 Credits

Course Objectives:

- To introduce students with transforms for analysis of discrete time signals and systems.
- To understand the digital signal processing, sampling and aliasing.
- To use and understand implementation of digital filters.
- 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

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

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

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

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 Lowpass filter)

UNIT - 5

FIR Filter Design

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.

UNIT - 6

Introduction to Multirate signal processing

Concept of Multirate DSP, Introduction to Up sampler, Down sampler and two channel filter bank, 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. S. L. Nalbalwar, Digital Signal Processing, Synergy Knowledgeware Publication, Mumbai, 2018
5. L.R. Rabiner and B. Gold, Theory and Application of Digital Signal Processing, Prentice Hall, 1992.
6. J.R. Johnson, Introduction to Digital Signal Processing, Prentice Hall, 1992.
7. D.J.DeFatta, J. G. Lucas and W.S.Hodgkiss, Digital Signal Processing, John Wiley& Sons, 1988.

BTEXC505	Microcontroller & its Applications	3 Credits

Course Objectives:

- Objective of this course is to introduce to the students the fundamentals of microcontroller.
- After learning Microcontroller course, students will get advantage to pursue higher studies in Embedded Systems or employment in core industries.
- The learner can design microcontroller based systems and thus can become successful entrepreneur and meet needs of Indian and multinational industries.
- The learners will acquaint optimization skills and undergo concepts design metrics for embedded systems.

- The students will get acquainted with recent trends in microcontroller like pipelining, cache memory etc.
- To understand the applications of Microcontrollers.
- To understand need of microcontrollers in embedded system.
- To understand architecture and features of typical Microcontroller.
- To learn interfacing of real world input and output devices.
- To study various hardware and software tools for developing applications.

Course Outcomes:

1. Learner gains ability to apply knowledge of engineering in designing different case studies.
2. Students get ability to conduct experiments based on interfacing of devices to or interfacing to real world applications.
3. Graduates will be able to design real time controllers using microcontroller based system.
4. Students get ability to interface mechanical system to function in multidisciplinary system like in robotics, Automobiles.
5. Students can identify and formulate control and monitoring systems using microcontrollers.
6. Students will design cost effective real time system to serve engineering solution for Global, social and economic context.
7. This course understanding will enforce students to acquire knowledge of recent trends like superscalar and pipelining and thus finds recognition of continuous updation.
8. Learners get acquainted with modern tools like Programmers, Debuggers, cross compilers and current IDE i.e. integrated development environment tools.
9. Learn importance of microcontroller in designing embedded application.
10. Learn use of hardware and software tools.
11. Develop interfacing to real world devices.

UNIT - 1

Fundamentals of Microcontrollers

Introduction to the general structure of 8 and 16 bit Microcontrollers Harward & Von Neumann architecture, RISC & CISC processors. Role of microcontroller in embedded system. Selection criteria of microcontroller Block diagram and explanation of 8051, Port structure, memory organization, Interrupt structure, timers and its modes, serial communication modes. Overview of Instruction set, Sample programs (assembly): Delay using Timer and interrupt, Programming Timer 0&1, Data transmission and reception using Serial port.

UNIT - 2

Interfacing with 8051 PART I

Software and Hardware tools for development of microcontroller-based systems such as assemblers, compliers, IDE, Emulators, debuggers, programmers, development board, DSO, Logic Analyzer. Interfacing LED with and without interrupt, Keypads, Seven Segment multiplexed Display, LCD, ADC Interfacing. All Programs in assembly language and C.

UNIT - 3

Interfacing with 8051 PART II

8051 timer programming, serial port and its programming, interrupt programming, LCD and keyboard interfacing, ADC and DAC interfacing, interfacing to external memory Interfacing of DAC, Temperature sensors, Stepper motor, Motion detectors, Relay, Buzzer, Opto-isolators. All programs in assembly and C.

UNIT - 4

PIC Microcontroller Architecture

PIC 10, PIC12, PIC16, PIC18 series comparison, features and selection as per application. PIC18FXX architecture, registers, memory Organization and types, stack, oscillator options, BOD, power down modes and configuration bit settings, timer and its programming. Brief summary of Peripheral support, Overview of instruction set, MPLAB IDE & C18 Compiler.

UNIT - 5

Real World Interfacing Part I

Port structure with programming, Interrupt Structure (Legacy and priority mode) of PIC18F with SFRS. Interfacing of switch, LED, LCD (4&8 bits), and Key board. Use of timers with interrupts, CCP modes: Capture, Compare and PWM generation, DC Motor speed control with CCP: All programs in embedded C.

UNIT - 6

Real World Interfacing Part I

Basics of Serial Communication Protocol: Study of RS232, RS 485, I2C, SPI, MSSP structure (SPI &I2C), UART, Sensor interfacing using ADC, RTC (DS1306) with I2C and EEPROM with SPI. Design of PIC test Board, Home protection System: All programs in embedded C..

TEXT/REFERENCE BOOKS

1. Mazidi, 8051 microcontroller & embedded system 3rd Edition ,Pearson
2. Mazidi, PIC microcontroller & embedded system 3rd Edition ,Pearson
3. Crisp, introduction to microprocessor & microcontrollers, 2e Elsevier, 2007.
4. Calcut, 8051 microcontrollers: Applications based introduction, Elsevier.
5. Udyashankara V., Mallikarjunaswamy, 8051 microcontroller, TMH.
6. Han-way Huang, using The MCS-51 microcontroller, Oxford university press
7. Ayala, 8051 microcontroller, cengage (Thomson)

BTEXPE506A	Probability Theory and Random Processes	3 Credits

Course Objectives:

- To develop basic of probability and random variables.
- 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

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

Definition of random variables, continuous and discrete random variables, cumulative distribution function (cdf) for discrete and continuous random variables; probability mass function (pmf);probability density functions (pdf) and properties, Jointly distributed random variables, conditional and joint density and distribution functions, independence; Bayes' rule for continuous and mixed random variables, Function of random a variable, pdf of the function of a random variable; Function of two random variables; Sum of two independent random variables, mean, variance and moments of a random variable, Joint moments, conditional expectation; covariance and correlation, independent, uncorrelated and orthogonal random variables.

UNIT - 3

Random vector and distributions

Mean vector, covariance matrix and properties, Some special distributions: Uniform, Gaussian and Rayleigh distributions; Binomial, and Poisson distributions; Multivariate Gaussian distribution, Vector- space representation of random variables, linear indepe ndence, inner product, Schwarz Inequality, Elements of estimation theory: linear minimum mean - square error and orthogonality principle in estimation; Moment - generating and characteristic functions and their applications, Bounds and approximations: Chebysev inequality and Chernoff Bound.

UNIT - 4

Sequence of random variables and convergence

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

Random process: realizations, sample paths, discrete and continuous time processes, examples, 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.

UNIT - 6

Spectral representation of a real WSS process

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, Line ar time - invariant system with a WSS process as an input: sationarity of the output, auto -correlation and power - spectral density of the output; examples with white - noise as input; linear shift - invariant discrete- time system with a WSS sequence as input, Spe ctral factorization theorem, 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, McGraw Hill.
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, UBS Publishers.
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, Academic Press.

BTEXPE506C	Data Structure & Algorithms using Java Programming	3 Credits

Prerequisites: Basic knowledge of C language is required.

Course Objectives:

- To assess how the choice of data structures and algorithm design methods impacts the performance of programs.
- To choose the appropriate data structure and algorithm design method for a specified application.
- To study the systematic way of solving problems, various methods of organizing large amounts of data.
- 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.
- 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

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

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

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 complexity analysis.

UNIT - 4

Trees

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

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.

UNIT - 6

Graph

Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.

TEXT/REFERENCE BOOKS

1. "How to Solve it by Computer", 2nd Impression by R. G. Dromey, Pearson Education.
2. Ellis Horowitz, Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Books Source. ISBN 10: 0716782928
3. Java: The Complete Reference, Seventh Edition, Herbert Schildt, McGraw Hill
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.

BTEXPE506D	Introduction to MEMS	3 Credits

Course Objectives:

- 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.
- 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.
- This will enables 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

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

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:

MEMS fabrication modules, Oxidation, Deposition Techniques, Lithography (LIGA), and Etching.

UNIT - 4

Micromachining

Micromachining, Surface Micromachining, sacrificial layer processes, Stiction; Bulk Micromachining, Isotropic Etching and Anisotropic Etching, Wafer Bonding

UNIT - 5

Mechanics of solids in MEMS/NEMS

Mechanics of solids in MEMS/NEMS: Stresses, Strain, Hookes's law, Poisson effect, Linear Thermal Expansion, Bending, Energy methods.

UNIT - 6

Finite Element Method and Electromechanical Systems

Overview of Finite Element Method, Modeling of Coupled Electromechanical 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 Microengineering (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.

BTEXPE506E	Audio & Video Processing	3 Credits

Course Objectives:

- The objective is to provide students with a strong understanding of the fundamental principles and practical applications of audio and video engineering with latest updates.

Course Outcomes:

After successfully completing the course students will be able to

1. Understand the concept of basic television signal processing.
2. Identify globally accepted color TV standards.
3. Demonstrate the need of audio and video compression techniques in real life.
4. Acquire knowledge of latest digital TV systems and applications.
5. Describe the attributes of acoustics, sound engineering and storage media.

UNIT - 1

Fundamentals of Color Television

Aspect, scanning, perception of brightness and colour, colour mixing, composite video signal, synchronisation details, digital TV camera, modulation of audio and video, terrestrial signal transmission, video displays: LCD vs LED.

UNIT - 2

Colour Standards and digital video

Standards: NTSC, PAL, SECAM colour system, generalized colour TV receiver block diagram, study of functionality of each block, alignment issues, sampling of video signal, colour sub sampling, composite vs component video, interlace vs progressive scan.

UNIT - 3

Digital TV

Digital video, resolution, notation, digital video formats, digital video quality measure, video restoration, video streaming, DTH, Video compression: MPEG 2, MPEG 4, comparison of SDTV, EDTV and HDTV.

UNIT - 4

Advanced TV Systems and Techniques

Introduction to UHDTV: 4K and 8K, IPTV/web TV, smart TV, Wi-Fi TV, digital surveillance, 3D TV concept, over view of H.264 features, camcorders, webcams, perspective of TV White spaces.

UNIT - 5

Acoustics

Human Hearing and sound, frequency range, dynamic range, masking, digital representation of sound wave, intensity, decibel sound level, sound waves in rooms, reverberation, room/studio acoustics as a component in speech system, PA systems, special types of microphones and speakers.

UNIT - 6

Audio and Video Recording Systems

Digital sound, sound recording, CD/ DVD player, MP3 player, Blue Ray DVD Player, ITU-T(G) compression standards, multichannel/Dolby 5.1sound in DTV.

TEXT/REFERENCE BOOKS

1. A. M. Dhake, Television and video Engineering, TMH Publication, 2ndEdition, 2001.
2. Kelth jack, Video Demystified: A Handbook for the Digital Engineer, 5thEdition, Newnes, 2007.
3. R.G. Gupta, Audio and Video Systems, McGraw Hill l Education (India), 2nd Edition, 2010.
4. S. P. Bali, Color Television Theory and Practice, McGraw Hill Education (India), 1994.
5. A. M. Tekalp, Digital Video, Prentice Hall, 1995.
6. R. P. Gulathi, Modern Television Practice, 4thedition, New Age International Publisher, 2014.

BTEXC601	Computer Architecture	3 Credits

Course Objectives:

- To introduce basic concepts of computer organization and to illustrate the computer organization concepts by Assembly Language programming.
- 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.
- 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.
- 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 computer's working
3. Analyze the performance of computers
4. Know how computers are designed and built
5. Understand issues affecting modern processors (caches, pipelines etc.).

UNIT - 1

Basics of Computers

Basic Structure of Computers, Functional units, software, performance issues software, machine Instructions and programs, Types of instructions, Instruction sets: Instruction formats, Assembly Language, Stacks, Queues, Subroutines.

UNIT - 2

Processor organization

Processor organization, Information representation, number formats.

UNIT - 3

ALU design

Multiplication & division, ALU design, Floating Point arithmetic, IEEE 754 floating point formats Control Design, Instruction sequencing, Interpretation, Hard wired control - Design methods, and CPU control unit.

UNIT - 4

Memory organization

Memory organization, device characteristics, RAMS, ROM, Memory management, Concept of Cache & associative memories, Virtual memory.

UNIT - 5

System organization

System organization, Input - Output systems, Interrupt, DMA, Standard I/O interfaces.

UNIT - 6

Parallel processing

Concept of parallel processing, Pipelining, Forms of parallel processing, interconnect network.

TEXT/REFERENCE BOOKS

1. V. Carl Hammacher, “Computer Organisation”, Fifth Edition.
2. A. S. Tanenbum, “Structured Computer Organisation”, PHI, Third edition
3. Y.Chu, "Computer Organization and Microprogramming”, II, Englewood Chiffs, N.J., Prentice Hall Edition
4. M. M. Mano, “Computer System Architecture”, Edition
5. C. W. Gear, “Computer Organization and Programming”, McGraw Hill, N.V. Edition
6. Hayes J.P, “Computer Architecture and Organization”, PHI, Second edition

BTEXC602	Power Electronics	3 Credits

Course Objectives:

- To introduce students to different power devices to study their construction, characteristics and turning on circuits.
- To give an exposure to students of working & analysis of controlled rectifiers for different loads, inverters, DC choppers, AC voltage controllers and resonant converters.
- 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 as SCR
2. Analyze and design controlled rectifier, DC to DC converters, DC to AC inverters,
3. Learn how to analyze these inverters and some basic applications.
4. Design SMPS.

UNIT - 1

Characteristics of Semiconductor Power Devices

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

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

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 - 4

Single-phase inverters

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

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.

UNIT - 6

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 of India.
2. Ned Mohan, Robbins, "Power electronics", edition III, John Wiley and sons.
3. P.C. Sen., "Modern Power Electronics", edition II, Chand& Co.
4. V. R. Moorthi, "Power Electronics", Oxford University Press.
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.

BTEXPE603A	Digital Communication	3 Credits

Course Objectives:

- To understand the building blocks of digital communication system.
- To prepare mathematical background for communication signal analysis.
- To understand and analyze the signal flow in a digital communication system.
- To analyze error performance of a digital communication system in presence of noise and other interferences.
- 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

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 speech synthesis.

UNIT - 2

Baseband Digital Transmission

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

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

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

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.

UNIT - 6

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, McGraw Hill.
7. P Ramkrishna Rao, Digital Communication, Mc Graw Hill Publication.

BTEXPE603B	Computer Network and Cloud Computing	3 Credits

Course Objectives:

- To develop an understanding of modern network architectures from a design and performance perspective.
- To introduce the student to the major concepts involved in wide-area networks (WANs), local area networks (LANs) and Wireless LANs (WLANs).
- To provide an opportunity to do network programming
- To provide a WLAN measurement ideas.
- Discuss, with confidence, what is cloud computing and what are key security and control
- Considerations within cloud computing environments.
- Identify various cloud services.

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 issues in local area networks and wide area networks.
3. To be familiar with contemporary issues in networking technologies.
4. To be familiar with network tools and network programming.
5. 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.
6. For a given problem related TCP/IP protocol developed the network programming.
7. Configure DNS DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls using open source available software and tools.

8. To impart fundamental concepts in the area of cloud computing.
9. To impart knowledge in applications of cloud computing.
10. Develop applications for cloud computing.

UNIT - 1

Physical Layer and Data Link Layer

Network types, OSI model, TCP / IP protocol suite, Addressing, Guided and Unguided Transmission media. Switching: Circuit switched networks, Packet Switching, Structure of a switch.

DLC Services, DLL protocols, HDLC, PPP, Media Access Control: Random Access, Controlled Access, Channelization. Wired LAN: Ethernet Protocol, Standard Ethernet, Fast Ethernet, Giagabit Ethernet.

UNIT - 2

Network Layer and Transport Layer

Switching, Logical addressing – IPV4, IPV6; Address mapping – ARP, RARP, BOOTP and DHCP–Delivery, Forwarding and Unicast Routing protocols.

Process to Process Communication, User Datagram Protocol (UDP), Transmission Control Protocol (TCP), SCTP Congestion Control; Quality of Service, QoS improving techniques.

UNIT - 3

Application Layer

Domain Name Space (DNS), DDNS, TELNET, EMAIL, File Transfer Protocol (FTP), WWW, HTTP, SNMP, Bluetooth, Firewalls, Basic concepts of Cryptography.

UNIT - 4

Wireless LANS & Virtual Circuit Networks

Introduction, Wireless LANS: IEEE 802.11 project, Bluetooth, Zigbee, Connecting devices and Virtual LANS: Connecting devices, Virtual LANS.

UNIT - 5

.Introduction and Cloud Computing Technology

Shift from distributed computing to cloud computing; principles and characteristics of cloud computing- IaaS, PaaS, SaaS; service oriented computing and cloud environment.

Client systems, Networks, server systems and security from services perspectives; accessing the cloud with platforms and applications; cloud storage.

UNIT - 6

Working with Cloud and Cloud Services

Infrastructure and working platform as a Service – conceptual model model and functionalities. Software as a Service –conceptual model and working. Trends inService provisioning with clouds.Using Cloud Services-Cloud collaborative applications and services.

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, Tata McGraw-Hill.
3. Data and Computer Communication, 8th Edition, William Stallings, Pearson Prentice Hall India.
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.
7. Anthony T. Velte, Toby J. Velte and Robert E, Cloud Computing – A Practical Approach, TMH 2010.
8. Michael Miller, Cloud Computing – Web based Applications, Pearson Publishing, 2011.

BTEXPE603C	Nano Electronics	3 Credits

Course Objectives:

- To convey the basic concepts of Nano electronics to engineering students with no background in quantum mechanics and statistical mechanics.
- 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.

- This subject gives idea about the role and importance of the Nano electronic devices system in engineering world to develop the research ideas in VLSI.
- 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.
- 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

Introduction to nanotechnology, Nano devices, Nano materials, Nano characterization, Definition of Technology node, Basic CMOS Process flow, meso structures.

UNIT - 2

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 - 3

MOS Scaling theory

Shrink-down approaches: Introduction, CMOS Scaling, The nanoscale MOSFET, Finfets, Vertical MOSFETs, limits to scaling, system integration limits (interconnect issues etc.)

UNIT - 4

Nano electronics Semiconductor devices

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 - 5

Properties of Nano devices

Vertical transistors -Fin FET and Surround gate FET. Metal source/drain junctions – Properties of schottky functions on Silicon, Germanium and compound semiconductors - Work function pinning.

UNIT - 6

Characterization techniques for Nano materials

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 Electronic Material 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.
5. C.P. Poole, F. J. Owens, Introduction to Nanotechnology, Wiley, 2003.

BTEXPE603D	Web Development and Design	3 Credits

Course Objectives:

- Define the principle of Web page design
- Define the basics in web design
- Visualize the basic concept of HTML.
- Recognize the elements of HTML.
- Introduce basics concept of CSS.
- Develop the concept of web publishing

Course Outcomes:

On completion of the course, student will be able to:

1. Develop the skill & knowledge of Web page design
2. Understand the knowhow and can function either as an entrepreneur or can take up jobs in the multimedia and Web site development studio and other information technology sectors.

UNIT - 1

Web Design Principles , Basic principles involved in developing a web site , Planning process , Five Golden rules of web designing , Designing navigation bar , Page design, Layout of pages , Design Concept.

UNIT - 2

Basics in Web Design , Brief History of Internet , What is World Wide Web , Why create a web site , Web Standards , Audience requirement.

UNIT - 3

Introduction to HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags , Heading, Paragraphs , Line Breaks , HTML Tags.

UNIT - 4

Elements of HTML, Working with Text , Lists, Tables and Frames , Hyperlinks, Images and Multimedia Working with Forms and controls.

UNIT - 5

Introduction to Cascading Style Sheets , CSS Properties , CSS Styling (Background, Text Format, Controlling Fonts) , Working with block elements and objects , Working with Lists and Tables , CSS Id and Class, Box Model (Introduction, Border properties, Padding Properties, Margin properties) , CSS Advanced (Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector) , CSS Color , Creating page Layout and Site Designs.

UNIT - 6

Introduction to Web Publishing or Hosting , Creating the Web Site ,Saving the site, Working on the web site, Creating web site structure, Creating Titles for web pages, Themes, Publishing web sites.

TEXT/REFERENCE BOOKS

1. J. N. Robbins, Learning Web Design, O'Reilly Media, 4th Edition, 2012
2. Steven M. Schafer, HTML, XHTML, and CSS Bible, Wiley India, 5th Edition, 2010
3. John Duckett, Beginning HTML, XHTML, CSS, and JavaScript, Wiley India, 3rd Edition, 2009
4. Hal Stern, David Damstra, Brad Williams, Professional WordPress: Design and Development, Wrox Publication, 3rd Edition, 2015
5. E. Robson, E. Freeman, Head First HTML & CSS, O'Reilly Media, nd Edition, 2012.

BTEXOE604A	Digital System Design	3 Credits

Course Objectives:

- 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.
- 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.
- 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

Logic Simplification and Combinational Logic Design

Review of Boolean algebra and De Morgan's Theorem, SOP & POS forms, Canonical forms, Karnaugh maps up to 6 variables, Binary codes, Code Conversion.

UNIT - 2

MSI devices

Comparators, Multiplexers, Encoder, Decoder, Driver & Multiplexed Display, Half and Full Adders, Subtractors, Serial and Parallel Adders, BCD Adder, Barrel shifter and ALU.

UNIT - 3

Sequential Logic Design

Building blocks like S-R, JK and Master-Slave JK FF, Edge triggered FF, Ripple and Synchronous counters, Shift registers, Finite state machines, Design of synchronous FSM, Algorithmic State Machines charts. Designing synchronous circuits like Pulse train generator, Pseudo Random Binary Sequence generator, Clock generation.

UNIT - 4

Logic Families and Semiconductor Memories

TTL NAND gate, Specifications, Noise margin, Propagation delay, fan-in, fan-out, Tristate TTL, ECL, CMOS families and their interfacing.

UNIT - 5

Memory Elements

Concept of Programmable logic devices like FPGA, Logic implementation using Programmable Devices.

UNIT - 6

VLSI Design flow

Design entry: Schematic, FSM & HDL, different modeling styles in VHDL, Data types and objects, Dataflow, Behavioral and Structural Modeling, Synthesis and Simulation VHDL constructs and codes for combinational and sequential circuits.

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.

BTEXOE604B	Neural Network & Fuzzy System	3 Credits

Course Objectives:

- This course covers basic concepts of artificial neural networks, fuzzy logic systems and their applications.
- Its focus will be on the introduction of basic theory, algorithm formulation and ways to apply these techniques to solve real world problems.
- It deals with Introduction and different architectures of neural network
- It deals with the Application of Neural Networks.
- It deals with Fuzzy Logic Controller.
- It deals with applications of Fuzzy logic

Course Outcomes:

1. The student will be able to obtain the fundamentals and types of neural networks.
2. The student will have a broad knowledge in developing the different algorithms for neural networks.
3. Student will be able analyze neural controllers.
4. Student will have a broad knowledge in Fuzzy logic principles.
5. Student will be able to determine different methods of Deffuzification.

UNIT - 1

Introduction

Biological neurons, McCulloch and Pitts models of neuron, Types of activation function, Network architectures, Knowledge representation, Learning process: Error-correction learning, Supervised learning, Unsupervised learning, Learning Rules.

UNIT - 2

Single Layer Perception

Perception convergence theorem, Method steepest descent - least mean square algorithms.

UNIT - 3

Multilayer Perception

Derivation of the back-propagation algorithm, Learning Factors.

UNIT - 4

Radial Basis and Recurrent Neural Networks

RBF network structure theorem and the reparability of patterns, RBF learning strategies, K-means and LMS algorithms, comparison of RBF and MLP networks, Hopfield networks: energy function, spurious states, error performance.

UNIT - 5

Neuro-dynamics

Attractors, Neuro dynamical model, Adaptive Resonance theory, Towards the Self Organizing Feature Map. Brain-state-in- a-box model,

UNIT - 6

Fuzzy logic

Fuzzy sets, Properties, Operations on fuzzy sets, Fuzzy relation Operations on fuzzy relations, The extension principle, Fuzzy mean Membership functions, Fuzzification and defuzzification methods, Fuzzy controllers.

TEXT/REFERENCE BOOKS

1. Simon Haykin, "Neural Network a - Comprehensive Foundation", Pearson Education.
2. Dr. S. N. Sivanandam, Mrs S.N. Deepa Introduction to Soft computing tool Wiley Publication.
3. Satish Kumar Neural Networks: A classroom Approach Tata McGraw-Hill.
4. Zurada J.M., "Introduction to Artificial Neural Systems, Jaico publishers.
5. Thimothv J. Ross, "Fuzz V Logic with Engineering Applications", McGraw.
6. Ahmad Ibrahim, "Introduction to Applied Fuzzy Electronics', PHI.

7. Rajsekaran S, VijaylakshmiPai, Neural Networks, Fuzzy Logic, and Genetic Algorithms, PHI.
8. Hagan, Demuth, Beale, ëNeural Network Designí, Thomson Learning
9. Christopher M Bishop Neural Networks for Pattern Recognition, Oxford Publication.
10. William W Hsieh Machine Learning Methods in the Environmental Sciences Neural Network and Kernels Cambridge Publication.
11. Dr. S. N. Sivanandam, Dr. S. Sumathi Introduction to Neural Network Using Matlab Tata McGraw-Hill

BTEXOE604D	Analog Integrated Circuit Design	3 Credits

Course Objectives:

- Introduction to Circuit Simulation & EM Simulations
- Deep Understanding of MOS Device Physics & Modeling
- Understanding of few transistor circuits like common gate, common source & common drain amplifiers with their frequency response
- Understanding of Operational Amplifier Design & Trade-offs
- Advanced Op-Amps and OTAs
- Temperature Compensated Biasing Schemes.

Course Outcomes:

At the end of the course, the student must be able to:

1. Design MOSFET based analog integrated circuits.
2. Analyze analog circuits at least to the first order.
3. Appreciate the trade-offs involved in analog integrated circuit design.
4. Understand and appreciate the importance of noise and distortion in analog circuits.

UNIT - 1

Introduction to Simulations

Introduction to Advanced Design System and Cadence Virtuoso, DC Simulations, AC Simulations, Harmonic Balance, Envelope Simulation, Electromagnetic Simulations- FEM, MOM, FDTD, Circuit Net listing.

UNIT - 2

MOSFET Device Physics & Modeling

MOSFET Structure, Threshold Voltage, Drain Current Equation, Transfer & Output Characteristics, Weak/Moderate/Strong Inversion, Linear/Triode/Saturation Region of Operation, Device Leakages and Losses, Short Channel Effects, High Frequency Small Signal Model of MOSFET, Cubic, BSIM and Materka Models of MOSFET.

UNIT - 3

Few Transistor Circuits

Current Mirrors, Common Source/Common Gate/Common Drain Amplifiers, Design and Analysis of CS/CG/CD Amplifiers, Cascode Amplifiers, Differential Gain Stage, Frequency Response & Design Trade-offs, Telescopic Cascode and Wide Swing Cascode Current Mirrors, PTAT, CTAT & Bandgap Bias Circuits.

UNIT - 4

Operational Amplifiers & OTAs

Design of Classical Op-Amps, Op-Amp Characteristics, Analysis and Trade-offs, Wideband Op-Amps, High Speed Op-Amps, Very High Gain Op-Amps, Operational Transconductance Amplifiers, Ultra Low Power OTAs for Medical Implants, Folded Cascode Op-Amps.

UNIT - 5

Biasing Schemes

Voltage and Current References, Vt reference bias, PTAT Current Reference, CTAT and Bandgap Voltage References, High Precision Voltage References, Voltage Level Shifters.

UNIT - 6

Non-Linear Circuits

Single and Balanced Diode Mixers, Translinear Cell, Gilbert Cell Mixers, Power Amplifiers, Even & Odd Order Mixing, In-Modulation (AM, PM Conversions) Distortions, Intermodulation Distortions, Intermodulation Products, ACPR & EVM.

TEXT/REFERENCE BOOKS

1. Tony Chan Carusone, David A. Johns, Kenneth W. Martin, "Analog Integrated Circuit Design", John Wiley & Sons
2. Keliu Shu, Edgar Sanchez-Sinencio, "CMOS PLL Synthesizers", Springer
3. Jose´ Carlos Pedro, Nuno Borges Carvalho, "Intermodulation Distortion in Microwave and Wireless Circuits", Artech House
4. Stephen A. Maas, "Microwave Mixers", Artech House.

BTEXOE605A	Embedded System Design	3 Credits

Course Objectives:

- To understand the embedded system design issues.
- To learn real time operating system concepts.
- To understand the Embedded Linux environment.
- To learn embedded software development and testing process.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Suggest design approach using advanced controllers to real-life situations.
2. Design interfacing of the systems with other data handling / processing systems.
3. Appreciate engineering constraints like energy dissipation, data exchange speeds etc.
4. Get to know the hardware – software co design issues and testing methodology for embedded system.

UNIT - 1

Introduction to Embedded Computing

The concept of embedded systems design, Characteristics of Embedding Computing Applications, Concept of Real time Systems.

UNIT - 2

Design Process

Requirements, Specifications, Architecture Design, Designing of Components, Embedded microcontroller cores, embedded memories. Examples of embedded systems.

UNIT - 3

Technological aspects of embedded systems

Interfacing between analog and digital blocks, signal conditioning, digital signal processing, subsystem interfacing, interfacing with external systems, user interfacing.

UNIT - 4

Design tradeoffs

Design tradeoffs due to process compatibility, thermal considerations, etc., Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

UNIT - 5

Operating System

Basic Features of an Operating System, Kernel Features: Real-time Kernels, Polled Loops System, Co-routines, Interrupt-driven System, Multi-rate System Processes and Threads, Context Switching: Cooperative Multi-tasking, Pre-emptive Multi- tasking.

UNIT - 6

Scheduling and Inter-process Communication

Rate-Monotonic Scheduling, Earliest-Deadline First Scheduling, Task Assignment, Fault-Tolerant Scheduling Signals, Shared Memory Communication, Message-Based Communication.

TEXT/REFERENCE BOOKS

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.

3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming, and Applications", Penram Intl, 1996

BTEXOE605B	Electronics System Design	3 Credits

Course Objectives:

- To understand the various processes and systems to address human needs by creating tangible Electronic Products.
- To pursue learners with emphasis on learning-by-doing and following a comprehensive process of design, engineering and producing products and systems.

Course Outcomes:

On completion of the course, student will be able to

1. Design electronic products using user centered design process
2. Develop sketches, virtual and physical appearance models to communicate proposed designs
3. Refine product design considering engineering design & manufacturing requirements and constraints.
4. Make mock-up model and working prototype along with design documentation.

UNIT - 1

Introduction to Industrial Design

General introduction in the course, role of ID in the domain of industry, product innovation, designer's philosophy and role in product design. Product development tools and methods.

UNIT - 2

Product Design Methodology and Product Planning

Electronic product design and development, Methodology, creativity techniques, brain storming, documentation, Defining the task, scheduling the task, estimation of labor cost and amount of documentation.

UNIT - 3

Ergonomics

Ergonomics of electronics electronic use of ergonomics at work places and plan layouts, ergonomics of panel design, case study**.**

UNIT - 4

Aesthetics and Visual Communication Techniques

Elements of aesthetics, aesthetics of control design, Visual Communication Techniques: perspective, band sketching and rendering technique, elements of Engineering drawing, assembly drawing part drawing , exploded views.

UNIT - 5

Product Anatomy and Product Detailing

Layout design, structure design, standard and non-standard structures, Industrials standards, Product detailing in sheet metal and plastics for ease of assembly, maintenance and aesthetics.

UNIT - 6

Product Manufacturing and Value Engineering

Different manufacturing processes in sheet metal and plastics, product finishing, finishing methods like platting, anodization, spray painting, powder coating etc, Introduction to marketing, graphics & packing.

TEXT/REFERENCE BOOKS

1. Peter Z. , “German Design Standard Vol 2”, Reddot(2006)
2. Jordan P. W., “Designing Pleasurable Products: An Introduction to the New Human Factors.” Taylor and Francis(2002)
3. Otto K. and Wood K., “Product design: Techniques in Reverse Engineering and New Product development”, Prentice Hall. (2001)

4. Cross N. "Engineering Design Methods: Strategies for Product Design", Willey.(2000)
5. Cagan J. and Vogel C. M. (2007) Creating Breakthrough Products, "Innovation from Product Planning to Program Approval". Pearson Education
6. Coats D. , "Watches Tell More than Time: Product Design, Information, Quest for elegance" McGraw Hill(2002)
7. Norman D. A., "The design of everyday things, Basic Books."(2002)
8. Chakrabarty D., "Indian Anthropometric Dimensions for Ergonomic Design Practice", NID, Ahmedabad (1999).
9. E.J. McCormic, Human factors in engineering design, McGraw Hill 1976

Journals

1. Behaviour & Information Technology, Taylor & Francis
2. The Journal of Sustainable Product Design, Publisher: Springer
3. International Journal of Design; College of Design, National Taiwan University of Science and Technology, Taiwan.
4. Virtual & Physical Prototyping, Taylor & Francis

Internet Sites

1. http://www.ulrich-eppinger.net/
2. http://www.npd-solutions.com
3. http://www.qfdi.org
4. http://www.cheshirehenbury.com/rapid/

BTEXOE605C	Project Management and Operation Research	3 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

1. Apply operations research techniques like L.P.P, scheduling and sequencing in industrial optimization problems.

2. Solve transportation problems using various OR methods.

3. Illustrate the use of OR tools in a wide range of applications in industries.

4. Analyze various OR models like Inventory, Queing, Replacement, Simulation, Decision etc and apply them for optimization.

5. Gain knowledge on current topics and advanced techniques of Operations Research for industrial solutions.

UNIT - 1

Definition, need and importance of organizational behaviour , nature and scope , frame work , organizational behaviour models.

UNIT - 2

Organization structure, formation, groups in organizations, influence, group dynamics, emergence of informal leaders and working norms, group decision making techniques, interpersonal relations, communication, control.

UNIT - 3

Evolution of Management thoughts, Contribution of Selected Management Thinkers, Various approaches to management, contemporary management practice, Managing in global environment, Managerial functions.

UNIT - 4

Importance of planning, Types of planning, decision making process, Approaches to decision making, Decision models, Pay off Matrices, Decision trees, Break Even Analysis.

UNIT - 5

Departmentation, Span of Control, Delegation, Centralisation and Decentralisation, Commitees, Line and Staff relationships, Recent trends in organisation structures.

UNIT - 6

Process of Recruitment, Selection, Induction Training, Motivation, Leading, Leadership styles and qualities, Communication, process and barriers. Managements control systems, techniques, Types of control.

TEXT/REFERENCE BOOKS

1. Bateman Snell, Management: Competing in the new era, McGraw,Hill Irwin, 2002.

2. Chandan J.S., Management Concepts and Strategies, Vikas Publishing House, 2002.

3. Hellriegel, Jackson and Slocum, Management: A Competency,Based Approach, South Western, 9th edition, 2002.

4. Koontz, Essentials of Management, Tata McGraw,Hill, 5th Edition, 2001.

5. Stephen P. Robbins and David A. Decenzo, Fundamentals of Management, Pearson Education, Third Edition, 2001.

6. Tim Hannagan, Management Concepts and Practices, Macmillan India Ltd., 1997.

BTEXOE605D	Android Programming	3 Credits

Course Objectives:

Android Application Development course is designed to quickly get you up to speed with writing apps for Android devices. The student will learn the basics of Android platform and get to understand the application lifecycle

Course Outcomes:

At the end of the course, students will demonstrate the ability to write simple GUI applications, use built-in widgets and components, work with the database to store data locally, and much more.

UNIT - 1

Introduction to Mobile Operating Systems and Mobile Application Development

Introduction to Mobile OS:

Palm OS, Windows CE, Embedded Linux, J2ME (Introduction), Symbian (Introduction), Overview of Android: Devices running android, Why Develop for Android, Features of android, Architecture of Android, Libraries

How to setup Android Development Environment: Android development Framework - Android-SDK, Eclipse, Emulators – What is an Emulator / Android AVD? , Creating & setting up custom Android emulator, Android Project Framework, My first android application.

UNIT - 2

Android Activities, UI Design and Database

Understanding Intent, Activity, Activity Lifecycle and Manifest, Form widgets, Text Fields, Layouts: Relative Layout ,Table Layout, Frame Layout, Linear Layout, Nested layouts.

UI design: Time and Date, Images and media, Composite, Alert Dialogs & Toast, Popup.

Menu: Option menu, Context menu, Sub menu.

Database: Introducing SQLite, SQLite Open Helper, SQLite Database, Cursor,

Content providers: defining and using content providers, example- Sharing database among two different applications using content providers, Reading and updating Contacts, Reading bookmarks.

UNIT - 3

Preferences, Intents and Notifications

Preferences: Shared Preferences, Preferences from xml, Intents:Explicit Intents, Implicit intents. Notifications: Broadcast Receivers, Services (Working in background) and notifications, Alarms.

UNIT - 4

Telephony, SMS and Location Based Services

Telephony: Accessing phone and Network Properties and Status, Monitoring Changes in Phone State, Phone Activity and data Connection.

SMS: Sending SMS and MMS from your Application, sending SMS Manually, Listening for incoming SMS

Location based Services: Using Location Based Services, Working with Google Maps, Geocoder.

UNIT - 5

Accessing Android Hardware

Networking: An overview of networking, checking the network status, communicating with a server socket, Working with HTTP, Web Services.

Bluetooth: Controlling local Bluetooth device, Discovering and bonding with Bluetooth devices, Managing Bluetooth connections, communicating with Bluetooth.

UNIT - 6

Audio Video Handling

Playing Audio and Video, Recording Audio and Video, Using Camera and Taking Picture.

TEXT/REFERENCE BOOKS

1. Reto Meier "Professional Android™ Application Development", Wrox Publications.
2. Lauren Dercy and Shande Conder "Sams teach yourself Android application development" , Sams publishing
3. Hello Android, Introducing Google's Mobile Development Platform, Ed Burnette, Pragmatic Programmers, ISBN: 978-1-93435-617-3

BTHM606	Employability & Skill Development	2 Credits

Course Objectives:

- To develop analytical abilities.
- To develop communication skills.
- To introduce the students to skills necessary for getting, keeping and being successful in a profession.
- 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

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

Aspects of intelligence, Bloom taxonomy, multiple intelligence theory, Number sequence test, mental arithmetic (square and square root, LCM and HCF, speed calculation, reminder theorem).

UNIT - 3

Analytical Reasoning and Quantitative Ability

Matching, Selection, Arrangement, Verifications (Exercises on each of these types). Verbal aptitude (Synonym, Antonym, Analogy).

UNIT - 4

Grammar and Comprehension

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 - 5

Skills for interviews

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 - 6

Problem Solving Techniques

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, Wiley.
2. Wren and Martin, "English grammar and Composition", S. Chand publications.
3. R. S. Aggarwal, "A modern approach to verbal reasoning", S. Chand publications.
4. Philip Carter, "The Complete Book of Intelligence Test", John Willey & Sons Ltd.
5. Philip Carter, Ken Russell, "Succeed at IQ test", Kogan Page.
6. Eugene Ehrlich, Daniel Murphy, "Schaum’s Outline of English Grammar", McGraw Hills.
7. David F. Beer, David A. Mc Murrey, “A Guide to Writing as an Engineer”, ISBN: 978-1-118-30027-5 4th Edition, 2014, Wiley.

BTEXC701	Antennas and Wave Propagation	3 Credits

Course Objectives:

- To understand the applications of electromagnetic engineering.
- To formulate and solve the Helmholtz wave equation and solve it for Uniform Plane Wave.
- To analyze and understand the Uniform plane wave propagation in various media.
- To solve the electric field and magnetic fields for a given wire antenna.

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 - 1

Uniform Plane Waves

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.

UNIT - 2

Wave Propagation

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 magnetic field. Virtual height, MUF, Skip distance. Ionospheric abnormalities. Multi-hop propagation. Space link geometry. Characteristics of Wireless Channel: Fading, Multipath delay spread, Coherence Bandwidth, and Coherence Time.

UNIT - 3

Antenna Fundamentals

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.

UNIT - 4

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 - 5

Antenna Arrays

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, nonuniform amplitude, array factor, binomial and Dolph Tchebyshev array. Planar Array, Circular Array, Log Periodic Antenna, Yagi Uda Antenna Array.

UNIT - 6

Antennas and Applications

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", John Wiley.
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”, Satya Prakashan, New Delhi.
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.

BTEXPE702A	Digital Image Processing	3 Credits

Course Objectives:

- To learn the fundamental concepts of Digital Image Processing.
- To study basic image processing operations.
- To understand image analysis algorithms.
- To expose students to current applications in the field of digital image processing.

Course Outcomes:

After successfully completing the course students will be able to

1. Develop and implement algorithms for digital image processing.
2. Apply image processing algorithms for practical object recognition applications.

UNIT - 1

Fundamentals of Image Processing

Steps in image processing, Human Visual System, Sampling & quantization, Representing digital images, Spatial & gray-level resolution, Image file formats, Basic relationships between pixels, Distance Measures, Basic operations on images-image addition, subtraction, logical operations, scaling, translation, rotation, Image Histogram, Color fundamentals & models – RGB, HSI YIQ.

UNIT - 2

Image Enhancement and Restoration

Spatial domain enhancement: Point operations-Log transformation, Power-law transformation, Piecewise linear transformations, Histogram equalization. Filtering operations- Image smoothing, Image sharpening. Frequency domain enhancement: 2D DFT, Smoothing and Sharpening in frequency domain. Homomorphic filtering. Restoration: Noise models, Restoration using Inverse filtering and Wiener filtering.

UNIT - 3

Image Compression

Types of redundancy, Fidelity criteria, Lossless compression – Runlength coding, Huffman coding, Bit-plane coding, Arithmetic coding, Introduction to DCT, Wavelet transform. Lossy compression – DCT based compression, Wavelet based compression. Image and Video Compression Standards – JPEG, MPEG

UNIT - 4

Image Segmentation and Morphological Operations

Image Segmentation: Point Detections, Line detection, Edge Detection-First order derivative –Prewitt and Sobe, Second order derivative – LoG, DoG, Canny, Edge linking, Hough Transform, Thresholding – Global, Adaptive. Otsu's Method, Region Growing, Region Splitting and Merging, Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss transform, Boundary Detection, Thinning, Thickening, Skeleton.

UNIT - 5

Representation and Description

Representation – Chain codes, Polygonal approximation, Signatures. Boundary Descriptors – Shape numbers, Fourier Descriptors, Statistical moments. Regional Descriptors – Topological, Texture, Principal Components for Description.

UNIT - 6

Object Recognition and Applications

Feature extraction, Patterns and Pattern Classes, Representation of Pattern classes, Types of classification algorithms, Minimum distance classifier, Correlation based classifier, Bayes classifier. Applications: Biometric Authentication, Character Recognition, Content based Image Retrieval, Remote Sensing, Medical application of Image processing.

TEXT/REFERENCE BOOKS

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Edition, - Pearson Education.
2. S Sridhar, "Digital Image Processing", Oxford University Press.
3. Rafael C. Gonzalez, Richard E. Woods, and Steven L. Eddins, "Digital Image Processing Using MATLAB", Second Edition, - Tata McGraw Hill Publication.
4. S Jayaraman, S Esakkirajan, T Veerakumar, "Digital Image Processing", Tata Mc Graw Hill Publication

BTEXPE702B	Data Compression and Encryption/Cryptography	3 Credits

Course Objectives:

- To teach the students Lossless and Lossy compression techniques for different types of data.
- To understand data encryption techniques.
- Network security and ethical hacking.

Course Outcomes:

After successfully completion of the course, students will able to:

1. Implement text, audio and video compression techniques.
2. Understand symmetric and asymmetric key cryptography schemes.
3. Understand network security and ethical hacking.

UNIT - 1

Data Compression

Compression Techniques: Loss less compression, Lossy compression, measure of performance, modeling and coding, different types of models, and coding techniques Text Compression: Minimum variance Huffman coding, extended Huffman coding, Adaptive Huffman coding. Arithmetic coding, Dictionary coding techniques, LZ 77, LZ 78, LZW

UNIT - 2

Audio Compression

High quality digital audio, frequency and temporal masking, lossy sound compression, μ-law and A-law companding, and MP3 audio standard.

UNIT - 3

Image and Video Compression

PCM, DPCM JPEG, JPEG –LS, and JPEG 2000 standards, Intra frame coding, motion estimation and compensation, introduction to MPEG -2 H-264 encoder and decoder.

UNIT - 4

Data Security

Security goals, cryptography, stenography cryptographic attacks, services and mechanics, Integer arithmetic, modular arithmetic, and linear congruence, Substitution cipher, transposition cipher, stream and block cipher, and arithmetic modes for block ciphers, Data encryption standard, double DES, triple DES, attacks on DES, AES, key distribution center.

UNIT - 5

Number Theory and Asymmetric Key Cryptography

Primes, factorization, Fermat's little theorem, Euler's theorem, and extended Euclidean algorithm, RSA, attacks on RSA, Diffie Hellman key exchange , key management, and basics of elliptical curve cryptography, Message integrity, message authentication, MAC, hash function, H MAC, and digital signature algorithm.

UNIT - 6

System Security

Malware, Intruders, Intrusion detection system, firewall design, antivirus techniques, digital Immune systems, biometric authentication, and ethical hacking.

TEXT/REFERENCE BOOKS

1. Khalid Sayood, Introduction to Data Compression, Morgan Kaufmann, 2000.
2. David Saloman, Data Compression: The complete reference, Springer publication.
3. Behrous Forouzen, ―Cryptography and Network Security, Tata McGraw–Hill Education 2011.
4. Berard Menezes, Network Security and Cryptography, learning publication Cengage.
5. William Stallings, Cryptography and Network Security, Pearson Education Asia Publication, 5th edition.

BTEXPE702D	Parallel Processing	3 Credits

Course Objectives:

- Learn the concepts of parallel processing as it pertains to high-performance computing.
- Learn to design parallel programs on high performance computing.
- Discuss issues of parallel programming.
- Learn the concepts of message passing paradigm using open source APIs.
- Learn different open source tools.
- Learn the concepts of Multi-core processor

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Describe different parallel processing platforms involved in achieving High
2. Performance Computing.
3. Discuss different design issues in parallel programming
4. Develop efficient and high performance parallel programming
5. Learn parallel programming using message passing paradigm using open source MPIs.
6. Design algorithms suited for Multicore processor and GPU systems using Open MP and CUDA.

UNIT - 1

Parallel Programming Platforms

Implicit Parallelism: Trends in Microprocessor Architectures ,Limitations of Memory System Performance, Dichotomy of Parallel Computing Platforms, Physical Organization of Parallel Platforms, Communication Costs in Parallel Machines, Routing Mechanisms for Interconnection Networks, Impact of Process-Processor Mapping and Mapping Techniques.

UNIT - 2

Principles of Parallel Algorithm Design algorithms

Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models.

UNIT - 3

Basic Communication Operations and algorithms

One-to-All Broadcast and All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Scatter and Gather, All-to-All Personalized Communication, Circular Shift, Improving the Speed of Some Communication Operations.

UNIT - 4

Analytical Modeling of Parallel Programs

Sources of Overhead in Parallel Programs, Performance Metrics for Parallel Systems, Effect of Granularity and Data Mapping on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost-Optimal Execution Time, Asymptotic Analysis of Parallel Programs, Other Scalability Metrics.

UNIT - 5

Programming Using the Message Passing Paradigm

Principles of Message-Passing Programming, the Building Blocks: Send and Receive Operations, MPI: The Message Passing Interface, Topologies and Embedding, Overlapping Communication with Computation, Collective Communication and Computation Operations, Groups and Communicators

UNIT - 6

Programming Shared Address Space Platforms Thread Basics

Threads, the POSIX Thread Application Programmer Interface, Synchronization Primitives in POSIX, Controlling Thread and Synchronization Attributes, Thread Cancellation, Composite Synchronization Constructs.

TEXT/REFERENCE BOOKS

1. Introduction to parallel programming, Ananth Grama, Anshul Gupta, George Karypis, Vipin Kumar, Pearson Publication.
2. Introduction to Parallel Processing, M. SasiKumar, Dinesh Shikhare P.Raviprakash, PHI Publication.

BTEXPE703A	IoT 4.0	3 Credits

Course Objectives:

- Students will be explored to the interconnection and integration of the physical world and the cyber space.
- To provide ability to design and develop IOT devices.

Course Outcomes:

1. Learner will be able to understand the meaning of internet in general and IOT in terms of layers, protocols, packets peer to peer communication
2. Learner will be able to interpret IOT working at transport layer with the help of various protocols.
3. Learner will be able to understand IOT concept at data link layer.
4. Learner will be able to apply the concept of mobile networking to the internet connected devices.
5. Learner will be able to measure and schedule the performance of networked devices in IOT.
6. Learner will be able to analyze the challenges involve in developing IOT architecture.

UNIT - 1

Introduction

What is the Internet of Things: History of IoT, about objects/things in the IoT, Overview and motivations, Examples of applications, IoT definitions, IoT Frame work, General observations, ITU-T views, working definitions, and basic nodal capabilities.

UNIT - 2

Fundamental IoT Mechanisms & Key Technologies:

Identification of IoT objects and services, Structural aspects of the IoT, Environment characteristics, Traffic characteristics ,scalability, Interoperability, Security and Privacy, Open architecture, Key IoT Technologies ,Device Intelligence, Communication capabilities, Mobility support, Device Power, Sensor Technology, RFID technology, Satellite Technology.

UNIT - 3

Radio Frequency Identification Technology:

Introduction, Principles of RFID, Components of an RFID system, Reader, RFID tags, RFID middleware, Issue. Wireless Sensor Networks: History and context, node, connecting nodes, networking nodes, securing communication.

UNIT - 4

Wireless Technologies For IoT : Layer ½ Connectivity :

WPAN Technologies for IoT/M2M, Zigbee /IEEE 802.15.4, Radio Frequency for consumer Electronics (RF4CE), Bluetooth and its low-energy profile , IEEE 802.15.6 WBANS, IEEE 802.15 WPAN TG4j, MBANS, NFC, dedicated short range communication(DSRC) & related protocols. Comparison of WPAN technologies cellular & mobile network technologies for IoT/M2M.

UNIT - 5

Governance of The Internet of Things:

Introduction, Notion of governance, aspects of governance, Aspects of governance Bodies subject to governing principles, private organizations, International regulation and supervisor, substantive principles for IoT governance, Legitimacy and inclusion of stakeholders, transparency, accountability. IoT infrastructure governance, robustness, availability, reliability, interoperability, access. Future governance issues, practical implications, legal implications.

TEXT/REFERENCE BOOKS

1. Hakima Chaouchi, The Internet of Things, Connecting Objects to the Web, Wiley Publications
2. Daniel Minoli,Building the Internet of Things with IPv6 and MIPv6 The Evolving World of M2M Communications, Wiley Publications
3. Bernd Scholz-Reiter, Florian Michahelles, Architecting the Internet of Things, ISBN 978-3842-19156-5, Springer.

4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things Key Applications and Protocols, ISBN 978-1-119-99435-0, Wiley Publications.

BTEXPE703B	Wireless Sensor Networks	3 Credits

Course Objectives:

- To introduce the emerging research areas in the field of wireless sensor networks
- 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
2. Understand emerging research areas in the field of sensor networks
3. Understand MAC protocols used for different communication standards used in WSN
4. Explore new protocols for WSN.

UNIT - 1

Introduction

Introduction to Sensor Networks, unique constraints and challenges, Advantage of Sensor Networks, Applications of Sensor Networks, Types of wireless sensor networks

UNIT - 2

Networks

Mobile Ad-hocNetworks (MANETs) and Wireless Sensor Networks, Enabling technologies for Wireless Sensor Networks. Issues and challenges in wireless sensor networks.

UNIT - 3

Protocols

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 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, Gateway Concepts Need for gateway, WSN to Internet Communication, and Internet to WSN Communication.

UNIT - 6

Single-node architecture, Hardware components & design constraints, Operating systems and execution environments.

TEXT/REFERENCE BOOKS

1. Waltenegus Dargie , Christian Poellabauer, “ Fundamentals Of Wireless Sensor Networks Theory And Practice”, By John Wiley & Sons Publications, 2011.
2. Sabrie Soloman, “Sensors Handbook" by McGraw Hill publication. 2009
3. Feng Zhao, Leonidas Guibas, “ Wireless Sensor Networks” , Elsevier Publications,2004
4. Kazem Sohrby, Daniel Minoli, “Wireless Sensor Networks”: Technology, Protocols and Applications, Wiley-Inter science
5. Philip Levis, And David Gay "TinyOS Programming” by Cambridge University Press 2009

BTEXPE703C	CMOS Design	3 Credits

Course Objectives:

- To develop an understanding of design different CMOS circuits using various logic families along with their circuit layout.
- 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. Use tools for VLSI IC design.

UNIT - 1

Review of MOS transistor models, Non-ideal behavior of the MOS Transistor, Transistor as a switch, Inverter characteristics.

UNIT - 2

Integrated Circuit Layout: Design Rules, Parasitics

UNIT - 3

Delay: RC Delay model, linear delay model, logical path efforts

UNIT - 4

Power, interconnect and Robustness in CMOS circuit layout

UNIT - 5

Combinational Circuit Design: CMOS logic families including static, dynamic and dual rail logic

UNIT - 6

Sequential Circuit Design: Static circuits, Design of latches and Flip-flops.

TEXT/REFERENCE BOOKS

1. N.H.E. Weste and D.M. Harris, CMOS VLSI design: A Circuits and Systems Perspective, 4^{th} 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

BTEXPE703D	**Process Instrumentation**	**3 Credits**

Course Objectives:

Course Outcomes:

At the end of the course the students will be able to

1. Understand various processes.
2. Develop Instrumentation for these processes.

3. Apply the control strategies for various process applications.
4. Mapping with PEOs.

UNIT - 1

Instrumentation for heat exchangers and dryers

Operation of heat exchanger, controlled and manipulated variables in heat exchanger control problem, instrumentation for feedback, feed-forward, cascade control strategies for heat exchanger, types and operation of dryers, controlled and manipulated variables in dryer control problem, instrumentation for feedback and feed-forward control of various types of dryers.

UNIT - 2

Instrumentation for evaporators & crystallizer

Types and operation of evaporators, Controlled and manipulated variables in evaporator control problem, instrumentation for feedback, feed-forward, cascade control strategies for evaporators, types and operation of crystallizers, controlled and manipulated variables in crystallizer control problem, instrumentation for control of various types of crystallizers.

UNIT - 3

Instrumentation for distillation columns

Operation of distillation column, manipulated and controlled variables in distillation column control, instrumentation for flow control of distillate, top and bottom composition control, reflux ratio control, pressure control schemes.

UNIT - 4

Boiler Instrumentation

Operation of boiler, manipulated and controlled variables in boiler control, safety interlocks and burner management system, instrumentation for boiler pressure controls, air to fuel ratio controls, boiler drum level controls, steam temperature control, optimization of boiler efficiency, operation and types of reactors, instrumentation for temperature, pressure control in CSTRs.

UNIT - 5

Instrumentation for pumps

Types and operation of pumps, manipulated and controlled variables in pump control problem, pump control methods and instrumentation for pump control.

UNIT - 6

Instrumentation for compressors

Types and operation of compressors, capacity control methods of compressors, instrumentation for control of different variables in centrifugal, rotary and reciprocating compressors including surge and anti-surge control.

TEXT/REFERENCE BOOKS

1. "Process Control, Instrument Engineering Hand book", B.G. Liptak, Chilton Book Company.
2. "Hand book of Process Instrumentation", Considine, McGraw Hill Publishing company.

BTEXPE704A	Microwave Theory and Techniques	3 Credits

Course Objectives:

- To lay the foundation for microwave engineering
- To understand the applications of microwave engineering
- 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

Introduction to Microwaves engineering: History of Microwaves, Microwave Frequency bands, Applications of Microwave, General solution for TEM, TE and TM waves, Parallel plate waveguide, and rectangular waveguide, Wave guide parameters, Introduction to coaxial line, Rectangular waveguide cavity resonators, Circular waveguide cavity resonators.

UNIT - 2

Microwave Components

Multi-port junctions: Construction and operation of E-plane, H-plane, Magic Tee and Directional couplers.

Ferrites components: - Ferrite Composition and characteristics, Faraday rotation, Construction and operation of Gyrator, Isolator and Circulator.

Striplines: Structural details and applications of Striplines, Microstrip line, Parallel Strip line, Coplanar Strip line, Shielded Strip Line.

UNIT - 3

Microwave Network Analysis

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, Related problems

UNIT - 4

Microwave Tubes

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 - 5

Microwave Solid State Devices

Microwave bipolar transistor, FET, MESFET, Varactor Diode, PIN Diode, Shottky Barrier Diode, Tunnel Diode, TEDs, Gunn Diodes, IMPATT diode and TRAPATT diode. Structural details, Principle of operation, various modes, specifications, and applications of all these devices.

UNIT - 6

Microwave Measurements

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.

TEXT/REFERENCE BOOKS

1. Samuel Y. Liao, “Microwave Devices and Circuits”, 3rd edition, Pearson
2. David M. Pozar, “Microwave Engineering", Fourth edition, Wiley.
3. M. Kulkarni, “Microwave and Radar engineering”, 3rd edition, Umesh Publications
4. M L Sisodia & G S Raghuvamshi, “Microwave Circuits and Passive Devices” Wiley, 1987
5. M L Sisodia & G S Raghuvanshi, “Basic Microwave Techniques and Laboratory
6. Manual”, New Age International (P) Limited, Publishers.

BTEXPE704B	Satellite Communication	3 Credits

Course Objectives:

- To provide students with good depth of knowledge in radar and Satellite communication.
- Knowledge of theory and practice of advanced communication techniques e.g. TDMA, CDMA, FDMA.
- 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

Radar Communication

Basic principles and fundamentals, block diagram of basic radar, classification, radar performance factors, radar range equation, f actors influencing maxi mum range, effects of noise, Pulsed radar systems, block diagram and description, antennas and scanning, display methods, moving target indication, radar beacons, other radar systems such as CW Doppler radar, FM CW Doppler radar, phased array radars, planar array radars, various applications of radar such as navigational aids, military, surveillance.

UNIT - 2

Basic Principles satellite communication systems

General features, frequency allocation for satellite services, properties of satellite communication systems, Earth Station: Introduction, earth station subsystem, different types of earth stations

Satellite Orbits

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)

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

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

Introduction, space segment access methods: TDMA, FDMA, CDMA, SDMA, assignment methods.

UNIT - 6

The Role and Application of Satellite Communication

Introduction to Digital Satellite and Mobile Satellite Communication.

TEXT/REFERENCE BOOKS

1. Skolnik, "Principles of Radar Engineering" MCH.
2. Timothy Pratt, Charles W. Bostian, Satellite Communications, John Wiley & Sons
3. Dennis Roddy, Satellite Communications, 3rd Ed., McGraw-Hill International Ed. 2001
4. W. L. Pritchard, J. A. Sciulli, Satellite Communication Systems Engineering, Prentice- Hall, Inc., NJ
5. M. O. Kolawole, Satellite Communication Engineering, Marcel Dekker, Inc. NY
6. Robert Gagliardi , "Satellite Communication" , CBS Publication
7. Ha, "Digital Satellite Communication", McGraw- Hill.

BTEXPE704C	Fiber Optic Communication	3 Credits

Course Objectives:

- To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures.
- To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors.
- To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
- Understand the functionality of each of the components that comprise a fiber-optic communication system: transmitter, fiber, amplifier, and receiver.
- Understand the properties of optical fiber that affect the performance of a communication link.
- Understand basic optical amplifier operation and its effect on signal power and noise in the system.
- 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 - 1

Introduction

Introduction to vector nature of light, propagation of light, propagation of light in a cylindrical dielectric rod, Ray model, wave model.

UNIT - 2

Types of optical fibers

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

LEDs and Lasers, Photo-detectors - pin-diodes, APDs, detector responsivity, noise, optical receivers. Optical link design - BER calculation, quantum limit, power penalties.

UNIT - 4

Optical switches

Coupled mode analysis of directional couplers, electro-optic switches.

UNIT - 5

Optical amplifiers

EDFA, Raman amplifier, WDM and DWDM systems, Principles of WDM networks.

UNIT - 6

Nonlinear effects in fiber optic links

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.

BTEXPE704D	Wireless Communication	3 Credits

Course Objectives:

- The objective of the course is to introduce the Concepts of basic wireless mobile communication systems.
- To learn and understand the basic principles of Telecommunication switching, traffic and networks.
- To learn and understand basic concepts of cellular system, wireless propagation and the techniques used to maximize the capacity of cellular network.
- To learn and understand architecture of GSM and CDMA system.
- To understand mobile management, voice signal processing and coding in GSM and CDMA system.

Course Outcomes:

After successfully completing the course students will be able to

1. Explain and apply the concepts telecommunication switching, traffic and networks.
2. Analyze the telecommunication traffic.
3. Analyze radio channel and cellular capacity.
4. Explain and apply concepts of GSM and CDMA system.

UNIT - 1

Introduction and Cellular Concept

Existing technology, Evolution in wireless systems, Trends in cellular system Frequency Reuse channel Assignment Strategies, Handoff Strategies, Interference and System Capacity, Cellular System, Design in worst case with an omni Directional Antenna, Co-Channel Interference Reduction with use of Directional Antenna, Improving Coverage and Capacity in Cellular systems, Trunking and Grade of service

UNIT - 2

Wireless Communication Systems GSM

GS Services and features, GSM Architecture and interfaces, GSM Radio Sub System, GSM Channel Types , Traffic Channels, Control Channels, Example of a GSM call, Frame structure for GSM , Signal Processing in GSM, GPRS.

UNIT - 3

Wideband Modulation Techniques and OFDM

Basic Principles, OFDM Signal Mathematical representation, Block Diagram, Selection Parameters for modulation, Pulse shaping, Windowing, Spectral Efficiency, Synchronization

UNIT - 4

Wireless Communication Systems CDMA IS95

Direct sequence Spread Spectrum, Spreading codes, Multipath Signal Propagation and RAKE receiver, Frame Quality and BER Requirements, Critical challenges of CDMA,TIA IS95 System, Physical and Logical Channels of IS95, CDMA IS95 call processing, soft hand off and power control in CDMA, Access and Paging Channel Capacity, Reverse and Forward Link Capacity of a CDMA System.

UNIT - 5

Wireless Communication Systems

CDMA 2000: CDMA layering structure, CDMA 2000 channels, logical channels, forward link physical, forward link features, reverse physical channels, CDMA 2000 Media Access control and LAC sub layer, Data services, Data services in CDMA 2000, mapping of logical channels to physicals, evolution of CDMA IS95 to CDMA 2000.

UNIT - 6

More Wireless Communication Systems

Bluetooth, Wi-Fi Standards, WIMAX, Wireless Sensor Networks, Zigbee, UWB, IEEE 802.20 and Beyond.

TEXT/REFERENCE BOOKS

1. Wireless Communication: Principles and Practice Theodare. S. Rappaport- Pearson Education.
2. Wireless Communication: Upena Dalal, Oxford Higher Education.
3. Wireless Network Evolution: 2G to 3G, Vijay. K. Garg, Pearson Education.

4. Principles and Application of GSM, Vijay Garg, Joseph. E. Wilkes Pearson Education.
5. Mobile Cellular Telecommunications: Analog and Digital Systems, William C. Y. Lee, Tata McGraw Hill Edition.
6. Introduction to Wireless Telecommunication Systems and Networks- Gary. J. Mullet, DELMAR CENGAGE Learning.
7. Wireless Communications and Networks: 3G and Beyond, ITI Saha Misra, Tata McGraw Hill Edition.
8. Fundamentals of Wireless Communication: David Tse, Pramod Viswanath, CAMBRIDGE University Press.
9. Mobile Wireless communications, Mischa Schwartz, CAMBRIDGE University Press.

BTEXPE801A	Surface Mounting Technology	3 Credits

UNIT - 1

Introduction To Electronics Manufacturing

History, Definition, Wafer Preparation By Growing, Machining, And Polishing, Diffusion, Microlithography, Etching And Cleaning, Printed Circuit Boards, Types- Single Sided, Double Sided, Multi-Layer And Flexible Printed Circuit Board, Design, Materials, Manufacturing, Inspection.

UNIT - 2

Components and Packaging

Introduction To Packaging, Types-Through Hole Technology(THT) And Surface Mount Technology(SMT), Through Hole Components – Axial, Radial, Multi Leaded, Odd Form. Surface- Mount Components- Active, Passive. Interconnections – Chip To Lead Interconnection, Die Bonding, Wire Bonding, TAB, Flip Chip, Chip On Board, Multi Chip Module, Direct Chip Array Module, Leaded, Leadless, Area Array And Embedded Packaging, Miniaturization And Trends.

UNIT - 3

Introduction to the SMT Process, SMT Equipment and Material Handling Systems

Handling Of Components And Assemblies – Moisture Sensitivity And ESD, Safety And Precautions Needed, IPC And Other Standards, Stencil Printing Process – Solder Paste Material, Storage And Handling, Stencils And Squeegees, Process Parameters, Quality Control.

UNIT - 4

Soldering- Process and Component Placement

Soldering- Reflow Process, Process Parameters, Profile Generation and Control, Solder Joint Metallurgy, Adhesive, Under fill and Encapsulation Process – Applications, Materials, Storage And Handling, Process And Parameters.

Component Placement- Equipment Type, Flexibility, Accuracy of Placement, Throughput, Packaging of Components For Automated Assembly, Cp And Cpk And Process Control.

UNIT - 5

Inspection and Testing

Inspection Techniques, Equipment and Principle – AOI, X-Ray, Defects And Corrective Action – Stencil Printing Process, Component Placement Process, Reflow Soldering Process, Underfill and Encapsulation Process, Electrical Testing Of PCB Assemblies- In Circuit Test, Functional Testing, Fixtures And Jigs.

UNIT - 6

Repair, Rework, Quality and Reliability of Electronics Assemblies

Repair Tools, Methods, Rework Criteria and Process, Thermo-Mechanical Effects And Thermal Management, Reliability Fundamentals, Reliability Testing, Failure Analysis, Design For Manufacturability, Assembly, Reworkability, Testing, Reliability, And Environment

TEXT/REFERENCE BOOKS

1. Ray Prasad, "Surface Mount Technology: Principles And Practice", Second Edition , Chapman And Hall ,1997 ,New York , ISBN 0-41-12921-3
2. Rao. R .Tummala, "Fundamentals of Microsystem Packaging", McGraw Hill, 2001 , ISBN 00- 71-37169-9
3. Puligandla Viswanadham and Pratap Singh, "Failure Modes And Mechanisms In Electronic Packages", Chapman And Hall, New York , N.Y. ISBN 0-412-105591-8
4. Paul Totta and Karl Puttlitz, and Kathleen Stalter, "Area Array Interconnection Handbook", Kluwer Academic Publishers, Norwell, MA, USA, 2001. ISBN 0-7923 7919-5.
5. Ning-Cheng Lee, "Reflow Soldering Process And Trouble Shooting SMT, BGA, CSP And Flip Chip Technologies", Elsevier Science, ISBN 0-7506-7218-8.
6. Phil Zarrow, "Surface Mount Technology Terms And Concepts", Elsevier Science And Technology,1997.ISBN 0750698756
7. C. A. Harper, "Electronic Packaging And Interconnection Handbook", Second Edition, McGraw Hill Inc., New York, N.Y.,1997,ISBN 0-07-026694-8

BTEXPE801B	Mixed Signal Design	3 Credits

Course Objectives:

- To introduce how to handle the practical situations where mixed signal analysis is required.
- To analyze and handle the inter-conversions between signals.
- 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, introduction to sampling theory; Analog continuous-time filters: passive and active filters.

UNIT - 2

Basics of analog discrete-time filters and Z-transform.

UNIT - 3

Switched-capacitor filters- Non idealities in switched-capacitor filters, Switched-capacitor filter architectures, Switched-capacitor filter applications.

UNIT - 4

Basics of data converters; Successive approximation ADCs, Dual slope ADCs, Flash ADCs, Pipeline ADCs, Hybrid ADC structures, High-resolution ADCs, DACs.

UNIT - 5

Mixed-signal layout, Interconnects and data transmission, Voltage-mode signaling and data transmission, Current-mode signaling and data transmission.

UNIT - 6

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, and 2008.
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 newer additions).
7. M. Burns et al., An introduction to mixed-signal IC test and measurement by, Oxford University Press, First Indian edition, 2008.

BTEXPE801C	Bio-medical Signal Processing	3 Credits

Course Objectives:

- To understand the basic signals in the field of biomedical.
- To study origins and characteristics of some of the most commonly used biomedical signals, including ECG, EEG, evoked potentials, and EMG.
- To understand Sources and characteristics of noise and artifacts in bio signals.
- To understand use of bio signals in diagnosis, patient monitoring and physiological investigation.
- To explore research domain in biomedical signal processing.
- 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

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

Principles of adaptive filters- Winer Filtering- Steepest Descent algorithms- Widrow Hopf Least mean square adaptive algorithms- Adaptive noise canceller- Interference cancellation in Electrocardiography- noise cancellation in electro surgery.

UNIT - 3

Event Detection

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 crossing rates.

UNIT - 4

Fourier Spectrum, Estimation of power spectral density

Moments and spectral power ratio. Power Cepstrum- Complex Cepstrum Biomedical applications of Cepstrum analysis.

UNIT - 5

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 - 6

Pattern classification and diagnostic decision:

Supervised and unsupervised pattern classification Probabilistic models and statistical decisions- Logistic regression analysis- training and test stepsneural networks- Measures of diagnostic accuracy and cost- Reliability of classifiers and decisions. Application: Normal versus Ectopic ECG beats- Detection of Knee Joint cartilage pathology.

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. Metin Akay, "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.

BTEXPE801D	Multirate Digital Signal Processing	3 Credits

Course Objectives:

- 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.
- 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.
- To analyze multi-rate systems and the effects of interpolation and decimation on deterministic signals.
- To analyze the effects of interpolation and decimation on random signals.

- 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

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

Introduction, Errors created in the QMF bank, A simple alias free QMFsystem, Power symmetric QMF banks, M-channel filter banks, Polyphase representation, Perfect reconstruction system, alias free filter banks, Treestructured filter banks, Transmultiplexer.

UNIT - 3

Paranitary Perfect Reconstruction Filter Banks

Introduction, Lossless transfer matrices, Filter banks properties induced by paraunitariness, Two channel FIR paraunitary QMF banks, Two channel paraunitary QMF lattice, M - channel FIR paraunitary filter banks, Tranformcoding and LOT.

UNIT - 4

Linear Phase and Cosine Modulated Filter Banks

Introduction, Some necessary conditions, Lattice structure for linear phase FIR PR banks, formal synthesis of linear phase FIR PR QMF Lattice. Pseudo QMF banks, Design of the pseudo QMF bank, Efficient polyphase structure, Cosine modulated perfect reconstruction system.

UNIT - 5

The Wavelet Transform and its Relation to Multirate Filter Banks

Introduction, Background and outline, Short time fourier transform, The Wavelet transform, DT orthonomal Wavelets, Continuous time orthonormal Wavelet basis.

UNIT - 6

Multidimensional, Multivariable and Lossless Systems

Introduction, Multidimensional signals, Sampling a multidimensional Signals, Multirate fundamentals.Review of discrete time multi-input multi-output LTI System, ParaUNITary and lossless system.

TEXT/REFERENCE BOOKS

1. P. P. Vaidyanathan , PTR Prentice Hall, Englewood Cliffs , New Jersey,Multirate System and Filter Banks.
2. N. J. Fliege , John Wiley & Sons, Multirate Digital Signal Processing.
3. Raghuveer Rao, Ajit Bopardikar, Pearson Education Asia,Wavelet Transforms Introduction to Theory and Application.
4. C. Sidney Burrus , R.A.Gopianath , Pretice Hall, Introduction to wavelet and wavelet Transform.

BTEXPE801E	Wavelet Theory	3 Credits

Course Objectives:

- To understand time-frequency nature of the signals.
- To introduce the students how wavelets can be applied on the signals.

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

1. Understand time-frequency nature of the signals.
2. Apply the concept of wavelets to practical problems.
3. Mathematically analyze the systems or process the signals using appropriate wavelet functions.

UNIT - 1

Introduction

Introduction to time frequency analysis; the how, what and why about wavelets, Short-time Fourier transform.

UNIT - 2

Continuous and Discrete Wavelet Transform

Wigner-Ville transform, Continuous time wavelet transform, discrete wavelet transform

UNIT - 3

Construction of Wavelets

Tiling of the time-frequency plane and wave packet analysis, Construction of wavelets

UNIT - 4

Multi Resolution Analysis

Multi resolution analysis, Introduction to frames and biorthogonal wavelets

UNIT - 5

Filter Bank Theory

Multirate signal processing and filter bank theory.

UNIT - 6

Applications

Application of wavelet theory to signal denoising, image and video compression, multi-tone digital communication, transient detection.

TEXT/REFERENCE BOOKS

1. Y. T. Chan, Wavelet Basics, Kluwer Publishers, Boston, 1993.
2. I. Daubechies, Ten Lectures on Wavelets, Society for Industrial and Applied Mathematics, Philadelphia, PA, 1992.
3. C. K. Chui, An Introduction to Wavelets, Academic Press Inc., New York, 1992.
4. Gerald Kaiser, A Friendly Guide to Wavelets, Birkhauser, New York, 1995.
5. P. P. Vaidyanathan, Multirate Systems and Filter Banks, Prentice Hall, New Jersey, 1993.
6. A.N. Akansu and R.A. Haddad, Multireso lution signal Decomposition: Transforms, Subbands and Wavelets, Academic Press, Oranld, Florida, 1992.
7. B.Boashash, Time-Frequency signal analysis, In S.Haykin, (editor), Advanced Spectral Analysis, pages 418--517. Prentice Hall, New Jersey, 1991.

BTEXPE802A	e-Yantra	3 Credits

BTEXPE802B	Mobile Communication & Networks	3 Credits

Course Objectives:

- To provide an overview of Mobile Communication Networks area and its applications in communication engineering.
- To appreciate the contribution of mobile communication networks to overall technological growth.
- 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 - 1

Cellular concepts

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

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

Antennas for mobile terminal- monopole antennas, PIFA, base station antennas and arrays

UNIT - 4

Multiple access schemes

FDMA, TDMA, CDMA and SDMA, Modulation schemes- BPSK, QPSK and variants, QAM, MSK and GMSK, multicarrier modulation, OFDM

UNIT - 5

Receiver structure

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 - 6

Performance measures

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.

BTEXPE802C	Geo-Informatics and Spatial Computing	3 Credits

Course Objectives:

- Maximizing the efficiency of planning and decision making
- Integrating information from multiple sources

Course Outcomes:

At the end of the course, students will be able to map, analyze, manipulate and store geographical data in order to provide solutions to real world problems and help in planning for the future.

UNIT - 1

Introduction to Geo-informatics

Introduction to GIS, History of GIS, Early developments in GIS, Applications of GIS.

UNIT - 2

Maps and Projection

Introduction to Maps, History of Maps, Map Scales, Types of Maps, Map and Globe, Understanding Earth, Coordinate System, Map Projection, Transformation, Geo-referencing.

UNIT - 3

Spatial DBMS and Data Models

Introduction, Data Storage, Database Structure Models, Database Management system, Entity Relationship Model, Normalization, GIS Data Model, Vector Data Structure, Raster Data structure, Geo-database and metadata.

UNIT - 4

Spatial Data Analysis

Primary Data, Secondary Data, Data Editing, Introduction to spatial analysis, Vector Operations and Analysis, Network Analysis, Raster Data Spatial Analysis

UNIT - 5

Cartographic Principles and Design

Introduction, Map layout, Data presentation, Toposheet Indexing, Distribution Maps.

UNIT - 6

Interpolation and Web GIS

Introduction to Interpolation, Global Methods of Interpolation, Local Methods of Interpolation, Introduction to Web GIS, OGC Standards and services.

TEXT/REFERENCE BOOKS

1. Burrough, P. A., and McDonnell, R. A., Principles of Geographical Information Systems, 2nd Edition, Oxford University Press, 1998
2. Demers, M. N., Fundamentals of Geographic Information Systems, John Wiley & Sons, 3rd Edition, 2002
3. Longley, P. A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W., Geographic Information Systems and Science, 2nd Edition, John Wiley and Sons, 2005
4. Longley, P. A., Goodchild, M. F., Maguire, D. J., and Rhind, D. W., Geographical Information Systems: Principles, Techniques, Management and Applications, 2nd Edition, John Wiley & Sons, 2005.
5. Kang-tsung Chang, "Introduction to Geographic Information Systems", McGraw-Hill Book Company, 2006.
6. Ramez Elmasri, Shamkant B.Navathe, "Fundamental of Database Systems", Pearson Addison Wesley, 2003.
7. Shashi Shekhar and Sanjay Chawla, "Spatial Databases: A Tour", Prentice Hall, 2003.

BTEXPE802D	Software Defined Radio	3 Credits

Course Objectives:

- The objective of this course is to provide knowledge of fundamental and state-of the art concepts in software defined radio.
- To understand the various components of software-defined-radios with the understanding of their limitation and application of ‘software-defined-solutions’ to overcome such limitations.

- 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 radio solution.

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:

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:

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:

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:

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:

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", Wiley 2003
3. Bard, Kovarik, "Software Defined Radio, The Software Communications Architecture", Wiley 2007
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

BTEXPE802E	Entrepreneurship Development	3 Credits

Course Objectives:

- 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.
- 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 - 1

Entrepreneurship

Entrepreneur – Types of Entrepreneurs – Difference Between Entrepreneur And Intrapreneur Entrepreneurship In Economic Growth, Factors Affecting Entrepreneurial Growth.

UNIT - 2

Motivation

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

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,

UNIT - 4

Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT - 5

Financing and Accounting

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of Working Capital, Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT - 6

Support to Entrepreneurs

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 Learning 2014.
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.

BTEXOE803A	Advance Industrial Automation	3 Credits

Course Objectives:

After the successful completion of this course, the student will be able:

- To identify potential areas for automation and justify need for automation.
- To select suitable major control components required to automate a process or an activity.
- To translate and simulate a real time activity using modern tools and discuss the benefits of automation.

Course Outcomes:

1. To identify suitable automation hardware for the given application.
2. To recommend appropriate modeling and simulation tool for the given manufacturing application.

UNIT - 1

Introduction:

Automation in Production System, Principles and Strategies of Automation, Basic Elements of an Automated System, Advanced Automation Functions, Levels of Automations. Flow lines & Transfer Mechanisms, Fundamentals of Transfer Lines. (SLE: Analysis of Transfer Lines).

UNIT - 2

Material handling and Identification Technologies:

Overview of Material Handling Systems, Principles and Design Consideration, Material Transport Systems, Storage Systems, Overview of Automatic Identification Methods (SLE: Material Identification Methods).

UNIT - 3

Automated Manufacturing Systems:

Components, Classification and Overview of Manufacturing Systems, Manufacturing Cells, GT and Cellular Manufacturing, FMS, FMS and its Planning and Implementation, Quality Control Systems: Traditional and Modern Quality Control Methods, SPC Tools, Inspection Principles and Practices, Inspection Technologies. (SLE: Usage of SPC tools using excel or Minitab).

UNIT - 4

Control Technologies in Automation:

Industrial Control Systems, Process Industries versus Discrete-Manufacturing Industries, Continuous Versus Discrete Control, Computer Process and its Forms, (SLE: Sensors, Actuators and other Control System Components).

UNIT - 5

Computer Based Industrial Control:

Introduction & Automatic Process Control, Building Blocks of Automation Systems: LAN, Analog & Digital I/O Modules, SCADA Systems& RTU. Distributed Control System: Functional Requirements, Configurations & some popular Distributed Control Systems (SLE: Display Systems in Process Control Environment).

UNIT - 6

Modeling and Simulation for Plant Automation:

Introduction, need for system Modeling, Building Mathematical Model of a Plant, Modern Tools & Future Perspective. Industrial Control Applications: Cement, Thermal, Water Treatment & Steel Plants. (SLE: Cases Studies minimum one for Cement, Thermal, Water Treatment & Steel Plants applications).

TEXT/REFERENCE BOOKS

1. Automation, Production Systems and Computer Integrated Manufacturing- M.P.Groover, Pearson Education.5th edition, 2009.
2. Computer Based Industrial Control- Krishna Kant, EEE-PHI,2nd edition,2010
3. An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk
4. Performance Modeling of Automated Manufacturing Systems,-Viswanandham, PHI, 1st edition, 2009.

BTEXOE803B	Electronics in Smart City	3 Credits

Course Objectives:

Course Outcomes:

UNIT - 1

Necessity of SMART CITY

The Smart City Philosophy, Development of Asian Cities, Megacities of India: Current Challenges, The India Story of Smart Cities, Conceptual Basis of a Smart City, Global Smart City Programs, Recommendations for Smart City Framework in GCC.

UNIT - 2

SMART CITY and IOT

Introduction to Internet of Things, applications in smart city & their distinctive advantages - smart environment, smart street light and smart water & waste management. What is an IOT? Role and scope of IOT in present and future marketplace.

UNIT - 3

SMART Objects

Smart objects, Wired – Cables, hubs, etc., Wireless – RFID, WiFi, Bluetooth, etc. Different functional building blocks of IOT architecture.

UNIT - 4

Smart Cities: Distributed Intelligence and Central Planning

On the Interplay between Humans and Smart Devices, Theoretical Tools, Intelligence-Artificial Intelligence (Machine Intelligence), Information Dynamics, Synergetic, Information Dynamics and Allometry in Smart Cities.

UNIT - 5

Wireless Protocols for Smart Cities

IPv6 over Low-Power Wireless Personal Area Network: Features, Addressing, Packet fragmentation, Operation, Security. ZigBee: Architecture Objectives, Wireless Networking Basics, Wireless Networking Assumptions, Bluetooth Low Energy, Constrained Application Protocol, Message Queue Telemetry Protocol.

UNIT - 6

Leveraging Smart City Projects for Benefitting Citizens: The Role of ICTs

Smart City and ICT: Using Technologies to Improve the Citizens' Quality of Life, Smart City Goals: The Impact on Citizens' Well-Being and Quality of Life, Critical Dimensions: Urbanization, Local Climate Change, and Energy Poverty, Environmental Issues: The Role of Local and Global Climate Chang.

TEXT/REFERENCE BOOKS

BTEXOE803C	Industrial Drives and control	3 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:

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:

Thermal Model of Motor for Heating and Cooling, Classes of Motor Rating, Determination of Motor Rating.

UNIT - 3

Control of Electrical Drives:

Modes of Operation, Speed Control, Drive Classification, and Closed loop Control of Drives

UNIT - 4

DC Drives:

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 this module)

UNIT - 5

AC Drives:

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 - 6

Special Motor Drives:

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, Narosa Publication
2. A First Course on Electrical Drives by S. K. Pillai, New Age International.
3. Electrical Drives: Concepts and Applications by Vedam Subramanyam, T.M.H
4. Modern Power Electronics and AC Drives by B.K.Bose, Prentice Hall PTR
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 McGraw Hill
8. Power Semiconductor Controlled Drives by G. K. Dubey, Prentice Hall International.

BTEXOE803D	Robotics Design	3 credits

Course Objectives:

- To prepare students with basics of robotics
- To familiarize students with kinematics & dynamics of robots
- To familiarize students with path & Trajectory planning of robots
- 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

Robot Classification, Robot Components, Degrees of freedom, Joints, Coordinates, Coordinate frames, workspace, applications.

UNIT - 2

Forward & Inverse Kinematics of Robots

Homogeneous transformation matrices, Inverse transformation matrices, Forward and inverse kinematic equations – position and orientation**,** Denavit-Hatenberg representation of forward kinematics, Inverse kinematic solutions, Case studies.

UNIT - 3

Velocity Kinematics & Dynamics

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

UNIT - 4

Robot Motion Planning

Concept of motion planning, Bug Algorithms – Bug1, Bug2, Tangent Bug

UNIT - 5

Potential Functions and Visibility Graphs

Attractive/Repulsive potential, Gradient descent, wave-front planner, navigation potential functions, Visibility map, Generalized Voronoi diagrams and graphs, Silhouette methods

UNIT - 6

Trajectory planning

Trajectory planning, Joint-space trajectory planning, Cartesian-space trajectories

UNIT - 7

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

BTEXOE803E	Block Chain Technology	3 Credits

Course Objectives:

Course Outcomes:

At the end of the course, students will demonstrate the ability to:

UNIT - 1

Introduction to Block chain

History: Digital Money to Distributed Ledgers, Design Primitives: Protocols, Security, Consensus, Permissions, and Privacy.

UNIT - 2

Block chain Architecture and Design

Basic crypto primitives: Hash, Signature, Hash chain to Block chain, Basic consensus mechanisms

UNIT - 3

Consensus

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 - 4

Hyperledger Fabric

Hyperledger Fabric I: Decomposing the consensus process, Hyperledger fabric components, Chain code Design and Implementation

Hyperledger Fabric II: Beyond Chain code: fabric SDK and Front End, Hyperledger composer tool

UNIT - 5

Use Cases

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 managementdiscounting, 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 - 6

Blockchain Cryptography Privacy and Security on Blockchain

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, Hyperledger, Ethereum and more

TEXT/REFERENCE BOOKS

1. Mastering Bitcoin: Unlocking Digital Cryptocurrencies, 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

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 Course Contents for

B. Tech. in Mechanical Engineering

w.e.f. June 2019

From 3rd Semester - 6th Semester

Vision

The vision of the department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.

Mission

Imparting quality education, looking after holistic development of students and conducting need based research and extension.

Graduate Attributes

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:

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, 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.

Program Educational Objectives

PEO 1	Graduates should excel in engineering positions in industry and other organizations that emphasize design and implementation of engineering systems and devices.
PEO 2	Graduates should excel in best post-graduate engineering institutes, acquiring advanced degrees in engineering and related disciplines.
PEO 3	Alumni should establish a successful career in an engineering-related field and adapt to changing technologies.
PEO 4	Graduates are expected to continue personal development through professional study and self-learning.
PEO 5	Graduates should be good citizens and cultured human beings, with full appreciation of the importance of professional, ethical and societal responsibilities.

Program Outcomes

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

PO 1	Apply the knowledge of mathematics, basic sciences, and mechanical engineering to the solution of complex engineering problems.
PO 2	Identify, formulate, research literature, and analyze complex mechanical engineering problems reaching substantiated conclusions.
PO 3	Design solutions for complex engineering problems and design mechanical system components that meet the specified needs.
PO 4	Use mechanical engineering research-based knowledge related to interpretation of data and provide valid conclusions.
PO 5	Create, select, and apply modern mechanical engineering and IT tools to complex engineering activities with an understanding of the limitations.
PO 6	Apply reasoning acquired by the mechanical 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.

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

B. Tech. Mechanical Engineering

Course Structure for Semester III [Second Year] w.e.f. 2018-2019

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTBSC301	BSC 7	Engineering Mathematics-III	3	1	--	20	20	60	100	4
BTMEC302	ESC 11	Materials Science and Metallurgy	3	1	--	20	20	60	100	4
BTMEC303	PCC 1	Fluid Mechanics	3	1	--	20	20	60	100	4
BTMEC304	PCC 2	Machine Drawing and CAD	2	--	--	20	20	60	100	2
BTMEC305	ESC 12	Thermodynamics	3	1	--	20	20	60	100	4
BTHM3401	HSMC 3	Basic Human Rights	2	--	--	50	--	--	50	Audit (AU/ NP)
BTMEL307	ESC 13	Materials Science and Metallurgy Lab	--	--	2	60	--	40	100	1
BTMEL308	PCC 3	Fluid Mechanics Lab	--	--	2	60	--	40	100	1
BTMEL309	PCC 4	Machine Drawing and CAD Lab	--	--	4	60	--	40	100	2
BTMEF310	Project 1	Field Training /Internship/Industrial Training I	--	--	--	--	--	50	50	1
		Total	16	4	8	330	100	470	900	23

B. Tech. Mechanical Engineering

Course Structure for Semester IV [Second Year] w.e.f. 2018-2019

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTMEC401	PCC 5	Manufacturing Processes - I	2	1	--	20	20	60	100	3
BTMEC402	PCC 6	Theory of Machines-I	3	1	--	20	20	60	100	4
BTMEC403	PCC 7	Strength of Materials	3	1	--	20	20	60	100	4
BTMEC404	BSC 8	Numerical Methods in Mechanical Engineering	2	1	--	20	20	60	100	3
BTID405	PCC 8	Product Design Engineering – I	1	--	2	60	--	40	100	2
BTBSE406A	OEC 1	Physics of Engineering Materials	3	--	--	20	20	60	100	3
BTBSE3405A		Advanced Engineering Chemistry								
BTHM3402		Interpersonal Communication Skill& Self Development								
BTMEL407	PCC 9	Manufacturing Processes Lab – I	--	--	2	60	--	40	100	1
BTMEL408	PCC 10	Theory of Machines Lab- I	--	--	2	60	--	40	100	1
BTMEL409	PCC 11	Strength of Materials Lab	--	--	2	60	--	40	100	1
BTMEL410	BSC 9	Numerical Methods Lab	--	--	2	60	--	40	100	1
		Total	14	4	10	400	100	500	1000	23
Minimum 4 weeks training which can be completed partially in third and fourth semester or in at one time.										

B. Tech. Mechanical Engineering

Course Structure for Semester V [Third Year] w.e.f. 2019-2020

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTMEC501	PCC 12	Heat Transfer	3	1	--	20	20	60	100	4
BTMEC502	PCC 13	Applied Thermodynamics – I	2	1	--	20	20	60	100	3
BTMEC503	PCC 14	Machine Design – I	2	1	--	20	20	60	100	3
BTMEC504	PCC 15	Theory of Machines-II	3	1	--	20	20	60	100	4
BTMEC505	PCC 16	Metrology and Quality Control	2	1	--	20	20	60	100	3
BTID506	PCC 17	Product Design Engineering - II	1	--	2	60	--	40	100	2
BTMEC506A	OEC 2	Automobile Engineering	3	--	--	--	--	--	--	Audit (AU/ NP)
BTMEC506B		Nanotechnology								
BTMEC506C		Energy Conservation and Management								
BTMEL507	PCC 18	Heat Transfer Lab	--	--	2	30	--	20	50	1
BTMEL508	PCC 19	Applied Thermodynamics Lab	--	--	2	30	--	20	50	1
BTMEL509	PCC 20	Machine Design Practice- I	--	--	2	30	--	20	50	1
BTMEL510	PCC 21	Theory of Machines Lab- II	--	--	2	30	--	20	50	1
BTMEF511	Project 2	Field Training /Internship/Industrial Training II	--	--	--	--	--	50	50	1
		Total	16	5	10	280	100	470	850	24

B. Tech. Mechanical Engineering

Course Structure for Semester VI [Third Year] w.e.f. 2019-2020

Course Code	Type of Course	Course Title	Weekly Teaching Scheme			Evaluation Scheme				Credits
			L	T	P	CA	MSE	ESE	Total	
BTMEC601	PCC 22	Manufacturing Processes- II	2	1	--	20	20	60	100	3
BTMEC602	PCC 23	Machine Design-II	3	1	--	20	20	60	100	4
BTMEC603	PCC 24	Applied Thermodynamics- II	2	1	--	20	20	60	100	3
BTMEC604A	PEC 1	Engineering Tribology	2	1	--	20	20	60	100	3
BTMEC604B		IC Engines								
BTMEC604C		Additive Manufacturing								
BTMEC604D		Mechanical Measurements								
BTMEC605A	OEC 3	Quantitative Techniques in Project Management	3	--	--	20	20	60	100	3
BTMEC605B		Sustainable Development								
BTMEC605C		Renewable Energy Sources								
BTMEC606A	OEC 4	Biology for Engineers	3	--	--	--	--	--	--	Audit (AU/ NP)
BTMEC606B		Solar Energy								
BTMEC606C		Human Resource Management								
BTMEL607	PCC 25	Metrology and Quality Control Lab	--	--	2	30	--	20	50	1
BTMEL608	PCC 26	Machine Design Practice-II	--	--	2	30	--	20	50	1
BTMEL609	PCC 27	IC Engine Lab	--	--	2	30	--	20	50	1
BTMEL610	PCC 28	Refrigeration and Air Conditioning Lab	--	--	2	30	--	20	50	1
BTMEM611	Project 3	Technical Project for Community Services	--	--	4	30	--	20	50	2
		Total	15	4	12	250	100	400	750	22

Semester III

Engineering Mathematics-III

BTBSC301	BSC 7	Engineering Mathematics-III	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	
CO2	
CO3	
CO4	
CO5	
CO6	
CO7	
CO8	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												
CO7												
CO8												

Course Contents:

Unit 1: Laplace Transform[07 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[07 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 [07 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 [07 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 $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$, and two dimensional heat flow equation (i.e. Laplace equation : $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$).

Unit 5: Functions of Complex Variables (Differential calculus)[07 Hours]

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.

Unit 6: Functions of Complex Variables (Integral calculus)[07 Hours]

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. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
3. A Course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune VidyarthiGrihaPrakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. RajnishVerma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books:

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
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 batch-wise. Each class should be divided into three batches for the purpose.
2. The Continuous 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.

Material Science and Metallurgy

BTMEC302	ESC 11	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		

All units carry 10 Marks each for End Semester Examination.

Course Contents:

Unit 1: Structure of Materials[08 Hours]
Crystal structures, indexing of lattice planes, Indexing of lattice directions, Imperfections in crystals-point defects, line defects, surface and bulk defects, Mechanism of plastic deformation, deformation of single crystal by slip, plastic deformation of polycrystalline materials.

Unit 2: Mechanical Properties and their Testing[08 Hours]

Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, compression test, bend test, torsion test, formability, hardness testing, different hardness tests-Vickers, Rockwell, Brinnel, Impact test, fatigue test, creep test.

Unit 3: Equilibrium Diagrams[09 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, property variation with microstructures, classification and application of steels, specification of steels, transformation products of austenite, TTTdiagram, critical cooling rate, CCT diagram.

Unit 4: 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 5: Metallography[08 Hours]

Microscopy, specimen preparation, polishing abrasives and cloths, specimen mounting, electrolytic polishing, etching procedure and reagents, electrolytic etching, optical metallurgical microscope, macroscopy, sulphur printing, flow line observations, examination of fractures, spark test, electron microscope.

Unit 6: Strengthening Mechanisms and Non-destructive Testing[08 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, acoustic emission inspection.

Texts:

1. V. D.Kodgire, S.V.Kodgire, "Material Science and Metallurgy for Engineers", Everest Publishing House, Pune, 24thedition, 2008.
2. W. D.Callister, "Materials Science and Engineering: An Introduction", John Wiley and Sons, 5thedition,2001.
3. V.Raghvan, "Material Science Engineering", Prentice Hall of India Ltd., 1992.
4. S. H.Avner, "Introduction to Physical Metallurgy", Tata McGraw Hill, 2ndedition, 1997.
5. R. A.Higgins, "Engineering Metallurgy: Part I", ELBS, 6thedition, 1996.

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, 3rd edition, 2000.
3. T. E.Reed-Hill, R.Abbaschian, "Physical Metallurgy Principles", Thomson, 3rdedition, 2003.

Fluid Mechanics

BTMEC303	PCC 1	Fluid Mechanics	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Continuous Assessment: 20 Marks

Tutorial: 1 hr/week	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 fluid, define and calculate various properties of fluid
CO2	Calculate hydrostatic forces on the plane and curved surfaces and explain stability of floating bodies
CO3	Explain various types of flow. Calculate acceleration of fluid particles
CO4	Apply Bernoulli's equation and Navier-Stokes equation to simple problems in fluid mechanics
CO5	Explain laminar and turbulent flows on flat plates and through pipes
CO6	Explain and use dimensional analysis to simple problems in fluid mechanics
CO7	Understand boundary layer, drag and lift

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
CO2	3	3	1	1	1							1
CO3	3	3	1	1	1							1
CO4	3	3										1
CO5	3	3										1
CO6	2	3										1
CO7	2	3										1

All units carry 10 Marks each for End Semester Examination.

Course Contents:

Unit 1: Basics[08 Hours]

Definition of fluid, fluid properties such as viscosity, vapour pressure, compressibility, surface tension, capillarity, Mach number etc., pressure at a point in the static mass of fluid, variation of pressure, Pascal's law, pressure measurement by simple and differential manometers using manometric expression.

Unit 2: Fluid Statics[08 Hours]

Hydrostatic forces on the plane and curved surfaces, centre of pressure, Buoyancy, centre of buoyancy, stability of floating bodies, metacentre and metacentric height its application in shipping.

Unit 3: Fluid Kinematics[08 Hours]

Velocity of fluid particle, types of fluid flow, description of flow, continuity equation, Coordinate freeform, acceleration of fluid particle, rotational and irrotational flow, Laplace's equation in velocity potential and Poisson's equation in stream function, flownet.

Unit 4: Fluid Dynamics[08 Hours]

Momentum equation, development of Euler's equation, Introduction to Navier-Stokes equation, Integration of Euler's equation to obtain Bernoulli's equation, Bernoulli's theorem, Application of Bernoulli's theorem such as venturimeter, orificemeter, rectangular and triangular notch, pitot tube, orifices, etc.

Unit 5: Types of Flow[08 Hours]

a) **Laminar Flow:** Flow through circular pipe, between parallel plates, Power absorbed in viscous flow in bearings, loss of head due to friction in viscous flow.
b) **Turbulent Flow:** Reynolds's experiment, frictional loss in pipe flow, shear stress in turbulent flow, major and minor losses, HGL and TEL, flow through series and parallel pipes.

Unit6: Dimensional Analysis[08 Hours]

a) **Dimensional Analysis:** Dimensional homogeneity, Raleigh's method, Buckingham's theorem, Model analysis, similarity laws and dimensionless numbers.
b) Introductionto boundary layer theory and its analysis.
c) **Forces on Submerged bodies:** Drag, lift, Drag on cylinder, Development of lift in cylinder.

Texts:

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.

References:

1. V. L. Streeter, K. W. Bedfordand 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 McGraw Hill, 2nd edition, 2003.

Machine Drawing and Computer Aided Drafting

BTMEC304	PCC 2	Machine Drawing and Computer Aided Drafting	2-0-0	2 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	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	PO12
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

Course Contents:

Unit 1: Sectional Views[04 Hours]
Full section, half section, partial section, off-set section, revolved sections, removed sections, auxiliary section, guidelines for hatching, examples on all above types of sections of machine elements.

Unit 2: Study of Machine Elements[04 Hours]
Study of simple machine elements and components such as screwed fasteners, shaft couplings, pipe joints, riveted and welded joints, bearings, gears, etc.

Unit 3: Interpenetration of Surfaces (Emphasis on Applied Cases)[04 Hours]
Line or curve of intersection of two penetrating cylinders, Cone and cylinder, prism and a cylinder, cone and prism, Forged ends, etc.

Unit 4: Drawing of Assembly and Details[04 Hours]
Part drawing of standard machine components such as valves, components of various machine tools, pumps, shaft couplings, joints, pipe fittings, engine parts, etc.

Unit 5: Production Drawing and Reading Blue Prints[04 Hours]
Types of production drawings, size, shape and description; limits, fits and tolerances, surface roughness and surface roughness symbols, reading the blue prints.

Unit 6: Computer Aided Drafting[04 Hours]
Introduction to Computer Aided Design and Drafting, Advantages of CADD, study of preliminary AutoCAD commands like drawing, dimensioning, viewing commands. Drawing 3D views in AutoCAD, Introduction to AutoLISP programming.

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 AutoLISPmanuals from Autodesk Corp. U.S.A.
3. ISCode: SP46-1988, Standard Drawing Practices for Engineering Institutes.

Thermodynamics

BTMEC305	ESC 12	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	Study different laws of thermodynamics and apply these to simple thermal systems like balloon, piston-cylinder arrangement, compressor, pump, refrigerator, heat exchanger, etc. to study energy balance.
CO3	Study various types of processes like isothermal, adiabatic, etc. considering system with ideal gas and represent them on p-v and T-s planes.
CO4	Apply availability concept to non-flow and steady flow type systems.
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				1							
CO5	1	1										

All units carry 10 Marks each for End Semester Examination.

Course Contents:

Unit 1: Fundamental Concepts and Definitions [08 Hours]
Thermodynamic systems; properties, processes and cycles. Thermodynamic equilibrium, Quasi-static process, Macroscopic vs. Microscopic viewpoint, 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, point function, path function.

Unit 2: First Law of Thermodynamics[08 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[08 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.

Unit 4: Entropy[08 Hours]
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 5: Availability[07 Hours]
Available energy pertaining a cycle, Quality of energy, law of degradation of energy, maximum work in a reversible process, Dead state, Availability in steady flow and non-flow processes, Second law efficiency.

Unit 6: Ideal Gas[09 Hours]
Avogadro's law, Equation of state, ideal gas and process, relation between C_p and C_v, other equation of states.

Properties of Pure Substance: Phase change of pure substance, phase diagram of pure substance, p-v, T-s, and h-s diagrams properties of steam, property table, representation of processes of steam on p-v, T-s, and 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. VanWylen, R. E. Sonntag, "Fundamental of Thermodynamics", John Wiley and Sons, 5th edition, 1998.
2. M. J. Moran, H. N. Shaprio, "Fundamentals of Engineering Thermodynamics", John Wiley and Sons, 4th edition, 2004.

Basic Human Rights

BTHM3401	HSMC 3	Basic Human Rights	2-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 2 hrs/week	Audit Course

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	PO12
CO1						2						
CO2												
CO3												
CO4									3			
CO5								2		2		
CO6												1

Course Contents:

Unit 1: The Basic Concepts[04 Hours]
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 Program [04 Hours]
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.

Unit 3: Workers and Human Rights[04 Hours]
Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy.

Unit 4: NGOs and Human Rights in India[04 Hours]
Land, Water, Forest issues.

Unit 5: Human Rights in Indian Constitution and Law[04 Hours]
i) The constitution of India: Preamble
ii) Fundamental rights.
iii) Directive principles of state policy.
iv) Fundamental duties.
v) Some other provisions.

Unit 6: UDHR and Indian Constitution[04 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 India.

Material Science and Metallurgy Lab

BTMEL307	ESC 13	Material Science and Metallurgy Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	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	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

List of Practicals/Experiments/Assignments (any ten experiments from the list)

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

Fluid Mechanics Lab

BTMEL308	PCC 3	Fluid Mechanics Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	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	Understand laminar and Turbulent flow and determine Critical Reynolds number using Reynolds Apparatus
CO2	Verify Bernoulli's theorem
CO3	Determine pressure drop in flow though pipes and pipe fittings
CO4	Verify momentum equation using impact of jet apparatus
CO5	Determine viscosity using viscometer
CO6	Do calibration of pressure gauges, rotameter
CO7	Use manometers for pressure measurement

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	1				1	2		1
CO2	1	1	1	3	1				1	2		1
CO3	1	1	1	3	1				1	2		1
CO4	1	1	1	3	1				1	2		1
CO5	1	1	1	3	1				1	2		1
CO6	1	1	1	3	1				1	2		1
CO7	1	1	1	3	1				1	2		1

List of Practicals/Experiments/Assignments (any ten experiments from the list)

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.

Machine Drawing and Computer Aided Drafting Lab

BTMEL309	PCC 4	Machine Drawing and Computer-aided Drafting Lab	0-0-4	2 Credits

Practical Scheme:	**Examination Scheme:**
Practical: 4 hrs/batch	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	Draw Conventional representation of standard machine components, welds, materials etc.
CO2	Draw sectional view of a given machine component.
CO3	Develop Assemble view from details of given component i.e. valve, pump, machine tool part, etc.
CO4	Combine details of given machine component and draw assembled view.
CO5	Use various Auto-Cad commands to draw orthographic projection
CO6	Draw sectional view from pictorial view of given machine component using Auto-Cad

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			
CO2	2	1	1		1				1			1
CO3	3	1	1		1				2	1		2
CO4	3	1	1		1				2	1		1
CO5	2	1	1		2				2	2		1
CO6	1	1	1		1				1	1		1

List ofPracticals/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 assignment 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.

Semester IV
Manufacturing Processes-I

BTMEC401	PCC 5	Manufacturing Processes-I	2-1-0	3 Credits

Pre-Requisites: None

Teaching Scheme:	Examination Scheme:
Lecture: 2hrs/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, planing and drilling, their types and related tooling's

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	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

All units carry 10 Marks each for End Semester Examination.

Course Contents:

Unit 1: Introduction and Casting Processes[06 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; Inspection of casting; melting practice and furnaces, general design considerations for casting.

Unit 2: Rolling and Forging Processes[06 Hours]
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; Forgeability of Metals: Forging Defects; Die Design, Die Materials, and Lubrication; Forging Machines.

Unit 3: Extrusion, Drawing and Sheet Metal Forming[06 Hours]
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.
Introduction to sheet metal forming; Shearing: Shearing operations, Characteristics and Type of Shearing Dies; Sheet-metal Characteristics and Formability, Formability Tests for Sheet Metals; Bending Sheets, Plates, and Tubes; Deep Drawing: Deep Drawability, Deep-drawing Practice; Spinning; Design Considerations in Sheet-metal Forming; Equipment for Sheet-metal Forming.

Unit 4: Joining Processes[06 Hours]
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; Joint Design and Process Selection.
Introduction to solid state welding, Friction Welding, Resistance Welding: Spot, Seam, Projection Welding. Introduction to brazing and soldering; Brazing: Brazing Methods, Design for Brazing; Soldering: Types of Solders and Fluxes, Solderability, Soldering Techniques, Soldering Applications and Design Guidelines; Mechanical Fastening, Design for Mechanical Fastening.

Unit 5: Machining Processes: Turning and Hole Making[06 Hours]
Introduction; The Turning Process; Lathes and Lathe Operations: Lathe Components, Work holding Devices and Accessories, Lathe Operations, Types of Lathes, Turning-process Capabilities, Design Considerations and Guidelines for Turning Operations, Chip Collection Systems, Cutting Screw Threads; Boring and Boring Machines; Drilling, Drills, and Drilling Machines: Drills, Material-removal Rate in Drilling, Thrust Force and Torque, Drill Materials and Sizes, Drilling Practice, Drilling Machines, Design Considerations for Drilling; Reaming and Reamers; Tapping and Taps.

Unit 6: Machining Processes: Milling, Broaching and Gear Manufacturing[06 Hours]
Introduction, Milling and Milling Machines: Peripheral Milling, Face Milling, End Milling, Other Milling Operations and Milling Cutters, Tool holders, Milling Process Capabilities, Design and Operating Guidelines for Milling, Milling Machines; Planing and Shaping; Broaching and Broaching Machines; Gear Manufacturing by Machining: Form Cutting, Gear Generating, Cutting Bevel Gears, Gear-finishing Processes, Design Considerations and Economics of Gear Machining.

Text:

1. SeropeKalpakjian and Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte. India Ltd., 6thedition, 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

BTMEC402	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	Perform kinematic analysis of a given mechanism analytically using vector or complex algebra method
CO5	Perform kinematic analysis of slider crank mechanism using Klein's construction and analytical approach

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	1		2								2
CO5	1	1		3								2

Course Contents:

Unit 1: Introduction [08 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 and Hooke's joint.

Instantaneous centre of rotation, body and space centrodes and their applications, Kennedy's theorem and its applications.

Unit 2: Velocity Acceleration Analysis [08 Hours]

Velocity and acceleration analysis and its purpose, velocity and acceleration diagrams using

relative velocity method, Corioli's component of acceleration, Velocity and acceleration analysis by vector methods, coordinate system, Loop closure equation, Chase solutions, velocity and acceleration by vector and complex algebra.
Velocity and acceleration of slider crank mechanism by analytical method and Klein's construction.

Unit 3: Friction and Lubrication[08 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 4: Clutch, Brakes and Dynamometers[08 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 5: Cams and Followers[08 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 6: Balancing[08 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.

Strength of Materials

BTMEC403	PCC 7	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, etc.
CO2	Recognize the stress state (tension, compression, bending, shear, etc.) and calculate the value of stress developed in the component in axial/eccentric static and impact load cases.
CO3	Distinguish between uniaxial and multiaxial stress situation and calculate principal stresses, max. shear stress, their planes and max. normal and shear stresses on a given plane.
CO4	Analyze given beam for calculations of SF and BM
CO5	Calculate slope and deflection at a point on cantilever /simply supported beam using double integration, Macaulay's , Area-moment and superposition methods
CO6	Differentiate between beam and column and calculate critical load for a column using Euler's and Rankine's formulae

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

All units carry 10 Marks each for End Semester Examination.

Course Contents:

Unit 1: Simple Stresses and Strains[08 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.

Unit 2: Principal Stresses and Strains[08 Hours]
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, Mohr's circle for stresses and strains.
Strain energy and resilience: Load-deflection diagram, strain energy, proof resilience, stresses due to gradual, sudden and impact loadings, shear resilience, strain energy in terms of principal stresses.

Unit 3: Combined Stresses[08 Hours]
Combined axial and flexural loads, middle third rule, kernel of a section, load applied off the axes of symmetry.

Shear and Moment in Beams: Shear and moment, interpretation of vertical shear and bending moment, relations among load, shear and moment.

Unit 4: Stresses in Beams[08 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.

Unit 5: Beam Deflections[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 area-moment 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.

Unit 6: Torsion[08 Hours]

Introduction and assumptions, derivation of torsion formula, torsion of circular shafts, stresses and deformation indeterminate solid/homogeneous/composite shafts, torsional strain energy.

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.

Texts:

1. S. Ramamrutham, "Strength of Materials", DhanpatRai and Sons, New Delhi.
2. F. L. Singer, Pytle, "Strength of Materials", Harper Collins Publishers, 2002.
3. S. Timoshenko, "Strength of Materials: Part-I (Elementary Theory and Problems)", CBS Publishers, New Delhi.

References:

1. E. P.Popov, "Introduction to Mechanics of Solid", Prentice Hall, 2nd edition, 2005.
2. S. H. Crandall, N. C. Dahl, T. J. Lardner, "An introduction to the Mechanics of Solids", Tata McGraw Hill Publications, 1978.
3. S. B. Punmia, "Mechanics of Structure", Charotar Publishers, Anand.
4. B. C. Punmia, Ashok Jain, Arun Jain, "Strength of Materials", Laxmi Publications.

Numerical Methods in Mechanical Engineering

BTMEC404	BSC 8	Numerical Methods in Mechanical Engineering	2-1-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 2hrs/week Tutorial: 1 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 [06 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 errors in computer programming.

Unit2: Roots of Equations [06 Hours]
Motivation, Bracketing methods: Bisection methods, Open methods: Newton Raphson method, Engineering applications.

Unit3: Numerical Solution of Algebraic Equations [06 Hours]
Motivation, Cramer's rule, Gauss- Elimination Method, pivoting, scaling, engineering applications.

Unit4: Numerical Integration and Differentiation [06 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 [08 Hours]
Motivation, Least Square Regression: Linear Regression, Polynomial regression.
Interpolation: Newton's Divide Difference interpolation, engineering applications.
Solution to Ordinary Differentiation Equations: Motivation**,** Euler's and Modified Euler's Method, Heun's method, Runge–Kutta Method, engineering applications.

Unit6: Computer Programming [04 Hours]
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", TataMcGraw Hill Publications, 2010.
2. E.Balagurusamy, "Numerical Methods", TataMcGraw Hill Publications,1999.

References:

1. V. Rajaraman, “Fundamental of Computers”, Prentice Hall of India,NewDelhi,2003.
2. S. S. Sastri,“IntroductoryMethodsofNumericalMethods”,PrenticeHallofIndia,NewDelhi, 3rdedition,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

Product Design Engineering - I

BTID405	PCC 8	Product Design Engineering - I	1-0-2	2 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture-cum-demonstration: 1 hr/week Design Studio/Practical: 2 hrs/week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

- **Pre-requisites:** Knowledge of Basic Sciences, Mathematics and Engineering Drawing
- **Design Studio/Practical:** 2 hrs to develop design sketching and practical skills
- **Continuous Assessment:** Progress through a product design and documentation of steps in the selected product design
- **End Semester Assessment:** Product design in studio with final product specification

Course Outcomes: At the end of the course, students will be able to

1. Create simple mechanical designs
2. Create design documents for knowledge sharing
3. Manage own work to meet design requirements
4. Work effectively with colleagues

Course Contents:

Unit 1: Introduction to Engineering Product Design

Trigger for Product/Process/System, Problem solving approach for Product Design, Disassembling existing product(s) and understanding relationship of components with each other, Sketching of components, identifying materials and their processing for final product, fitting of components, understanding manufacturing as scale of the components, Reverse engineering concept, case studies of products in markets, (or in each discipline), underlying principles, Case studies of product failures, Revival of failed products, Public/Society’s perception of products, and its input into product design.

Unit 2: Ideation

Generation of ideas, Funneling of ideas, Short-listing of ideas for product(s) as an individual or group of individuals, Sketching of products, Market research for need, competitions, Scale and cost, Initial specifications of products.

Unit 3: Conceptualisation

Designing of components, Drawing of parts and synthesis of a product from its component parts, Rendering the designs for 3-D visualization, Parametric modelling of product, 3-D visualization of mechanical products, Detail engineering drawings of components.

Unit 4: Detailing

Managing assembling, product specifications – data sheet, Simple mechanical designs, Workshop safety and health issues, Create documents for the knowledge sharing.

- **Hands-on Activity Charts for Use of Digital Tools:**

		No. of hrs
Activity 1	Learn the basic vector sketching tools	2
Activity 2	General understanding of shading for adding depth to objects. Understanding of editing vectors	2
Activity 3	Begin developing a thought process for using digital sketching	3
Activity 4	Create a basic shape objects sphere, box cylinders	3
Activity 5	Create automotive wheel concepts	3
Activity 6	Understanding navigation and data panel interface	2
Activity 7	Solid and surface modelling, rendering 3-D models	4
Activity 8	Product market and product specification sheet	3
Activity 9	Documentation for the product	2

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.

Physics of Engineering Materials

BTBSE406A	OEC 1	Physics of Engineering Materials	3-0-0	3 Credits

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 different types of structures of solid, defects in solids and analysis of crystal structure by X-ray diffraction technique.
CO2	Understand the origin and types of magnetism, significance of hysteresis loo in different magnetic materials and their uses in modern technology
CO3	Understand the band structure of solids and conductivity, categorization of solids on the basis of band structure, significance of Fermi-Dirac probability functions
CO4	Understand the principles of superconductivity, their uses in modern technology
CO5	Understand the position of Fermi level in intrinsic and extrinsic semiconductors, Semiconductor conductivity
CO6	Understand the electric field in dielectric
CO7	Understand basics of Nano materials, synthesis methods and characterization 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	2		3	3		1					3
CO2	3	3			1		2		2		1	2
CO3	2	2			1		1					3
CO4	3	3			1		3		1		1	2
CO5	3	2		2	1		1					1
CO6	3	2			2		2		3		1	2
CO7	2	3	1		3	1	3	1				1

Course Contents:

Unit 1: Crystallography [06 Hours]

Crystal directions and planes, Diatomic Crystal (CsCl, NaCl, Diamond, $BaTiO_3$) Crystal imperfection, Point defects, Line defects, Surface and Volume defects, Structure properties relationship, structure determination by X-ray diffraction.

Unit 2: Magnetic Materials [06 Hours]

Origin of magnetization using atomic theory, classification of magnetic materials and properties, Langevin's theory of Dia, Para and ferromagnetism, Soft and Hard magnetic materials and their uses, Domain theory of ferromagnetism, Hysteresis loss, Antiferromagnetic and Ferrimagnetic materials, Ferrites and Garnets, magnetic bubbles, magnetic recording.

Unit 3: Conducting and Superconducting Materials[06 Hours]
Band theory of solids, Classical free electron theory of metals, Quantum free electron theory, Density of energy states and carrier concentration, Fermi energy, Temperature and Fermi energy distribution, Superconductivity, Factor affecting Superconductivity, Meissner effect, Type-I and Type-II superconductors, BCS theory, Josephson effect, High temperature superconductors, Application of superconductors (Cryotron, magnetic levitation)

Unit 4: Semiconducting Materials [06 Hours]
Band structure of semiconductor, Charge carrier concentration, Fermi level and temperature, Electrical conductivity, Hall effect in semiconductors, P-N junction diode, Preparation of single crystals, LED, Photovoltaic Cell

Unit 5: Dielectric Materials [06 Hours]
Dielectric constant and polarizability, types of polarization, temperature and frequency dependences of Dielectric parameter, internal fields in solids, Clausius-Mosotti equation, dielectric loss, dielectric breakdown, ferroelectric, pyroelectric and piezoelectric materials, applications of dielectric materials

Unit 6: Nano Materials [06 Hours]
Nano materials: Introduction and properties, synthesis of nano materials, Carbon Nano Tubes, Characterization techniques of nano materials- SEM, TEM, EDAX, FMR, XRD. Applications of Nano materials.

Texts:
1. Kittle, "Introduction to Solid state Physics", John Wiley and Sons, 8th edition, 2004.
2. M. Srivastava, C. Srinivasan, "Science of Engineering Materials and Carbon Nanotubes", New Age International Publication, 3rd edition, 2010.
3. A. J. Dekker, "Solid State Physics", Pan Macmillan and Co. Ltd., London, 01stJuly, 1969.

References:
1. V. Raghavan, "Material Science and Engineering", Prentice Hall Publication, 5th edition, 2007.
2. A. J. Dekker, "Electrical Engineering Materials", Prentice Hall Publication, 1st edition, 1959.

Advanced Engineering Chemistry

BTBSE3405A	OEC 1	Advanced Engineering Chemistry	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	Classify and explain various types of Corrosion and should apply methods to minimize the rate of corrosion.
CO2	Understand and apply the concepts of Photochemical and Thermal reactions.
CO3	Understand the basic concepts of Polymers, Polymerization and Moulding techniques; Determine molecular weight of High-Polymers.
CO4	Understand and apply the basic techniques in Chemistry and capable to explain the concepts of Solvent Extraction.
CO5	Understand and apply various types of Spectroscopic, Chromatographic techniques and also able to explain the concepts of Thermo-Gravimetric Analysis (TGA).

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
CO2	2	2	1				2		1		1	1
CO3	2	2	2		3	1	1		1		1	1
CO4	3	2	1		3				2		1	1
CO5	3	2	1		3				2		1	1

Course Contents:

Unit 1: Corrosion and Its Control [08 Hours]

Introduction, Fundamental reason, Electrochemical Corrosion, Direct Chemical Corrosion, Factors affecting the rate of corrosion, types of corrosion-Galvanic, Pitting Corrosion, Stress corrosion, methods to minimize the corrosion- Proper design, Cathodic and Anodic protection.

Unit 2: Photochemical and Thermal Reactions [06 Hours]

Introduction, Laws of Photochemistry, Measurement of absorbed intensity, Quantum yield or efficiency, Jablonski Diagram, Photosynthesis reaction of Hydrogen Bromide, Brief Discussion on Thermal Reactions – Cope Rearrangement.

Unit 3: Polymers [06 Hours]

Introduction, Nomenclature of Polymers, Type of Polymerization, Molecular Weight Determination by Osmotic Pressure and Viscosity Method, Plastic and its Classification, Constituents of Plastic, Moulding of Plastic by Injection Method.

Unit 4: Reaction Mechanism and Reaction Intermediates [06 Hours]

Introduction of Reaction Mechanism, Brief introduction of Reactivity of Substrate (Inductive Effect, Mesomeric Effect, Electromeric Effect, Hyperconjugative Effect), Bond Fission: Homolytic and Heterolytic Bond Fission, Reaction Intermediates: Carbocation (Structure, Stability and Applications).

Rearrangement Reactions

Intramolecular Rearrangement: Isomerisation, Beckmann Rearrangement, Benzidine

Rearrangement.
Intermolecular Rearrangement: Orton Rearrangement, Diazoamino Rearrangenment.

Unit 5: Spectroscopy [08 Hours]
Brief introduction to spectroscopy, UV–Visible Spectroscopy: Laws of absorption, instrumentation and application. IR spectroscopy: introduction, theory, instrumentation and application. Brief discussion on NMR Spectroscopy, AAS (Atomic Absorption Spectroscopy).

Unit 6: Instrumental Methods of Analysis [06 Hours]
Introduction to Chromatography, Types of Chromatography (Adsorption and partition chromatography), Thin Layer Chromatography, Gas Chromatography – introduction, theory, instrumentation. Brief discussion of Thermo gravimetric analysis (TGA).

Texts:

1. Bhal and Bhal, "Advance Organic Chemistry", S. Chand and Company, New Delhi, 1995.
2. P. C. Jain, Monica Jain, "Engineering Chemistry", Dhanpat Rai and Sons, Delhi, 1992.
3. Bhal, Tuli, "Text book of Physical Chemistry", S. Chand and Company, New Delhi, 1995.
4. Chatwal Anand, "Instrumental Methods of analysis", Himalaya Publication.
5. Text Book of Organic Chemistry by Rakesh K. Parashar, V.K. Ahluwalia.

References:

1. L. Finar, "Organic Chemistry", Vol. I and II, Longman Gr. Ltd and English Language Book Society, London.
2. G. M. Barrow, "Physical Chemistry", Tata McGraw Hill Publication, New Delhi.
3. Shikha Agarwal, "Engineering Chemistry-Fundamentals and applications", Cambridge Publishers, 2015.
4. O. G. Palanna, "Engineering Chemistry", Tata McGraw Hill Publication, New Delhi.
5. WILEY, Engineering Chemistry, Wiley India, New Delhi 2014.
6. Willard, "Instrumental Methods of analysis", Merrit, Tata McGraw Hill Publications.
7. Glasstone, "Physical Chemistry", D. Van Nostrand Company Inc., 2nd edition, 1946.
8. Peter Atkins, "Physical Chemistry", W. H. Freeman and Co., 9th edition, 2009.

Interpersonal Communication Skill & Self Development

BTHM3402	OEC 1	Interpersonal Communication Skill& Self 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	Acquire interpersonal communication skills
CO2	Develop the ability to work independently.
CO3	Develop the qualities like self-discipline, self-criticism and self-management.
CO4	Have the qualities of time management and discipline.

CO5	Present themselves as an inspiration for others
CO6	Develop themselves as good team leaders

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										2		
CO3												2
CO4									1			
CO5										2		
CO6											3	

Course Contents:

Unit 1:Development of Proficiency in English[06 Hours]
Speaking skills, Feedback & questioning technique, Objectivity in argument (Both one on one and in groups). 5 Wsand 1 H and 7 Cs for effective communication.
Imbibing etiquettes and manners. Study of different pictorial expressions of non-verbal communication and their analysis

Unit 2: Self-Management[06 Hours]
Self-Management, 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 and Team Dynamics

Unit 3: Time Management Techniques[06 Hours]
Practice by game playing and other learning strategies to achieve the set targets Time Management Concept; Attendance, Discipline and Punctuality; Acting in time, Quality /Productive time.

Unit 4: Motivation/Inspiration[06 Hours]
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

Unit 5: Interpersonal Skills Development[06 Hours]
Positive Relationship, Positive Attitudes, Empathise: comprehending others' opinions, points of views, and face them with understanding, Mutuality, Trust, Emotional Bonding, Handling Situations (Interview), Importance of interpersonal skills.

Unit 6: Effective Computing Skills[06 Hours]
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.

References:

1. Mitra, Barun, “Personality Development and Soft Skills”, Oxford University Press, 2016.
2. Ramesh, Gopalswamy, “The Ace of Soft Skills: Attitude, Communication and Etiquette for Success”, Pearson Education, 2013.
3. Stephen R. Covey, “Seven Habits of Highly Effective People: Powerful Lessons in Personal Change”, Free Press Publisher, 1989.
4. Rosenberg Marshall B., “Nonviolent Communication: A Language of Life” 3rd edition, Puddle dancer Press, 1st September, 2003.

Manufacturing Processes Lab-I

BTMEL407	PCC 9	Manufacturing Processes Lab - I	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	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	Perform plain turning, step turning, knurling, eccentric turning, chamfering and facing operations on lathe.
CO2	Prepare setup and fabricate composite job using milling, shaping and drilling machine.
CO3	Making spur gears on a milling machine.
CO4	Prepare sand casting setup using split pattern for simple component.
CO5	Perform joining of two plate using TIG/MIG welding.
CO6	Demonstrate cutting of a sheet metal using flame cutting.

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	1		1		1	2		1
CO2	1	1		3	1		1		1	2		1
CO3	1	1		3	1		1		1	2		1
CO4	2	1		3	1		1		1	2		1
CO5	2	1		3	1		1		1	2		1
CO6	1	1		3	1		1		1	1		1

List of Practicals/ Experiments/ Assignments

Each student shall be required to submit any six jobs from the following:

1. Making a job with a process plan involving plain, step and taper turning as well thread cutting as operations on a Centre lathe.
2. Preparation of process planning sheet for a job including operations such as milling, drilling and shaping.
3. Making a spur gear using universal dividing head on milling machine.
4. Making a simple component by sand casting using a split pattern.
5. Cutting of a steel plate using oxyacetylene flame cutting /plasma cutting.

6. Making a butt joint on two stainless steel plates using TIG/MIG Welding.
7. An experiment on shearing operation.
8. An experiment on blanking operation.
9. An experiment on drawing operation

Theory of Machines Lab-I

BTMEL408	PCC 10	Theory of Machines Lab- I	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	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	Perform graphically kinematic analysis of any planar mechanism using ICR and RV methods.
CO2	Perform graphically kinematic analysis of slider crank mechanism using Klein's construction.
CO3	Demonstrate use of graphical differentiation method for kinematic analysis of slider crank mechanism or any other planar mechanism with a slider.
CO4	Sketch polar diagram for a Hooke's joint.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

List of Practicals/Experiments/Assignments

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.Atleastone problem containing Corioli's component of acceleration.
2. **Experiments (any 2)**
   a) Experimental determination of velocity and acceleration of Hooke'sjoint.
   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.

Strength of Materials Lab

BTMEL409	PCC 11	Strength of Materials Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	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	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

List of Practicals/Experiments/Assignments (any ten experiments from the list)

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.

Numerical Methods Lab

BTMEL410	BSC 9	Numerical Methods Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	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	
CO2	
CO3	
CO4	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												

Student should develop the computer programme along with the results on following topics. (Any six)

1. Programme to demonstrate the effect of round off error and significant number
2. Programme to find real single root of an Equation by Bisection Method
3. Programme to find real single root of an Equation by Newton- Raphson Method
4. Programme to solve linear simultaneous algebraic equations
5. Programme to solve the integration using Multi Trapezoidal Rule
6. Programme to solve the integration using Simpson's 1/3 rule
7. Programme to solve simple practical problem using finite difference method
8. Programme to solve ODE

It is expected that student should take up the simple real life problem for writing the programme.

Student should maintain a file containing all the programmes with results in printed form and also submit a CD containing all the programmes in soft form.

Semester - V

Heat Transfer

BTMEC501	PCC 12	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, mass transfer and 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:

Unit 1: Introduction

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.

Unit 2: Overall Heat Transfer and Extended Surfaces

Thermal contact resistance, Critical radius of insulation, Electrical analogy, Overall heat

transfer coefficient, Heat source systems, Variable thermal conductivity, Extended surfaces.
Unsteady State Conduction: Lumped system analysis, Biot and Fourier number, Heisler chart **(No numerical examples)**.

Unit 3: Principles of Convection
Continuity, Momentum and Energy equations, Hydrodynamic and Thermal boundary layer for a flat plate and pipe flow. Dimensionless groups for convection, relation between fluid friction and heat transfer, turbulent boundary layer heat transfer.

Unit 4: Forced Convection
Empirical relations for pipe and tube flow, flow across cylinders, spheres, tube banks.
Free Convection: Free convection from a vertical, inclined and horizontal surface, cylinder and sphere.

Unit 5: Boiling and Condensation
Film-wise and drop-wise condensation, pool boiling regimes, forced convection boiling (Internal flows).
Introduction to Mass Transfer: Introduction, Mechanism of diffusion, Fick's law of mass transfer, mass diffusion coefficient.
Heat Exchangers: Types of heat exchangers, 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.

Unit 6: Radiation Heat Transfer
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, diffuse surfaces, Radiation shields and the radiation effect.

Texts:

1. F. P. Incoropera, D. P. Dewitt, "Fundamentals of Heat and Mass Transfer", John-Wiley, 5^{th} edition, 1990.
2. S. P. Sukhatme, "A Textbook on Heat Transfer", Tata McGraw Hill Publications, 3^{rd} edition.

References:

1. Y. A. Cengel, "Heat Transfer – A Practical Approach", Tata McGraw Hill Publications ,3^{rd} edition, 2006.
2. J. P. Holman, "Heat Transfer", Tata McGraw Hill Publications, 9^{th} edition, 2004.

Applied Thermodynamics - I

BTMEC502	PCC 13	Applied Thermodynamics - I	2-1-0	3 Credits

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: 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	Study and Analyze gas power cycles and vapour power cycles like Otto, Diesel, dual, Joule and Rankine cycles and derive expressions for the performance parameters like thermal efficiency, P_m
CO3	Classify various types of boiler, nozzle, steam turbine and condenser used in steam power plant.
CO4	Classify various types of IC engines. Sketch the cut section of typical diesel engine and label its components. Define the terms like TDC, BDC, r_c, etc.
CO5	Draw P-v diagram for single-stage reciprocating air compressor, with and without clearance volume, and evaluate its performance. Differentiate between reciprocating and rotary 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		1							
CO5		2										

Course Contents:

Unit 1: Fuels and Combustion

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

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

Carnot cycle, ideal Rankine cycle, Reheat and Regeneration, Stirling cycle, Joule-Brayton cycle. Calculation of thermal efficiency, specific steam/fuel consumption, work ratio for above cycles.

Unit 4: 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 5: Steam Turbines

Advantages and classification of steam turbines, compounding of steam turbines, velocity diagrams, work one done and efficiencies, losses in turbines.

Condensers and Cooling Towers: Elements of steam condensing plants, advantages of using condensers, types of condensers, thermodynamic analysis of condensers, efficiencies, cooling towers.

Unit 6: Reciprocating Air Compressor

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 vane 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, 2^{nd} edition.
4. Sharma and Mathur, "Internal Combustion Engines", Tata McGraw Hill Publications.

Machine Design - I

BTMEC503	PCC 14	Machine Design - I	2-1-0	3 Credits

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: 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:

Unit 1: Mechanical Engineering Design Process

Traditional design methods, general industrial design procedure, design considerations, phases in design, creativity in design, use of standardization, preferred series, introduction to ISO9000, use of design data book, aesthetic and ergonomic considerations in design.

Unit 2: Design of Machine Elements against Static Loading

Theories of Failure (Yield and Fracture Criteria): Maximum normal stress theory, Maximum shear stress theory, Maximum distortion energy theory, comparison of various theories of failure, Direct loading and combined loading, Joints subjected to static loading e.g. cotter and knuckle joint, turnbuckle, etc. introduction to fluctuating loads.

Unit 3: Design against Fluctuating Loads

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.

Unit 4: Design of Shafts Keys and Couplings

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 fitment in keyways, Design of various types of keys.

Couplings: Design consideration, design of rigid, muff and flange type couplings, design of flexible couplings.

Unit 5: Design of Threaded Joints

Stresses in screw fasteners, bolted joints under tension, torque requirement for bolt tightening, preloading of bolt under static loading, eccentrically loaded bolted joints.

Power Screws: Forms of threads used for power screw and their applications, torque analysis for square and trapezoidal threads, efficiency of screw, collar friction, overall efficiency, self-locking in power screws, stresses in the power screw, design of screw and nut, differential and compound screw, re-circulating ball screw.

Welded Joints: Type of welded joints, stresses in butt and fillet welds, strength of welded joints subjected to bending moments.

Unit 6: Mechanical Springs

Stress deflection equation for helical spring, Wahl's factor, style of ends, design of helical compression, tension and torsional spring under static loads, construction and design consideration in leaf springs, nipping, strain energy in helical spring, shot peening.

Texts:

1. V. B. Bhandari, "Design of Machine Elements", Tata McGraw Hill Publications, New Delhi, 2008.
2. R. L. Nortan, "Machine Design: An Integrated Approach", Pearson Education Singapore, 2001.

References:

1. R. C. Juvinall, K. M. Marshek, "Fundamental of machine component design", John Wiley & Sons Inc., New York, 3rd edition, 2002.
2. B. J. Hamrock, B. Jacobson and Schmid Sr., "Fundamentals of Machine Elements", International Edition, New York, 2nd edition, 1999.
3. A. S. Hall, A. R. Holowenko, H. G .Langhlin, "Theory and Problems of Machine Design", Schaum's Outline Series, Tata McGraw Hill book Company, New York, 1982.
4. J. E. Shigley and C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Publications, 7th edition, 2004.
5. M. F. Spotts, "Design of Machine Elements", Prentice Hall of India, New Delhi.

Theory of Machines - II

BTMEC504	PCC 15	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 and rope drive for a particular application
CO2	Evaluate gear tooth geometry and select appropriate gears, gear trains
CO3	Define governor and select/suggest an appropriate governor
CO4	Characterize flywheels as per engine requirement
CO5	Understand gyroscopic effects in ships, aeroplanes, and road vehicles.
CO6	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										2
CO4		2		1								

CO5	2	3		2								3
CO6	2	3		3								3

Course Contents:

Unit 1: Belt and Rope Drives
Flat belts, Effect of slip, Centrifugal tension, Creep, Crowing of pulley, Initial tension in belts. V- Belts, Virtual coefficient of friction, Effect of V-groove on torque transmitted. Rope drives, Rope constructions, Advantages of rope drives.

Unit 2: Toothed Gears
Classification of gears, Terminology of spur gears, Conjugate action, Involute and cycloidal profiles, Path of contact, Contact ratio, Interference, Undercutting, Rack shift, Effect of center distance variations, Friction between gear teeth, Internal gears.
Helical gear terminology, Normal and transverse module, Virtual number of teeth, Torque transmitted by helical gears, Spiral gears, Efficiency of spiral gears, Worm gears, Bevel gear terminology, Tooth forces and geometric relationship, Torque capacities.

Unit 3: Gear Trains
Velocity ratios, Types of gear trains, Tooth load, Torque transmitted and holding torque.

Unit 4: Governor and Flywheel
Governors: Function of governor, Inertia and centrifugal type of governors, Controlling force analysis, Governor Effort and governor power, Sensitivity, stability, Isochronisms and Hunting, Friction insensitiveness.
Flywheel: Turning moment diagram, Fluctuation of energy and speed, Determination of flywheel size for different types of prime movers and machines.

Unit 5: Gyroscope
Gyroscope: Principles of gyroscopic action, Precession and gyroscopic acceleration, gyroscopic couple, Effect of the gyroscopic couple on ships, aeroplanes and vehicles, inclined rotating discs, gyroscopic stabilization.

Unit 6: Vibration
Basic concepts and definitions; vibration measuring parameters - displacement, velocity, and acceleration.
Mechanical Vibration: Single degree of freedom system, SHM, Undamped free vibrations, damped free vibrations, Types of damping.
Forced Vibration: Effect of excitation, Excitation due to reciprocating and rotating unbalance, Vibration isolation and transmissibility.
Critical Speeds: Whirling of vertical and horizontal shaft carrying single rotor with damped and un-damped system, Whirling speed of multi rotor shafts.
Torsional Vibrations: Single degree of freedom system Forced an free damped and undampedvibratins, Two rotor and three rotor system, Geared rotor system , Natural frequency , Modes of vibrations, Torsional dampers, Introduction to Holzer's method for multi 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.

Metrology and Quality Control

BTMEC505	PCC 16	Metrology and Quality Control	2-1-0	3 Credits

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: 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

Measurement Standard, Principles of Engineering Metrology, Line end, wavelength, Traceability of Standards. Types and Sources of error, Alignment, Temperature, Plastic deformation, 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
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
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
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
Quality Function Deployment, 5S, Kaizan, Kanban, JIT, Poka yoke, TPM, FMECA, FTA, Zero defects.

Unit 6: Statistical Quality Control
Statistical Quality Control: statistical concept, Frequency diagram, Concept of Variance analysis, Control chart for variable & attribute, Process Capability.
Acceptance Sampling: Sampling Inspection, OC curve and its characteristics, sampling methods.
Introduction to ISO 9000: Definition and aims of standardizations, Techniques of standardization, Codification system, Varity control and Value Engineering.

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. Amitava Mitra, "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.
11. J. M. Juran, "Quality Planning and Analysis", Tata McGraw Hill Publications.

Product Design Engineering - II

BTID506	PCC 17	Product Design Engineering - II	1-0-2	2 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture-cum-demonstration: 1 hr/week Design Studio/Practical: 2 hrs/week	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

Pre-requisites:
Product Design Engineering: Part-I, Basic Knowledge of electronics, electrical, computer and Information Technology

- Design Studio/Practical: 2 hrs to develop design sketching and practical skills
- Continuous Assessment: Progress through a product design and documentation of steps in the selected product design
- End Semester Assessment: Product Design in Studio with final product specifications

Course Outcomes: At the end of the course, students will be able to

1. Create prototypes
2. Test the prototypes
3. Understand the product life cycle management

Unit 1: Testing and Evaluation

Prototyping, Design Automation, Product architecture, Prototype testing and evaluation, Working in multidisciplinary teams, Feedback to design processes, Process safety and materials, Health and hazard of process operations.

Unit 2: Embedded Engineering- User Interface

Firmware and Hardware Design, UI programming, Algorithm and Logic Development, Schematic and PCB layout, Testing and Debugging.

Unit 3: Manufacturing

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 4: Environmental Concerns

Product life-cycle management, Disposal of product and waste.

Hands-on Activity Charts for Use of Digital Tools

		Hrs.
Activity 1	Prototyping/Assembly	4
Activity 2	Testing and evaluation	3
Activity 3	UI Programming	3
Activity 4	PCB Layout, Testing and debugging	3
Activity 5	CNC Programming	3
Activity 6	CNC Programming with CAM software	3
Activity 7	Product market and Product Specification Sheet	3
Activity 8	Documentation for the product	2

References:

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-HILL Book Company.
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 Publication.

Automobile Engineering

BTMEC506A	OEC 2	Automobile Engineering	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

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.
CO5	Analyze the environmental implications of automobile emissions. And suggest suitable regulatory modifications.
CO6	Evaluate future developments in the automobile technology.

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							
CO5		2			1	1	2					
CO6	1		2			2						

Course Contents:

Unit 1: 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.

Unit 2: 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.

Unit 3: 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.

Unit 4: 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.

Unit 5: 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.

Unit 6: Vehicle Testing and Maintenance
Need of vehicle testing, Vehicle tests 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.

Nanotechnology

BTMEC506B	OEC 2	Nanotechnology	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

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

Types of Nanotechnology and Nano machines: the Hybrid nanomaterial. Multiscale hierarchical structures built out of Nano sized building blocks (nano to macro). Nanomaterials 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

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

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

Quantum dots, Nano wires, Nano tubes, 2D and 3D films, Nano and mesopores, micelles, bilayer, vesicles, bionano machines, biological membranes.

Unit 5: Influence of Nano Structuring

Influence of Nano structuring on mechanical, optical, electronic, magnetic and chemical properties-gram size effects on strength of metals- optical properties of quantum dots.

Unit 6: Nano Behaviour

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

BTMEC506C	OEC 2	Energy Conservation and Management	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

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	Analyse 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:

Unit 1: Introduction
General energy problem, Energy use patterns and scope of conservation. Energy Management Principles: Need, Organizing, Initiating and managing an energy management program.

Unit 2: Energy Auditing
Elements and concepts, Types of energy audits, Instruments used in energy auditing.
Economic Analysis: Cash flows, Time value of money, Formulae relating present and future cash flows-single amount, uniform series.

Unit 3: Financial Appraisal Methods
Payback period, Net present value, Benefit-cost ratio, Internal-rate of return, Life cycle costs/benefits. Thermodynamics of energy conservation, Energy conservation in Boilers and furnaces, Energy conservation in Steam and condensate system.

Unit 4: Cogeneration
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.

Unit 5: 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), and Heat treatment by induction heating in the electric arc furnace industry.

Unit 6: Energy Conservation in Electric Utility and Industry
Energy costs and two part tariff, Energy conservation in utility by improving load factor, Load curve analysis, Energy efficient motors, Energy conservation in illumination systems,

Importance of Power factor in energy conservation, Power factor improvement methods, Energy conservation 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 McGraw Hill Publications.
3. S. P. Sukhatme, "Solar Energy", Tata McGraw Hill Publications.

Heat Transfer Lab

BTMEL507	PCC 18	Heat Transfer Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the various heat transfer mode of heat transfer and its application and verify
CO2	Learn the experimental methodology
CO3	Describe the concept the terms like least count, calibration of the instruments

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		3	2							
CO2	3	3		3	2		2					
CO3	3	3		3	2		2					

List of Practicals/Experiments/Assignments

Any eight experiments from the list:

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 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.

Applied Thermodynamics Lab

BTMEL508	PCC 19	Applied Thermodynamics Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: Thermodynamics, Applied Thermodynamics - I

Course Outcomes: At the end of the course, students will be able to:

CO1	Conduct test on Bomb calorimeter, nozzle, steam turbine, condenser, compressor etc. to study their performance.
CO2	Draw performance curves of these machines.
CO3	Analyze the results obtained from the tests.
CO4	Draw conclusions based on the results of the experiments
CO5	Based on your visit to Industry, sketch its layout and write specifications.

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								
CO2	2	1		1								
CO3	1	2	1	2	1	1						
CO4				2								
CO5		1				1				2		2

List of Practicals/Experiments/Assignments

Experiment Number 10 and any seven experiments from 1-9 experiments from the list:

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 **(Compulsory).**

Machine Design Practice - I

BTMEL509	PCC 20	Machine Design Practice - I	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Apply design process to an open ended problem
CO2	Determine suitable material and size for structural component of machine/system
CO3	Apply iterative technique in design including making estimate of unknown values for first computation and checking or revisiting and re-computing
CO4	Choose logically and defend selection of design factors
CO5	Design of components for given part/system i.e. shaft, keys, coupling, links, screws, springs etc.
CO6	Work effectively as a part of design group/team
CO7	Have good communication skill, orally, graphically as well as in writing

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	2	2			2	1				
CO2	1	3	2	1			1	1				1
CO3	3	2	2	1			1	1				1
CO4	2	2	2	2			1	1				1
CO5	3	3	2	1			2	1				1
CO6						1	1	1	2	2		2
CO7								1	1	2	2	3

List of Practicals/Experiments/Assignments

1. The term work shall consist of two design projects based on the syllabus of Machine Design I. Each design project shall consist of two 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, wherever necessary, so as to make it working drawing
2. A design report giving all necessary calculations for the design of components and assembly should be submitted in a separate file.
3. Two assignments based on topics of syllabus of Machine Design I.

Theory of Machines Lab - II

BTMEL510	PCC 21	Theory of Machines Lab - II	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Explain various types of gear boxes, gear trains, belt and rope drives
CO2	Interpreting physical principles and phenomenon of governor, gyroscopic, flywheel
CO3	Measure vibration parameters in single degree of freedom systems
CO4	Evaluating natural frequency of 1 dof

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	2		2					
CO2	2	2	1	2	2							3
CO3	3	3		3	3							3
CO4	2	3		3	3							3

List of Practicals/Experiments/Assignments

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 behaviour.

Field Training/Internship/Industrial Training - II

BTMEF511	Project 2	Field Training/Internship/Industrial Training - II	---	1 Credit

Examination Scheme: End Semester Exam: 50 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	To make the students aware of industrial culture and organizational setup
CO2	To create awareness about technical report writing among the student.

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			2		1			3	3
CO2		1	1			2		1			3	2

Students will have to undergo 4 weeks training programme in the Industry during the summer vacation after IVth semester examination. It is expected that students should understand the organizational structure, various sections and their functions, products/services, testing facilities, safety and environmental protection measures etc.

Also, students should take up a small case study and propose the possible solution(s).

They will have to submit a detailed report about the training programme to the faculty coordinator soon after joining in final year B.Tech. Programme. They will have to give a power point presentation in front of the group of examiners.

Semester - VI

Manufacturing Processes - II

BTMEC601	PCC 22	Manufacturing Processes - II	2-1-0	3 Credits

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: 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	Design jigs and fixtures for 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	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
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; Design Considerations for Grinding; Finishing Operations

Unit 2: Mechanics of Metal Cutting
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, friction in metal cutting

Unit 3: Thermal aspects, Tool wear, and Machinability

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; the work material and its machinability
Cutting fluids: Action of coolants and application of cutting fluids.

Unit 4: Processing of Powder Metals
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; Design Considerations.

Unit 5: Processing of Ceramics and Glasses
Introduction; Shaping Ceramics: Casting, Plastic Forming, Pressing, Drying and Firing, Finishing Operations; Forming and Shaping of Glass: Flat-sheet and Plate Glass, Tubing and Rods, Discrete Glass Products, Glass Fibers; Techniques for Strengthening and Annealing Glass: Finishing Operations; Design Considerations for Ceramics and Glasses

Unit 6: Processing of Plastics
Introduction; Extrusion: Miscellaneous Extrusion Processes, Production of Polymer Reinforcing Fibers; Injection Moulding: 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., 6th edition, 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

BTMEC602	PCC 23	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, belts and chain
CO5	Design of elements like gears, belts and chain for given power rating
CO6	Design thickness of pressure vessel using thick and thin criteria

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	3	2	2	1		1		1		1		1

Course Contents:

Unit 1: Rolling Contact Bearings
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 survival other than 90% Lubrication and mountings of rolling contact bearings.
Sliding Contact Bearings: Methods of lubrication, Viscosity and its measurement, Effect of temperature, viscous flow through rectangular slot, Hydrostatic step bearing, Load capacity and energy losses, Reynolds equation, Raimondi and Boyd method, temperature rise, Constructional details of bearing, Bearing material, Lubrication oils, Additives and greases, Sintered metal bearings, Comparison of rolling and sliding contact bearings.

Unit 2: Spur Gear
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, Beam strength equation, Effective load on gear tooth, Estimation of module based on beam 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.

Unit 3: Bevel Gears
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

Unit 4: Belt and Chain Drives
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, power rating of roller chain, sprocket wheels, and Silent chains.
Flywheel: Introduction, types of flywheel, stresses in disc and armed flywheel.

Unit 5: Brakes and Clutches
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.

Unit 6: Pressure Vessel
Thin cylinders, thick cylinders, principal stresses, Lame's equation, Clavirino and Birnie's equation, cylinder with external pressure, autofrettage, compounding of cylinders, gasketed joint, unfired pressure vessel, thickness of cylindrical and spherical pressure shells, end closure, opening in pressure vessel, area compensation method

Texts:
1. V. B. Bhandari, "Design of machine Elements", Tata McGraw Hill Publications, New Delhi, 1998
2. R. L. Nortan, "Machine Design: An Integrated Approach", Pearson Education.

References:
1. J. E. Shigley, C. Mischke, "Mechanical Engineering Design", Tata McGraw Hill Inc, New York, 6th edition, 2003.
2. R. C. Juvinall, K. M. Marshek, "Fundamentals of Machine Component Design", John Wiley & Sons, Inc, New York, 2002.

Applied Thermodynamics – II

BTMEC603	PCC 24	Applied Thermodynamics – II	2-1-0	3 Credits

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: Thermodynamics, Applied Thermodynamics - I

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Unit 1: Fundamentals of IC Engines
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.
Combustion: Introduction, important qualities and ratings of SI Engines fuels; qualities and ratings of CI Engine fuels.
Combustion in S.I. Engines, Combustion in C.I. Engines, types of SI and CI Engine combustion chambers.

Unit 2:
Various Engine Systems
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.
Alternate fuels for SI and CI engines: Alcohols, Biodiesels, vegetable oil extraction, Trans-esterification process, properties of alternative fuels and fuel blends.

Unit 3: Refrigeration
Fundamental of refrigeration, Unit, Applications, Methods of cooling, Refrigeration systems, Thermodynamics of Refrigeration, Air refrigeration system
Vapour Compression System
Theoretical and actual cycle, use for P-h and T-s charts for problem solving, various effects on system performance. Refrigerants
Vapour Absorption System: Introduction, comparison with vapour compression system Aqua-ammonia system, lithium bromide-water system.

Unit 4: Air Conditioning

Properties of moist air, psychometric chart, Sensible and latent heat loads SHF, GSHF, RSHF, bypass factor, air conditioning processes. Refrigeration and air conditioning controls.

Unit 5: Source of Energy for Power Plant

Fossil fuels, petroleum products, Hydel, Nuclear, Wind, Tidal and Geo-thermal energy etc.

Cycle for Steam and Gas Turbine Power Plant: Rankine cycle, Reheat cycle, Regenerative cycle, Reheat-regenerative cycle, Binary cycle, topping cycle, Cogeneration, Regeneration, and Intercooling.

Unit 5: Types of Power Plant

Thermal Power Plant: Introduction, general layout of modern thermal power plant, working, site selection and material requirements

Diesel Power Plant: Introduction, field of use, plant layout, comparison of diesel power plant with other power plants.

Gas Turbine power plant: Introduction, classification and comparison with other types, types GTPP, advantages and disadvantages over other power plants

Hydro-electric Power Plant: Introduction, general layout of hydro-electric power plant, Site selection, Classification, Advantages of hydro-electric power plant

Nuclear Power Plant: Introduction, nuclear reactions, nuclear fuels, site selection, components of reactors, types of reactors, material requirement, effect of nuclear radiation, disposal of nuclear waste, safety requirement of nuclear power plant.

Texts:

1. V. Ganeshan, "Internal Combustion Engines", Tata McGraw Hill Publications, New Delhi, 3rd edition.
2. C. P. Arora, "Refrigeration and Air Conditioning", Tata McGraw Hill Publications, New Delhi, 2nd edition, 2000.
3. W. F. Stoeker, J. P. Jones, "Principles of Refrigeration and Air Conditioning", Tata McGraw Hill Publications, New York, 2nd edition, 1982.
4. P. K. Nag, "Power Plant Engineering", Tata McGraw Publishing Hill Co.
5. El Wakil, "Power Plant Technology", Tata McGraw Hill Publishing Co.

References:

1. J. B. Heywood, "Internal Combustion Engine Fundamentals", Tata McGraw Hill Publications, New York, International Edition, 1988.
2. ASHRAE Handbook, "Fundamentals and Equipment", 1993.
3. ASHRAE Handbook – Applications, 1961.
4. ISHRAE Handbook
5. Prof. Ram Gopal, NPTL Lectures, www.nptel.com, IIT Kharagpur.
6. Carrier Handbook
7. R.C. Jordan, G. B. Priester, "Refrigeration and Air Conditioning", Prentice Hall of India Ltd., New Delhi, 1969.
8. J. L. Threlkeld, "Thermal Environmental Engineering", Prentice Hall, New York, 1970.
9. S. C. Arora, S. Domkundwar, " A Course in Power Plant Engineering", Dhanpat Rai and Sons, New Delhi.
10. Frederick T. Morse, "Power Plant Engineering", Affiliated East-West Press Pvt. Ltd. New Delhi.

Engineering Tribology

BTMEC604A	PEC 1	Engineering Tribology	2-1-0	3 Credits

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: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the basic concepts and importance of tribology.
CO2	Evaluatethenatureofengineeringsurfaces,theirtopographyandsurface 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:

Unit 1: Introduction
Definition of tribology, friction, wear and lubrication; importance of the tribological studies.
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

Unit 2: Friction
Coulomb and Amontons laws of friction, its applicability and limitations, comparison between static, rolling and kinetic friction, friction theories, mechanical interlocking, molecular attraction, electrostatic forces and welding, shearing and ploughing, models for asperity deformation.

Unit 3: Lubrication
Types of lubrication, viscosity, characteristics of fluids as lubricant, hydrodynamic lubrication, Reynold's equation, elasto-hydrodynamic lubrication: partial and mixed,

boundary lubrication, various additives, solid lubrication.

Unit 4: Wear
Sliding wear: Abrasion, adhesion and galling, testing methods pin-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.

Unit 5: Wear and Design
Introduction, estimation of wear rates, the systems approach, reducing wear by changing the operating variables, effect of lubrication on sliding wear, selection of materials and surface engineering. Principles and applications of tribo design.

Unit 6: 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 Brothers and 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", McMillan 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".

IC Engines

BTMEC604B	PEC 1	IC Engines	2-1-0	3 Credits

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: Applied Thermodynamics – I

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	

CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Unit 1: Fundamentals of IC Engines

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

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

Starting systems, fuel supply systems, engine cooling system, ignition system, engine friction and lubrication systems, governing systems.

Unit 4: 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 5: Alternate fuels

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 6: Layout of Electric vehicle and Hybrid vehicles

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.
11. Transactions of SAE on Biofuels (Alcohols, vegetable oils, CNG, LPG, Hydrogen, Biogas etc.).

Additive Manufacturing

BTMEC604C	PEC 1	Additive Manufacturing	2-1-0	3 Credits

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: 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)

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

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

Introduction, selection methods for a part, challenges of selection, example system for preliminary selection, production planning and control

Unit 4: AM Applications

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

Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparation for use as a pattern, property enhancements using non-thermal and thermal techniques.

Unit 6: 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, Emand Abouel 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.

Mechanical Measurements

BTMEC604D	PEC 1	Mechanical Measurements	2-1-0	3 Credits

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: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Define measurement parameters, and Identify errors in measurement
CO2	Identify methods and devices for measurement of length, angle
CO3	Identify methods and devices for measurement of pressure, flow, force, torque, strain, velocity, displacement, acceleration, temperature

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	3	1							2
CO2	1	2	2	1	1							2
CO3	1	1	3	2	1							1

Course Contents:

Unit 1: Mechanical Measurement
Need of mechanical measurement, Basic definitions: Hysteresis, Linearity, Resolution of measuring instruments, Threshold, Drift, Zero stability, loading effect and system response. Measurement methods, Generalized Measurement system, Static performance characteristics, Errors and their classification.

Unit 2: Linear and Angular Measurements
Linear Measurement Instruments, Vernier calliper, Micrometer, Interval measurements: Slip gauges, Checking of slip gauges for surface quality, Optical flat, Limit gauges, Problems on measurements with gauge.

Unit 3: Measurement of Pressure
Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures (high vacuum). Flow Measurement: Measurement of fluid velocity, Hot Wire Anemometry, Laser Doppler Velocimetry. Flow measuring devices, Rotameter.

Unit 4: Measurement of Force, Torque and Strain
Force measurement: load cells, cantilever beams, proving rings, differential transformers. Measurement of torque: Torsion bar dynamometer, servo controlled dynamometer, absorption dynamometers. Power measurements.
Measurement of strain: Mechanical strain gauges, electrical strain gauges, strain gauge: materials, gauge factors, theory of strain gauges and method of measurement, bridge arrangement, temperature compensation.

Unit 5: Displacement, Velocity/Speed and Acceleration Measurement
Working principal of Resistive Potentiometer, Linear variable differential transducers, Electro Magnetic Transducers, Mechanical, Electrical and Photoelectric Tachometers, Piezoelectric Accelerometer, Seismic Accelerometer,

Unit 6: Temperature Measurement
Temperature Measuring Devices: Thermocouples, Resistance Temperature Detectors, Thermistor, Liquid in glass Thermometers, Pressure Thermometers, Pyrometer, Bimetallic strip. Calibration of temperature measuring devices, Numerical Examples on Flow Measurement.

Texts:

1. I. C. Gupta, "Engineering Metrology", Dhanpat Rai and Sons.
2. R. K. Jain, "Mechanical & Industrial Measurements", Khanna Publishers.

References:

1. E. O. Doebelin, "Measurement Systems, Application and Design", Tata McGraw Hill Publications.
2. G. Beckwith and G. Thomas, "Mechanical Measurements", Pearson Education.

Quantitative Techniques in Project Management

BTMEC605A	OEC 3	Quantitative Techniques in Project 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: 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

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

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

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

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

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.

Unit 6: 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.

Sustainable Development

BTMEC605B	OEC 3	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

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

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
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
Need for indicators, Statistical procedures Aggregating indicators, Use of principal component analysis, Three environmental quality indices.

Unit 5: 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 6: Environmental Management and Social Dimensions
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.

Renewable Energy Sources

BTMEC605C	OEC 3	Renewable Energy Sources	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 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

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: Introduction

Energy resources, Estimation of energy reserves in India, Current status of energy conversion technologies relating to nuclear fission and fusion, Solar energy.

Unit 2: Solar Radiations

Spectral distribution, Solar geometry, Attenuation of solar radiation in Earth's atmosphere, Measurement of solar radiation, Properties of opaque and transparent surfaces.

Unit 3: Solar Collectors

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 4: Solar Energy Applications

Air/Water heating, Space heating/cooling, solar drying, and solar still, Photo-voltaic conversion.

Unit 5: Wind Energy and Biomass

Types of wind mills, Wind power availability, and wind power development in India. Evaluation of sites for bio-conversion and bio-mass, Bio-mass gasification with special reference to agricultural waste.

Unit 6: Introduction to Other Renewable Energy Sources

Tidal, Geo-thermal, OTEC; Mini/micro hydro-electric, Geo-thermal, Wave, Tidal System design, components and economics.

Texts:

1. Chetansingh Solanki, "Renewable Energy Technologies", Prentice Hall of India, 2008.

References:

1. S. P. Sukhatme, "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill Publications, New Delhi, 1992.
2. G. D. Rai, "Solar Energy Utilization", Khanna Publisher, Delhi, 1992.

Biology for Engineers

BTMEC606A	OEC 4	Biology for Engineers	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

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
Origin of life and Evolution, Cells, Biomolecules-Lipids

Unit 2: Biomolecules
Carbohydrates, water, Amino acids and proteins, Enzymes, Nucleotides

Unit 3: Cell structure
Cell structure and function, Prokaryotes, Eukaryotes

Unit 4: Cell cycle
Cell division, mitosis, meiosis, culture growth,

Unit 5: Genetics
Mendelian genetics, genetic disorders, Mendelian inheritance principle, pedigree analysis, Non- Mendelian inheritance

Unit 6: 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.

Solar Energy

BTMEC606B	OEC 4	Solar Energy	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

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

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
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
Introduction, types of air heater, testing procedure.

Unit 4: Concentrating Collectors
Types of concentrating collectors, performance analysis

Unit 5: Thermal Energy Storage
Introduction, sensible heat storage, latent heat storage and thermo chemical storage
Solar Pond: Solar pond concepts, description, performance analysis, operational problems.

Unit 6: 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 McGrawHill 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.

Human Resource Management

BTMEC606C	OEC 4	Human Resource Management	3-0-0	Audit

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Audit Course

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:

Unit 1: Introduction to Human Resource Management

Concept of management, concept of human resource management, personnel to human resource management, human resource management model, important environmental influences like government regulations, policies, labor laws and other legislation. **Acquisition of human resources:** Human resource planning, Demand for manpower, Weaknesses of manpower planning, job analysis, job specification, recruitment sources, recruitment advertising, the selection process, selection devices, equal opportunities: Indian and foreign practices, socializing the new employee

Unit 2: Development of Human Resources

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

Unit 3: Motivation of Human Resources

Definition of motivation, Nature and Characteristics of Motivation, Theories of motivation: Maslow's Need Hierarchy Theory, Drucker Theory, Likert Theory, Herzberg Two Factor Theory, McClell and Theory, McGregor Theory X and Y, etc., Psychological approach.

Job Design and Work Scheduling: Design, Scheduling and Expectancy Theory, Job characteristics model, job enrichment, job rotation, workmodules, flex-time, new trends in work scheduling.

Unit 4: Performance Appraisal

Performance appraisal and expectancy theory; appraisal process, appraisal methods, factors that can destroy appraisal.

Rewarding the Productive Employee: Rewards and expectancy theory, types of rewards, qualities of effective rewards, criterions for rewards.

Unit 5: Maintenance of Human Resources

Compensation Administration: Concept of Compensation Administration, Job evaluation, Pay structures, Incentives compensation plans.

Benefits and Services Benefits: Something for everybody, Services, Trends in benefits and services.

Discipline: Concept of Discipline, types of discipline problems, general guidelines, disciplinary action, employment-at-will doctrine, disciplining special employee groups

Safety and Health: safety programs, health programs, stress, turn out.

Unit 6: Labor Relations

Unions, Major laborl egislation, 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, why research in human resource management, Secondary sources: where to look it up, Primary sources: relevant research methods, current trends and implications for human resource management.

Texts:

1. David A. DeCenzo, Stephen P. 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 – Transforming the Workplace", Infinity Books, 2001.
2. G.S.Batra, R.C.Dangwal, "Human Resource Management New Strategies", Deep and Deep Publications Pvt. Ltd., 2001.
3. D. M. Silvera, "HRD: The Indian Experience", New India Publications, 2nd edition, 1990.

Metrology and Quality Control Lab

BTMEL607	PCC 25	Metrology and Quality Control Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Measure linear, angular circular features, dimensional and geometric features
CO2	Measure surface roughness of components
CO3	Calibration of metrological equipment

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	1							2
CO2			2	2		1		1				2
CO3			3	2		1						2

List of Practicals/Experiments/Assignments

A] Any Four from experiment No. 1 to 5 and Any Four from experiment No. 6 to 10

1. Determination of linear and angular dimensions of given composite part using precision/non precision measuring instruments.
2. Error determination with linear / angular measuring instruments.
3. Calibration of measuring instrument. Example – Dial gauge, Micrometer, Vernier (any one)
4. Verification of dimensions & geometry of given components using Mechanical & Pneumatic comparator.
5. Machine tool alignment testing on any two machines.
6. Identification of surfaces using optical flat/interferometers and measure surface roughness using surface roughness tester.
7. Determination of geometry & dimensions of given composite object using profile projector and measurement of various angles of single point cutting tool using tool maker's microscope.
8. Measurement of thread parameters using floating carriage diameter measuring machine.
9. Measurement of spur gear parameters using Gear Tooth Vernier, Span, Gear Rolling Tester.
10. Determination of given geometry using coordinate measuring machine (CMM).

B] Statistical Quality Control (SQC) (Any Two)
Note - Use of computational tools are recommended

1. Analyze the fault in given batch of specimens by using seven quality control tools for engineering application.
2. Determination of process capability from given components and plot variable control chart/ attribute chart.
3. Case study on various tools in Total Quality Management (TQM).

C] Industrial visit to Calibration lab /Quality control lab / Gear manufacturing unit / Automotive Industry / Engineering Industry.

Machine Design Practice - II

BTMEL608	PCC 26	Machine Design Practice - II	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks

	End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Apply design process to an open ended problems
CO2	Determine suitable material and size for structural component of machine/system
CO3	Apply iterative technique in design including making estimate of unknown values for first computation and checking or revisiting and re-computing
CO4	Choose logically and defend selection of design factors
CO5	Design of components for given part/system i.e shaft, keys, coupling, links, screws, springs etc.
CO6	Work effectively as a part of design group/team
CO7	Have good communication skill, orally, graphically as well as in writing

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	2	2			2	1				
CO2	1	3	2	1			1	1				1
CO3	3	2	2	1			1	1				1
CO4	2	2	2	2			1	1				1
CO5	3	3	2	1			2	1				1
CO6						1	1	1	2	2		2
CO7								1	1	2	2	3

List of Practicals/Experiments/Assignments

1. The term work shall consist of 2 design projects based on syllabus of Machine Design-II. Each design project shall consist of 2 full imperial size sheets-one involving assembly drawings with a partlist and overall dimensions and other sheet involving drawings of individual components. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified, wherever necessary, so as to make it a working drawing.
   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 printouts using plotter of the same will be attached along with the design report.
2. At least two assignments based on topics of syllabus of Machine Design-II.

IC Engine Lab

BTMEL609	PCC 27	IC Engine Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Conduct test on IC Engines to study their performance.
CO2	Draw performance curves of these machines/systems.
CO3	Analyse the results obtained from the tests.
CO4	Draw conclusions based on the results of the experiments

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	1	1			1							
CO3		1			1							
CO4				2								

List of Practicals/Experiments/Assignments (Any Six from the list and Industrial Visit)

1. Study of Carburetor, Fuel Injector
2. Study of Ignition System
3. Trial on Diesel engine- variable load test and energy balance.
4. Trial on Petrol engine- variable speed test and energy balance.
5. Trial on Petrol Engine- Morse Test.
6. Measurements of exhaust emissions of Petrol engine & Diesel engine.
7. Measurement of smoke density using smoke meter
8. Measurement of flash point of fuel sample
9. Oil extraction by using Soxhelet apparatus
10. Production of Biodiesel using Homogeneous/Heterogeneous catalysts
11. Visit to Large Vehicle Service Center/Industry related Automobiles/Components.

Refrigeration and Air Conditioning Lab

BTMEL610	PCC 28	Refrigeration and Air Conditioning Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 30 Marks End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Conduct test on Refrigeration and air conditioning test units to study their performance.
CO2	Draw performance curves of these machines/systems.
CO3	Analyse the results obtained from the tests.

CO4	Draw conclusions based on the results of the experiments

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	1	1			1							
CO3		1			1							
CO4				2								

List of Practicals/Experiments/Assignments

- **Refrigeration (Any Six** from the list**) and Air-conditioning (Any Three** from the list**)**

1. Trial on vapour compression Refrigeration system
2. Trial on Ice Plant
3. Trial on Window Air Conditioner
4. Trial on Water to Water Heat Pump
5. Trial on Air to Water Heat Pump
6. Trial on Vortex Tube Refrigeration system
7. Trial on Electrolux Vapour Absorption Refrigeration system
8. Study and practice of sensible heating and cooling Air- conditioning process
9. Study and practice of cooling and dehumidification Air- conditioning process
10. Study and practice of heating and humidification Air- conditioning process
11. Study and practice of adiabatic air mixing Air- conditioning process
12. Study and practice of reheating Air- conditioning process
13. Study and practice of direct Evaporative cooling Air- conditioning system
14. Study and practice of indirect – direct Evaporative cooling Air- conditioning system
15. Field visit to Central Air-conditioning plant/Ice plant/Refrigeration plant

Technical Project for Community Services

BTMEM611	Project 3	Technical Project for Community Services	0-0-4	2 Credits

Examination Scheme:
Continuous Assessment: 30 Marks
End Semester Exam: 20 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Visit nearby places to understand the problems of the community
CO2	Select one of the problems for the study, state the exact title of the project and define scope of the problem
CO3	Explain the motivation, objectives and scope of the project

CO4	Evaluate possible solutions of the problem
CO5	Design, produce, test and analyze the performance of product/system/process
CO6	Modify, improve the product/system/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						2	1	1		2		1
CO2		2								2	1	
CO3						1				2	1	
CO4		1	2				1	2				
CO5	1	1	2	3	1	1	1	2	1	1	1	
CO6			2	1	1		1	1				

Rationale

The role of technical institutes in giving technical and advisory services to the surrounding community need not be emphasized. It is desirable that each faculty member and student be involved in rendering services to community and economy. Moreover, as per Section (4) of the Act of this University, technical services to community, particularly the backward areas, is one of the basic objects of the University. In view of this, "Technical Project related to Community Services" has been included in the curriculum. This will ensure the participation of each student as well as faculty in this activity.

The weekly contact hours and the evaluation scheme for this project are as stated above. The nature of project work should be as given below in the course contents.

List of Practicals/Experiments/Assignments

The projects may be of varying nature such as a technical study/survey, design/development of a technology solution for an identified need, infusion/transfer of technology, etc. All this will be within the ambit of technology and expertise available within the University.

The student may form small groups, typically of 2 to 3 students, and carry out the project under the supervision of a faculty member.