B.Tech in Mechanical Engineering

Department of Mechanical Engineering

Tezpur University

Curriculum :: Module-wise distribution of courses

ID	Module	Course Detail								Total Credits
		SN	Code	Title	L	T	P	CH	Cr	
I	Humanities/ Social Science/ Management	1	EG101	Communicative English	3	0	0	3	3	09
		2	BM321	Fundamentals of Management	3	0	0	3	3	
		3	BM322	Social Responsibility and Professional Ethics in Engineering	3	0	0	3	3	
II	Basic Science	1	MS101	Mathematics I	3	1	0	4	4	29
		2	MS103	Mathematics II	3	1	0	4	4	
		3	MS201	Mathematics III	2	1	0	3	3	
		4	MS202	Mathematics IV	2	1	0	3	3	
		5	PH101	Physics I	2	1	1	5	4	
		6	PH102	Physics II	2	1	1	5	4	
		7	CH101	Chemistry	2	1	1	5	4	
		8	ES101	Environmental Science	3	0	0	3	3	
III	Engineering Science	1	EL101	Basic Electrical Engineering	2	1	1	5	4	35
		2	EL102	Basic Electronics	3	1	1	6	5	
		3	EL202	Electrical Technology	3	0	1	5	4	
		4	CO101	Introductory Computing	2	1	0	3	3	
		5	CO102	Computing Laboratory	0	0	2	4	2	
		6	CO221	Data Structures & Object Oriented Programming	3	0	1	5	4	
		7	ME101	Engineering Graphics	1	0	2	5	3	
		8	ME102	Engineering Mechanics	3	1	0	4	4	
		9	ME103	Workshop Practice	0	0	2	4	2	
		10	ME205	Thermodynamics	3	1	0	4	4	
IV	Professional Core	1	ME201	Solid Mechanics	3	1	0	4	4	63
		2	ME202	Fluid Mechanics I	2	1	0	3	3	
		3	ME203	Material Science	3	0	0	3	3	
		4	ME204	Machine Drawing	0	0	2	4	2	
		5	ME206	Mechanical Engineering Laboratory I	0	0	3	6	3	
		6	ME207	Theory of Mechanisms & Machines	3	1	0	4	4	
		7	ME208	Manufacturing Technology I	3	0	0	3	3	
		8	ME209	Fluid Mechanics II	2	1	0	3	3	
		9	ME210	Mechanical Engineering Laboratory II	0	0	3	6	3	
		10	ME301	Dynamics and Vibration of Machinery	3	0	0	3	3	
		11	ME302	Mechanical Measurements and Instrumentation	3	0	0	3	3	
		12	ME303	Manufacturing Technology II	3	0	0	3	3	
		13	ME304	Applied Thermodynamics I	2	1	0	3	3	
		14	ME305	Mechanical Design	3	1	0	4	4	
		15	ME306	Advance Workshop Practice	0	0	3	6	3	
		16	ME307	Applied Thermodynamics II	2	1	0	3	3	
		17	ME308	Heat and Mass Transfer	3	1	0	4	4	
		18	ME309	Systems and Control	3	0	0	3	3	
		19	ME310	Mechanical Engineering Laboratory III	0	0	3	6	3	
		20	ME401	Industrial Systems Engineering	3	0	0	3	3	
V	Professional Elective	1	MExxx	ME Elective I	3	0	0	3	3	12
		2	MExxx	ME Elective II	3	0	0	3	3	
		3	MExxx	ME Elective III	3	0	0	3	3	
		4	MExxx	ME Elective IV	3	0	0	3	3	
VI	Open Elective	1	xxxxx	Open Elective I	3	0	0	3	3	09
		2	xxxxx	Open Elective II	3	0	0	3	3	
		3	xxxxx	Open Elective III	3	0	0	3	3	
VII	Project/ Internship	1	ME471	Industrial Summer Training #	0	0	0	0	2	20
		2	ME481	Project I	0	0	6	12	6	
		3	ME482	Project II	0	0	12	24	12	
Total					**110**	**20**	**45**	**220**	**177**	**177**

B.Tech in Mechanical Engineering

Department of Mechanical Engineering

Tezpur University

Curriculum :: Semester-wise distribution of courses

Sem	Course detail				L	T	P	CH	Cr	Total Credits
	SN	Code	Title							
I	1	MS101	Mathematics I		3	1	0	4	4	24
	2	PH101	Physics I		2	1	1	5	4	
	3	CH101	Chemistry		2	1	1	5	4	
	4	EL101	Basic Electrical Engineering		2	1	1	5	4	
	5	ME101	Engineering Graphics		1	0	2	5	3	
	6	ME103	Workshop Practice		0	0	2	4	2	
	7		*Humanities Elective*		3	0	0	3	3	
			EG101	Communicative English						
			SO101	Sociology						
			BM101	Elementary Economics						
II	1	MS103	Mathematics II		3	1	0	4	4	25
	2	PH102	Physics II		2	1	1	5	4	
	3	ME102	Engineering Mechanics		3	1	0	4	4	
	4	EL102	Basic Electronics		3	1	1	6	5	
	5	CO101	Introductory Computing		2	1	0	3	3	
	6	CO102	Computing Laboratory		0	0	2	4	2	
	7		*Science Elective*		3	0	0	3	3	
			BT101	Elements of Modern Biology						
			ES101	Environmental Science						
			CH102	Introductory Material Science						
III	1	MS201	Mathematics III		2	1	0	3	3	24
	2	ME201	Solid Mechanics		3	1	0	4	4	
	3	ME202	Fluid Mechanics I		2	1	0	3	3	
	4	ME203	Material Science		3	0	0	3	3	
	5	EL202	Electrical Technology		3	0	1	5	4	
	6	ME205	Thermodynamics		3	1	0	4	4	
	7	ME206	Mechanical Engineering Laboratory I		0	0	3	6	3	
IV	1	MS202	Mathematics IV		2	1	0	3	3	22
	2	ME204	Machine Drawing		0	0	2	4	2	
	3	ME207	Theory of Mechanisms & Machines		3	1	0	4	4	
	4	ME208	Manufacturing Technology I		3	0	0	3	3	
	5	ME209	Fluid Mechanics II		2	1	0	3	3	
	6	ME210	Mechanical Engineering Laboratory II		0	0	3	6	3	
	7	CO221	Data Structures & Object Oriented Programming		3	0	1	5	4	
V	1	ME301	Dynamics and Vibration of Machinery		3	0	0	3	3	22
	2	ME302	Mechanical Measurements and Instrumentation		3	0	0	3	3	
	3	ME303	Manufacturing Technology II		3	0	0	3	3	
	4	ME304	Applied Thermodynamics I		2	1	0	3	3	
	5	ME305	Mechanical Design		3	1	0	4	4	
	6	ME310	Mechanical Engineering Laboratory III		0	0	3	6	3	
	7	BM321	Fundamentals of Management		3	0	0	3	3	
VI	1	ME306	Advance Workshop Practice		0	0	3	6	3	22
	2	ME307	Applied Thermodynamics II		2	1	0	3	3	
	3	ME308	Heat and Mass Transfer		3	1	0	4	4	
	4	ME309	Systems and Control		3	0	0	3	3	
	5	BM322	Social Responsibility and Professional Ethics in Engineering		3	0	0	3	3	
	6	MExxx	ME Elective I		3	0	0	3	3	
	7	xxxxx	Open Elective I *		3	0	0	3	3	
	***** Open Elective Course: Any course of level 400 and above offered in the University and recommended by the department.									
VII	1	ME401	Industrial Systems Engineering		3	0	0	3	3	20
	2	MExxx	ME Elective II		3	0	0	3	3	
	3	MExxx	ME Elective III		3	0	0	3	3	
	4	xxxxx	Open Elective II		3	0	0	3	3	
	5	ME471	Industrial Summer Training #		0	0	0	0	2	
	6	ME481	Project I		0	0	6	12	6	
	# Industrial Summer Training: Training shall be of 12 weeks duration carried out during the summer break after the 6th semester. The report will be submitted in the 7th semester.									
VIII	1	MExxx	ME Elective IV		3	0	0	3	3	18
	3	xxxxx	Open Elective III		3	0	0	3	3	
	4	ME482	Project II		0	0	12	24	12	
Total	**51**				**110**	**20**	**45**	**220**	**177**	**177**

Syllabus

First year

MS 101: Mathematics I **L-T-P-CH-CR: 3 1 0 4 4**

Analysis:

Properties of real numbers, Sequence and series of real numbers, continuity and differentiability of single variable, Rolle's theorem, Cauchy's mean value theorem (Taylor's and Maclaurin theorems with remainders), Indeterminate forms, Concavity and convexity of curve, points of inflexion. Asymptotes and curvature.

Limit, continuity and differentiability of functions of several variables, partial derivatives andtheir geometrical interpretation, differentials, derivatives of composite and implicit functions, derivatives of higher order and their commutativity , Euler's theorem on homogeneous functions, harmonic functions, Taylor's expansion of functions of several variables, maxima and minima of functions of several variables – Lagrange's method of multipliers.

Scalar and vector fields, level surfaces, directional derivative, Gradient, Curl, Divergence,

Laplacian, line and surface integrals, theorems of Green, Gauss and stokes, orthogonal curvilinear coordinates.

Riemann integration, fundamental theorem of integral calculus, mean value theorems, evaluation of definite integrals – reduction formulae.

Differential equation:

First order differential equations – exact, linear and Bernoulli's form, second order differential equations with constant coefficients, Euler's equations.

Textbooks

1. T M Apostol, "Calculus", Vol. – I, 2nd Ed. Wiley, 1967

2. T M Apostol, "Calculus", Vol. – II, 2ndEd. Wiley, 1969

3. G B Thomas and R L Finney, " Calculus and Analytic Geometry", 6th/9th Ed.Narosa/Addision Wesley/Pearson, 1985/1996

4. Piskunov, "Differential & Integral Calculus", Vol – I & II, Mir Pub.

5. B S Grewal, "Engineering Mathamatics", S Chand & Co. New Delhi.

6. R G Bartle and DR Sherbert, "Introduction to Real Analysis", 3rd Ed., Wiley, 1999.

PH-101: Physics I **L-T-P-CH-CR: 2-1-1-5-4**

Conservation Principles, rotational Dynamics, free, forced and damped oscillations, coupled oscillations, wave motion, reflection and refraction, interference, diffraction, polarization;

Vector calculus: Curvilinear co-ordinates, gradient of a scalar fields, divergence and curl of a vector field, Gauss's and Stokes theorems;

Electrostatics, magnetostatics, motion of charges in electric and magnetic fields, electromagnetic induction, displacement current, Maxwell's equations, electromagnetic Waves;

Laboratory Experiments:

1. To determine the coefficient of viscosity of a liquid from its rate of flow through a capillary tube.
2. To determine the velocity of sound in a solid by Kundt's tube method.
3. To determine the acceleration due to gravity (g) by Kater's pendulum.
4. To determine the wavelength of a monochromatic light by Fresnel's biprism and Lloyd's mirror.
5. To determine the wavelength of light and radius of curvature of the convex surface of a lens by Newton's ring method.
6. To determine the wavelength of light by diffraction through a plane transmission grating.
7. To determine the value of Planck's constant using photocells.
8. To determine the melting point of a solid with a thermocouple.
9. To determine the value of e/m of an electron by using a cathode ray tube and a pair of bar magnets (Thompson's method).
10. To observe waveforms and to measure amplitude, frequency and phase with cathode ray oscilloscope.

11. To verify Thevenin's, Norton's and maximum power transfer theorems.
12. To study the performance of inverting and non-inverting amplifiers using an operational amplifiers.

Textbooks
1. *Introduction to Electrodynamics*-David J. Griffiths, Prentice-Hall of India Pvt. Ltd.
2. *Electricity and Magnetism* by A.S. Mahajan and A.A. Rangwala, Tata McGraw Hill Publishing Co. Ltd.
3. *Optics*-A.K. Ghatak, Tata McGraw Hill Publishing Co. Ltd.
4. *Vibrations and Waves in Physics*, Iain G. Main, Amazon Books
5. *Fundamentals of Physics*, D. Halliday and R. Resnick, John Wiley Publication

CH-101: Chemistry **L-T-P-CH-CR: 2-1-1-5-4**

Thermodynamics of Chemical Processes: Concept of entropy, Chemical potential, Equilibrium conditions for closed systems, Phase and reaction equilibria, Maxwell relations, Real gas and real solution;

Electrochemical Systems: Electrochemical cells and EMF, Applications of EMF measurements: Thermodynamic data, activity coefficients, solubility product and pH, corrosion;

Kinetics of Chemical Reactions : Reversible, consecutive and parallel reactions, Steady state approximation, Chain reactions, Photochemical kinetics;

Bonding Models in Inorganic Chemistry: Molecular orbital theory, Valence-bond theory, Crystal field theory;

Fundamentals of Microwave, IR and UV-VIS Spectroscopy: Basic concepts of spectroscopy, Selection rule, Determination of molecular structure;

Coordination Chemistry: Coordination numbers, Chelate effect, Coordination complexes and application, Bio-inorganic chemistry: Metal ions in Biological systems, environmental aspects of Metals, NOx, CO, CO2;

Organic Reaction Mechanism: Mechanisms of selected organic, bio-organic, polymerization and catalytic reactions;

Stereochemistry of Carbon Compounds: Selected Organic Compounds: Natural products and Biomolecules (Amino acids/nucleic acids/proteins);

Laboratory Experiments:

(At least nine of the experiments listed below)
1. Surface tension and parachor
2. Measurement of the coefficient of viscosity.
3. Conductometric titration
4. pH-metric/potentiometric titration
5. Solubility product
6. Kinetics of ester hydrolysis
7. Estimation of Fe2+
8. EDTA titration
9. Estimation of base content and acid content of commercially available antacid and vitamin C respectively
10. Synthesis of Mohr's salt
11. Synthesis of aspirin
12.Demonstration of a few important physico-chemical processes. (e.g. Gel electrophoresis, Oscillatory reactions)
13. Determination of CMC of a surfactant

Textbooks
1. *Physical Chemistry*, Rakshit P. C.
2. *Inorganic Chemistry*, Dutta R. L.
3. *Organic Chemistry*, Finar I. L
4. *Text Book of Physical Chemistry*, Glasston Samuel
5. *Concise Inorganic Chemistry*, Lee J. D

EG-101: Communicative English **L-T-P-CH-CR: 3-0-0-3-3**

1. To develop overall proficiency in English with a view to enabling the students to use English for communication and for study purposes;

2. To develop the student's interactive skills by developing their ability to listen to English for formal as in class lectures and informal as in face to face interactive situations) with a high degree of understanding, and helping them to speak English with a reasonable degree of fluency and with an acceptable pronunciation of the sounds of English;

3. To develop students ability to read English texts-both of scientific and non-scientific nature silently with a high degree of comprehension;

4. To develop the student's skill of writing short paragraphs, formal and informal letters, curriculum vitae/resume, applications of various types, study notes, summery and appropriate words-both scientific and non-scientific.

Course content and activities

A. Oral Communicative Activities
Information transfer activities: Pair and group works involving transfer of information (reading a brochure and advertise/a notice a schedule or programme/drawing etc. and discussing these, finding a solution, arriving at a decision through speaking); extempore speech using clues, group discussion etc.

Pair work: describing pictures, interpreting diagrams, gleaning information from different types of written materials including articles etc and talking about them, formal seminar presentation, formal group discussion.

B. Reading
Reading and comprehension: global and local comprehension, drawing interferences Materials: Stories and essays (preferably a collection of comparatively short essays on scientific, interestingly written topics, biographical/autobiographical writtings, short stories-adventure and scientific fiction), Reading silently in class followed by short comprehension questions, brief writing exercises, summaries in brief, personal responses (not typical question-answer type)-both oral and written. Reading material from Internet and talking and writing about them; reading scientific reports, articles collected from newspapers and magazines, Internet etc. and writing notes etc. on them

C. Writing
Preparing reports, project proposals. Writing applications of various types and for various purposes, curriculum vitae/resume, letters to the editors, letters to various agencies. Writing short notes on article/reports read summary of articles/paragraphs read, notes on lectures (talks-radio/TV/audio, video cassettes), opinions on discussions/letters heard, notice both formal and informal/friendly, notes to inform others etc., interpreting pictures, advertisements, visuals (video, TV etc.) and writing briefly about them.

D. Vocabulary and grammar:
Using useful but unfamiliar words and phrases in conversation and in writing; Group verbs, idiomatic expressions; synonyms and antonyms.

Structure of simple sentences; use of adverbials, longer sentences, combining sentences, Tenses, Use of passive in scientific discourse, various types of questions, direct and indirect narration.

Evaluation:
Oral skills: 15% of total marks

Interview/interacting; group discussion; formal seminar presentation

Reading-comprehension: 25% of total marks

Continuous text; chart/graph/drawing/pictures etc.

Vocabulary

Writing: 40% of total marks

Notes/summery/writing; letters; report writing; short essay

Grammar and usages 20% of total marks

Questions on grammar in use (using texts/passages from texts); questions to test knowledge of grammar.

Textbooks

1. Anna University, Madras. *English for Engineers and Technologists: a skill approach.* Vol 182. Hyderabad: Orient Longman, 1990.
2. *Collins Cobuild English Grammar*. Harper Collins India, 1990
3. Graves, Graham. *Foundation English for Science Students.* Delhi: Oxford University Press, 1975
4. *Oxford Advanced Learner's Dictionary* (with CD-ROM), 7th edition, 2005
5. Thomson and Martinet. *A Practical English Grammar*. Delhi Oxford ELBS, 1980
6. Sudarsanam, K., *Understanding Technical English*. New Delhi: Sterling Publishers Pvt. Ltd., 1988.

SO-101: Sociology **L-T-P-CH-CR: 3-0-0-3-3**

Society: Meaning and element of society – Distinction between society, Aggregation and Organisation – Relationship between Individual and Society;

Social Group : Meaning and brief classification of social group- Primary group- meaning, characteristic and importance of primary ground – method of making decision in a primary group – Secondary group- meaning and characteristics – Organization of authority in a Secondary group;

Social Change : Concepts and direction of social Change- Deterioration – and Cycle theory- Causes of social change- Deterministic theories of social change- a brief explanation of biological, physical, cultural and technical factors influencing the rate and direction of social change;

Social Disorganisation : Meaning, characteristics and causes- social problem- meaning classification and causes- methods for solving social problems;

Personal Administration : Concept, aims and objectives, functions and principles of personal administration. Interview- types of interview – training- importance and methods- induction;

Human Relations & Behavioural Approach to Manpower : Concept of Human relations- origin and growth- (a brief References to the Hawthrone Experiments, Mechanical or Commodity concept and social or Human concept of Labour – Classification made by Doghlas Megxg theory – X and theory – Y – importance of Human Relations;

Werlmotivation – Meaning and kinds – Baslow's need Hierarchy- Motivational techniques- meaning and significance of group Dynamics- Employees Morale – meaning and importance of and steps to promote employee morale;

Concept, characteristics and techniques of leadership- types of leader- functions and qualities of a leader;

Textbooks

1. *Induction of Sociology*, Dr. Sachdeva and Vidya Bhusan
2. *Business Administration and management*, Dr. S.C. Saksena
3. *Principle of Sociology*, R.N. Sarma
4. *Human Relation in Management*, S. G. Huneryager & L.L. Hechkm.

ME-101: Engineering Graphics L-T-P-CH-CR: 1-0-2-5-3

Introduction to IS code of drawing; Conics and Engineering Curves – ellipse, parabola, hyperbola, cycloid, trochoid, involute; Projection of lines – traces, true length; Projection of planes and solids; sold objects – cube, prism, pyramid, cylinder, cone and sphere; Projection on Auxiliary planes; Isometric projection, isometric scale; Section of solids – true shape of section; Introduction to CAD tools – basics; Introduction of Development and Intersection of surfaces.

Textbooks

1. *Engineering Graphics*, K. L. Narayana, P. Kannaaiah, Tata McGrawHill, New Delhi
2. *Elementary Engineering Drawing*, N. D. Bhatt, Charotar Book Stall, Anand.
3. *Engineering Graphics*, V. Lakshminarayanan, R. S. Vaish Wanar, Jain Brithers, New Delhi.
4. *Engineering Graphics*, A. M. Chandra, S. Chandra, Narosa.
5. *Engineering Drawing and Graphics + AutoCAD*, K. Venugopal, New Age International, New Delhi.

EL-101: Basic Electrical Engineering L-T-P-CH-CR: 2-1-1-5-4

Engineering Circuit Analysis - Current, Voltage, Power, Circuit elements, Ohm's law, Kirchoff's law, Nodal Analysis, Mesh Analysis, Source transformations, Linearity and Superposition, Thevenin's and Norton's Theorems, Maximum power transfer theorem, Star-Delta and Delta-Star Conversion, Simple RL and RC Circuits, Unit Step Forcing Function, source free RLC Circuits, Sinusoidal Forcing Function, Complex Forcing Function, Phasor Concept, Impedance and Admittance, Phasor diagrams, Response as a Function of w, Instantaneous Power, Average Power, RMS values of Current and Voltage, Apparent Power and Power Factor, Complex Power, Introduction to Three Phase Circuits;

AC Machines - Transformer : Working principle, Ideal Transformer, Equivalent Circuit, Transformer tests, Voltage regulation, Efficiency. Three Phase Induction Motor : Construction, Production of rotating field, Slip, Torque and Slip, Equivalent Circuit. Single Phase Induction Motor : Double field revolving theory, Equivalent circuit, Typical Applications, Stepper Motors;

DC Machines - Principle of DC Generator, Methods of excitation, Characteristics and Applications, Principle of DC Motor, Types, Speed ◆Torque Characteristic, Speed Control, Motor starting, Applications;

Electrical Measuring Instruments - Basic Characteristics of Measuring Devices, Error Analysis, Standards and Calibration, Moving Coil, Moving Iron and Electrodynamic Meters, AC/DC ammeters and voltmeters, Ohmmeters, Wattmeters, Watt-hour meter, AC bridges, Q.meter, Cathode Ray Oscilloscope;

Power System - Introduction to generations, Transmissions and Distribution Power Systems, Domestic Wiring, Safety measures;

Laboratory Experiments

Experiments on Circuits - Verification of Network Theorems, Design and Study on circuits using R, L and C, Power measurement in single phase A.C. Circuits;

Transformer - Open circuit and Short Circuit Tests;

D.C machines - Open Circuit Characteristic of Generator, Speed Control of D.C. motors;

Electrical Measuring Instruments - Calibration of meters, Power measurement in 3-phase circuits, AC bridges;

Power System - Design and Physical model of domestic wiring.

Textbooks

1. W.H. Hayt and J.E. Kemmerly : *Engineering Circuit Analysis*; Mc Graw-Hill, 1993
2. V. Del Toro : *Electrical Engineering Fundamentals*; PHI, 1994
3. R.J. Smith and R-C-Dorf : *Circuits, Devices and Systems*; John Wiley & Sons, 1992
4. D. Helfrick and W.D Copper : *Modern Electronic Instrumentation and Measuring Techniques*; PHI, 1990

Referencess

1. Golding and Widdis : *Electrical Measurements and Measuring Instruments*; A.H. Wheeler & Company, Calcutta, 1993.
2. H. Cotton, *Advanced Electrical Technology*, Issac Pitman, London.
3. D.P. Kothari, I.J. Nagrath : *Basic Electrical Engineering*, 2nd Edition, Mc Graw-Hill, 2002
4. Rana : *Basic Electrical Science*

ME-103: Workshop Practice L-T-P-CH-CR: 0-0-2-4-2

Machining - Introducing to various machine tools and demonstration on various machining process. Making jobs as per drawings;

Fitting Practices - Study of different vices, power hammer. Making jobs as per drawing;

Welding Practice - Introduction to different welding processes. Practice on Oxy-acetylene gas welding and manual metal arc welding;

Carpentry - Introduction to different hand tools and wood turning lathe. Making jobs.

1. M. L. Begeman and B. H. Amstead, *Manufacturing Process*, John Wiley.
2. W. A **Textbooks**. J. Chapman and E. Arnold, *Workshop Technology Vol. I & II*, Viva Low Priced Student Ed.
3. B. S. Raghuwanshi, *Workshop Technology Vol. I & II,* Dhanpat Rai & Sons.

MS-103: Mathematics II L-T-P-CH-CR: 3-1-0-4-4

Linear Algebra:

Vector spaces – Linear dependence of vectors, basis, linear transformations, rank and inverse of a matrix, solution of algebraic equations – consistency conditions.
Eigenvalues and eigenvectors, Systems of differential equations, Hermitian and skew Hermitian matrices.

Complex Analysis:

Limit, continuity, differentiability and analytical of functions, CaucheyReimann equations, Elementary complex functions, Line integrals, Cauchy's integral theorem,
Cauchy's integral formula, Power series, Taylor's series, Laurent's series, Zeros and singularities, Residue theorem..

Laplace and Fourier Transforms:

Polynomials – Orthogonal Polynomials – Lagrange's Chebysev Polynomials;
Trigonometric Polynomials – Fourier Series, Fourier transforms, Laplace transforms, z-transform, Wavelet transforms.

Numerical Analysis:

Finite differences, Newton's forward and backward interpolation formulae, Central difference interpolation. Trapezoidal rule and Simpson's 1/3 rd rule of integration. Solution of polynomial and transcendental equations – bisection method, Newton Raphson method and Regulafalsi method.

Textbooks

Linear Algebra

1. K. Hoffman and R Kunze, "Linear Algebra" Prentice Hall, 1996
2. Krishnamurthy V, Mainra V P, Arora J L, An Introduction to Linear Algebra.
3. T M Apostol, "Calculus", Vol – II, 2nd Ed. Wiley, 1969

Complex Analysis
4. R V Churchill and J W Brown, "Complex Variables and Applications", 5 th Ed.

McGraw Hill, 1990
5. J H Mathew and R W Howell, " Complex Analysis for Mathematics and Engineering", 3rd Ed. Narosa, 1998

Laplace and Fourier Transforms
6. K SankaraRao, "Introduction to Partial DifferentialEquations", PHI, 1995
7. Kreyszig E, "Advance Engineering Mathematics".
8. Grewal B S., "Engineering Mathematics".

Numerical Analysis
9. Kreyszig E, "Advance Engineering Mathematics".
10. Grewal B S., "Engineering Mathematics".

PH-102: Physics II **L-T-P-CH-CR: 2-1-1-5-4**

Elements of special theory of relativity: postulates, Galilean and Lorentz transformations, equivalence of mass and energy;

Introduction to quantum mechanics and applications: limitations and failure of classical physics, wave-particle duality, uncertainty Principle, atomic and molecular spectra, elements of lasers and holography;

Solid state physics: Bravais lattice, Reciprocal lattice, X-ray diffraction, Brillouin zones, Band theory of solids;

Statistical physics: Quantum statistics, Fermi energy of metals;

Nuclear physics: Nuclear force, properties and models of nuclei, nuclear excitations and decay, nuclear reactions, elementary particles.

Laboratory Experiments:

1. To verify Hooke's law and determination the Young's modulus of elasticity of the material of a bar the method of flexure.
2. To determine the thermal conductivity of a bad conductor in the form of a disc by the Lees and Chorlton method.
3. To determine the thermal conductivity of a good conductor by Searle's method.
4. To determine the Rydberg constant by studying the Hydrogen spectrum.
5. B-H curve and determination of Curie temperature of a ferromagnetic material.
6. To determine the value of Stefan's constant.
7. To determine the Lande's g-factor with Electron Spin Resonance spectrometer.
8. To study the current-voltage, power output versus load, aerial characteristics and spectral response of the photoelectric solar cell.
9. To determine the Hall co-efficient of a given semiconductor.
10. To determine the band gap by measuring the resistance of a thermistor at different temperatures.
11. To construct AND, OR and NOT gates from NOR and NAND gates using IC chips.
12. To determine the dielectric constant of a given dielectric material.

Textbooks

1 *Concepts of Modern Physics*- Arthur Beiser, McGraw Hill, International Student Edition.
2 *Introduction to Special Relativity*-Robert Resnick

References:

1 *Introduction to Solid State Physics VII Edition* - C. Kittel, Wiley Eastern Ltd.
2 *Quantum Mechanics* - L.S.Schiff, Tata McGraw Hill
3 *Quantum Mechanics* - Ghatak and Lokanathan

CO-101: Introductory Computing **L-T-P-CH-CR: 2-1-0-3-3**

Computer Fundamentals:
- History, Generations, Classification of Computers;
- Organization of a Computer;
- Concept of Programming and Programing Languages;

Introduction to Programming:

- Concept of Algorithm, Flow Chart, Pseudocode, Illustrative Problem Solving Examples;
- Features of a Programming Language: Character Set, Identifiers, Keywords, Data Types, Variables, Declarations, Operators & Expressions; Statements: Assignment, Input/Output; Flow Control- Conditionals and Branching; Iteration; Functions, Function Types, Scope Rule; Recursion; Arrays, Pointers, Structures. (A programming language like C/C++ shall be used as a basis language. The same language is to be used for the laboratory).

Textbooks

1 *Programming in C*, Balaguruswamy.
2 *Let us C*, Kanetkar Y
3 *Programming in C*, Gotfreid, McGrawHill
4 *Fundamentals of Computers*, Rajaram, V

References:

1 *The Elements of Programming Style*, Kerningham, B. W.
2 *Techniques of Program Structures and Design*, Yourdon, E.
3 *Theory and Problems of Computers and Programming*, Schied, F. S.
4 *The C Programming Language*, Kerningham & Ritchie.

CO-102: Computing Laboratory L-T-P-CH-CR: 0-0-2-4-2

Laboratory exercises shall involve the following:

1. Familiarization of a computer and the environment and execution of sample programs
2. Expression evaluation
3. Conditionals and branching
4. Iteration
5. Functions
6. Recursion
7. Arrays
8. Structures
9. Linked lists
10. Data structures

It is suggested that some problems related to continuous domain problems in engineering and their numerical solutions are given as laboratory assignments. It may be noted that some of basic numerical methods are taught in the Mathematics course.

Textbooks

1. *The Elements of Programming Style*, Kerningham, B. W.
2. *The C Programming Language*, Kerningham & Ritchie.
3. *Programming in C*, Balaguruswamy.
4. *Let us C*, Kanetkar Y.
5. *Programming in C*, Gotfreid, McGrawHill

EL-102: Basic Electronics L-T-P-CH-CR: 3-1-1-6-5

Diodes and Transistors : Semiconductor Materials, Semiconductor Diode, Equivalent Circuits, Diode Testing, Zener Diodes, Load Line Analysis, Rectifier Circuits, Wave Shaping Circuits, Bipolar Junction Transistors, Field-Effect Transistors, Transistors Biasing, Transistors Small Signal Analysis, Transistor Amplifier Circuits;

Operational Amplifiers : Operational Amplifier Basics, Equivalent Circuit, Practical Op-amp Circuits, DC Offset, Constant Gain Multiplier, Voltage Summing, Voltage Buffer, Controlled Sources, Instrumentation Amplifiers, Comparator, Oscillator Circuits;

Thyristors: Silicon Controlled Rectifier, Silicon Controlled Switch, Shockley Diode, DIAC,TRIAC;

Digital Systems: Number Systems and Codes, r's Complements and (r-1)'s Complements, Binary Addition and Subtraction, Representation of Negative Number, Floating Point Representation. Logic Gates: Basic and Universal, Boolean Theorems, DeMorgan's theorems, Sum-of-Products form, Algebraic Simplification, Karnaugh Map, Basic Combinational Circuit Concept : Half Adder, Full Adder, Sequential circuit concept : Basic Flip-Flops (RS, D, JK Flip-Flop);

Experiments using diodes and bipolar junction transistor (BJT): diode characteristics, designs and analysis of half-wave and full-wave rectifiers, Clipping circuits and Zener regulators, BJT characteristics and BJT amplifiers;

Experiments using Operational amplifiers: Summing amplifier, Comparator, Oscillators;

Experiments using logic gates: Digital IC testing, Realization of Boolean Equation, Realization of Adder, Subtrator;

Experiments using flip-flops: Realization of Basic Flip-Flops.

Textbooks

1. R.L. Boylestad and L.Nashelsky : *Electronic Devices and Circuit Theory*; PHI, 6e, 2001.
2. R.J. Tocci : *Digital Systems*; PHI, 6e, 2001
3. A.P. Malvino : *Electronic Principles*; New Delhi, Tata Mc Graw-Hill, 1993
4. J. Millman & A. Grabel, *Micro electronics*, 2nd Edition, Mc Graw-Hill, 1987
5. R.A. Gayakward, *Op.Amps and Linear Integrated Circuits*, New Delhi : PHI, 2002

ME-102: Engineering Mechanics L-T-P-CH-CR: 3-1-0-4-4

Force systems: Moment of a force about a point and about an axis; couple moment; reduction of a force system to a force and a couple;

Equilibrium: Free body diagram; equations of equilibrium; problems in two and three dimensions; plane frames and trusses;

Friction: Laws of Coulomb friction., problems involving large and small contact surfaces; square threaded screws; belt friction; rolling resistance;

Properties of areas: Moments of inertia and product of inertia of areas, polar moment of inertia, principal axes and principal moments of inertia;

Principle of Virtual Work;

Kinematics and Kinetics of particles: Particle dynamics in rectangular coordinates cylindrical coordinates and in terms of path variables; central force motion;

Rigid Body Dynamics: Relative velocity, Translation, Pure rotation and plane motion of rigid bodies, D'Alembert's principle, linear momentum, principle of conservation of momentum, Impact of solid bodies, work, energy, power, principle of conservation of energy.

Textbooks

1. F. P. Beer and F. R. Johnston, *Mechanics for Engineering*, McGraw Hill
2. I. H. Shames, *Engineering Mechanics*, Prentice Hall India.
3. Timoshenko and Young, *Engineering Mechanics*, McGraw Hill.

Referencess:

1. R.C. Hibbler, Engineering Mechanics, McMillan
2. K.L. Kumar, Engineering Mechanics, Tata McGraw Hill

BT-101: Elements of Modern Biology L-T-P-CH-CR: 3-0-0-3-3

Biological Structures and Organization:

- Biological macromolecules, Cellular Organization, Cell types, Membrane structures and functions;
- Cellular energetics: Structure of Mitochondria, Energy transduction; Structure of Plastids (chloroplast), Photosynthetic light and dark reactions;

Biological systems:

- Muscular skeletal system, Nervous system (Overview of the major human sensory organs and their functioning), Cardiovascular system;

Biological Information:

- DNA : Structure, Genetic code, Central dogma in Molecular biology;
- Protein synthesis;
- Biological data and Bioinformatics;
- Signal transduction in plants and animals - Basic concepts.

Textbooks/Referencess

1. N. Hopkins, J. W. Roberts, J. A. Steitz and A. M. Weiner : *Molecular Biology of the Gene*, J. Watson, Fourth Ed, Benjamin Cummings, Singapore, 1987.
2. J. L. Tymoczko, L. Stryer, *Biochemistry*, J.M. Berg, Fifth Ed, W.H. Freeman & Co, New York, 2002.
3. Dr. C. C. Chatterjee, *Human Physiology*, 11th Ed, Vol. I and II, Medical Allied Agency, Kolkata, 1987.
4. Guyton, *Human Physiology.*

ES-101: Environmental Science **L-T-P-CH-CR: 3-0-0-3-3**

General –
Basic ideas of environment, basic concepts related to environmental perspective, man, society and environment, their interrelationship. 1L

Mathematics of population growth and associated problems, definition of resource, types of resource, renewable, nonrenewable, potentially renewable, effect of excessive use vis-a-vis population growth, definition of pollutant and contaminant. Environmental impact assessment. 2L

Environmental degradation - Acid rain, toxic element, particulates, noise pollution, air pollution and its effect on man. 1L
Overall methods for pollution prevention, environmental problems and sustainable development, components of environment. 1L

Ecology –

Elements of Ecology: System, open system, closed system, definition of ecology, species,population, community, definition of ecosystem, biotic and abiotic components. Ecological balance and consequence of change: Effect of abiotic factor on population, flow chart of different cycles with only elementary reaction [oxygen, nitrogen, phosphate, sulphur], food chain [definition and one example of each foodchain] . 3L
Air Pollution and Control :
Atmospheric Composition: Troposphere, stratosphere,mesosphere,thermosphere, tropopause, stratopause andmesopause.
Energy Balance: Conductive and convective heat transfer, radiation heat transfer, simple global temperature modal (Earth as a black body, earth albedo), problems. 3L
Green-house effects: Definition, impact of greenhouse gases on the global climate and consequently on sea water level, agriculture and marine food. 1L

Climate, weather:
Difference between climate and weather, Global warming and its consequence: Adiabatic lapse rate, atmospheric stability, temperature inversion, radiation inversion, Atmospheric dispersion: Maximum mixing depth, ventilation coefficient, smokestack plumes and atmospheric lapse rate. 3L
The point-source Gaussian plume model excluded.
Source and effect of pollutants: Toxic chemicals in the environment, toxic chemicals in air, suspended particulate matter, carbon dioxide, sulphur dioxide, nitric oxide, lead, carbon monoxide. 2L
Primary and secondary pollutants: Emission standard, criteria pollutant, oxides of carbon, oxide of nitrogen, oxide of sulphur, particulate, PAN. 1L
Depletion Ozone layer: CFC, destruction of ozone lair by CFC, impact of other greenhouse gases, effect of ozone modification. 1L
Standards and control measures: Industrial, commercial and residential air quality air quality standard, Control measure (ESP, Cyclone separator, bag house, catalytic converter, scrubber (ventury). Statement with brief References) 1L

Water Pollution and Control :
Hydrosphere: Hydrological cycle. 1L
Natural water, Pollutants : their origin and effects: Oxygen demanding wastes, pathogens, nutrients, salts, thermal application, heavy metals, pesticides, volatile organic compounds. 1L
River / lake / ground water pollution :
River : DO, 5day BOD test, BOD reaction rate constants, temperature dependents of BOD, effect of oxygen demanding wastes on river [Deoxygenation, reaeration], COD, Oil, Grease, pH. 2L
Lake : Eutrophication [Definition, source and effect] 1L
Ground Water: Aquifers, hydraulic gradient, ground water flow. (Definition only) 1L
Standard and control: Waste water standard [BOD,COD,Oil, Grease], Water treatment system [coagulation and flocculation, sedimentation and f1ltration, disinfection, hardness and alkalinity, softening], wastewater treatment, primary treatment, secondary treatmens [Trickling f1lters, rotating biological contractor, activated sludge, sludge treatment, oxidation ponds], tertiary treatment definition. 3L
Arsenic pollution: Biochemical effect, contamination, speciation 2L
Land Pollution:
Lithosphere Composition, Pollutants: Municipal, industrial, commercial, agricultural, hazardous solid wastes. 1L
Recovery and conversion method Waste and waste management Land filling, incineration, composting.2L
Noise Pollution, Sources, effects: Definition of noise, effect of noise pollution, noise classification, transport noise, occupational noise, neighbourhood noise, definition of noise intensity, noise threshold limit value. 2L

Textbooks

1. Masters, G.M., *"Introduction to Environmental Engineering and Science"*, Prentice Hall of India

Pvt.Ltd., 1991
2. Nebel, B.J., *"Environmental Science"*, Prentice Hall Inc., 1987
3. Odum, E.P., *"Ecology: The Link between the natural and social sciences"*, IBH Publishing Co. Delhi.

CH-102: Introductory Material Science **L-T-P-CH-CR: 3-0-0-3-3**

Structure of Materials:Atomic bonding and bonding types, Crystallography and x-ray diffaraction, Defect structures, Amorphous structures in metals, ceramics, and polymers;

Kinetics:Diffusion and diffusion pathways, Fick's 1st and 2nd law, Avrami-rate equation, T.T.T. diagrams, specific attention shown to Fe-Fe3C system;

Phase Equilibria:Uniary and binary phase diagrams, Gibbs's phase rule, Cooling curves and setermination, Solid solution, eutectics, peritectics, eutectoids, peritectoid reactions;

Mechanical Properties:Elastic and plastic behaviour constrasted in ceramics, metals, and polymers, Stress-strain curves, Hardening mechanisms in polymers and metals, Time dependent mechanical properties, creep mechanisms,Fracture toughness;

Composite Materials:Designing composite materials, Average property description, Connectivity;
Electrical Properties:Conductivity (metals), Semiconductors, intrinsic versus extrinsic, Insulators, Superconductors, Magnetic materials, Optical materials, refractive indices, and colour;

Textbooks

1. J.F. Shakleford, *Introduction to Material Science and Engineering*
2. W. D. Callister, *Material Science and Engineering - An Introduction*, Wiley, 2002.
3. V. Raghavan, *Materials Science and Engineering*, Prentice Hall, 1996.

Referencess:

1. W. F. Smith, *Principles of Materials Science*, McGraw Hill, 1996
2. G. E. Dieter, *Mechanical Metallurgy*, McGraw Hill, 1988

Second Year

MS-201: Mathematics III **L-T-P-CH-CR: 2-1-0-3-3**

Discrete probability :
- Randomness, finite probability space, probability measure, events;
- Conditional probability, independence, Bayes theorem;
- Discrete random variables;
- Binomial, Poisson, geometric distributions;
- Mean and variance: concepts, significance, computations, applications;
- Integer random variables;

Continuous probability :
- Continuous random variables, the nature of these, illustrations of use;
- Exponential and normal distribution: probability density functions, calculation of mean and variance;
- The central limit theorem and the implications for the normal distribution;
- Joint distribution;

Expectation :
- Moments, transform methods, mean time to failure;
- Conditional expectation, examples;
- Imperfect fault coverage and reliability;

Stochastic processes :
- Introduction: Bernoulli and Poisson processes, renewal process, renewal model of program behavior;
- Discrete parameter Markov chains: transition probabilities, limiting distributions;

- Queuing: M/M1 and M/G/1, birth and death process;
- Finite Markov chains, program execution times;

Sampling distributions :
- Purpose and the nature of sampling, its uses and applications;
- Random approaches to sampling: basic method, stratified sampling and variants thereof, cluster sampling;
- Non-random approaches: purposive methods, sequential sampling;
- Data analysis; tools; graphical and numerical summaries;
- Multivariate distributions, independent random variables;

Estimation :
- Nature of estimates: point estimates, interval estimates;
- Criteria to be applied to single point estimators: unbiased estimators, consistent estimators, efficiency and sufficiency of estimators;
- Maximum likelihood principle approach, least squares approach; applicability conditions for these
- Confidence intervals;
- Estimates for one or two samples;

Hypothesis tests :
- Development of models and associated hypotheses, the nature of these;
- Hypothesis formulation: null and alternate hypotheses;
- Testing hypothesis based on a single parameter, choice of test statistic; choice of samples and distributions;
- Criteria for acceptance of hypothesis;
- t-test, chi-squared test; applicability criteria for these;

Correlation and regression :
- The nature of correlation and regression, definitions;
- Definition and calculation of correlation coefficients;
- Approaches to correlation: the linear model approach, the least squares fitting approach, strengths and weaknesses of these and conditions for applicability.

Textbooks

1. *Statistical Methods for Engineeris and Scientists*, R. m. Bethea, B. S. Duran, T. L. Boullion, Marcell Dekker Inc.
2. *Statistics : Concepts and Applications*, H. Frank, S. C. Altheon, Cambridge Low Priced Edition.
3. *Theory and Problems of Probablity and Statistics*, M. R. Spiegel, Scaum$\diamond$s Outline Series, McGrawHill.
4. *Probability, Random Variables, and Stochastic Processes, Papoulis*, McGrawHill.

MS 202: Mathematics IV **L-T-P-CH-CR: 2-1-0-3-3**

Partial differential equations: What are partial differential equations (PDEs), and where do they come from ? Flows, vibrations and diffusions. Second-order linear equations and their classification. Initial and boundary conditions, with an informal description of well-posed problems. D'Alembert's solution of the wave equation. Duhamel's principle for one dimensional wave equation;

Separation of variables: application of the method to simple problems in Cartesian coordinates. The Laplacian in plane, cylindrical and spherical polar coordinates. Bessel functions. Legendre functions;

Boundary-value problems: Solution of boundary-value problems for various linear PDEs in various geometries. Fourier method for IBV problems for wave and heat equation, rectangular region, Fourier method for Laplace equation in 3 dimensions. Numerical methods for Laplace and Poisson's equation;

Conservation of mass; incompressibility; the continuity equation; streamfunctions;

Newton’s laws applied to fluids; ideal fluids; the concept of pressure in fluids; Euler’s equations of motion; simple hydrostatics; fluids in solid-body rotation; example of swinging bucket;

Energy equation; (steady) Bernoulli’s theorem; simple pipe flows; examples of problems solvable using just Bernoulli’s theorem and conservation of mass;

Introduction to vorticity; vorticity equation; the Rankine vortex (simple model of a tornado); Kelvin’s circulation theorem; Helmholtz’s laws; idea of vortex stretching (bath-tub vortices); irrotational flow; persistence of irrotational flow; extension of Bernoulli’s theorem to unsteady irrotational case; example of expanding/ contracting gas bubble; example of steady flow past a cylinder and past a sphere;

Special solutions of the Navier-Stokes Equations, Navier-Stokes Equations in a Rotating Frame, Ekman Layer.

Textbooks

1. *Advanced Engineering Mathematics*, Kreyszig, E
2. *Advanced Engineering Mathematics, Vol II*, Reza Malek-Madani, Addison Wesley Longman
3. *Differential Equations of Applied Mathematics*, Duff, G.F.D, & Naylor, D.

CO-221: Data Structures & Object Oriented Programming L-T-P-CH-CR: 3-0-1-5-4

- Review of elementary programming;
- Recursion: The concept of recursion; recursive specification of mathematical functions (such as factorial and Fibonacci); simple recursive procedures (Towers of Hanoi, permutations, fractal patterns); divide-and-conquer strategies; recursive backtracking; implementation of recursion;
- Introduction to computational complexity: Asymptotic analysis of upper and average complexity bounds; big-O notation; standard complexity classes; empirical measurements of performance;
- Fundamental computing algorithms: O(N log N) sorting algorithms (Quicksort, heapsort, mergesort); hashing, including collision-avoidance strategies; binary search trees;
- Fundamental data structures: Linked structures; implementation strategies for stacks, queues, hash tables, graphs, and trees; strategies for choosing data structures;
- Object-oriented programming: Object-oriented design; encapsulation and information-hiding; separation of behavior and implementation; classes, subclasses, and inheritance; polymorphism; class hierarchies; collection classes and iteration protocols; fundamental design patterns.

Textbooks

1. *Data Structures and Algorithms*, A. V. Aho, J. E. Hoppcroft, J. E. Ullman, Addision Wesley.
2. *Fundamentals of Data Structures*, E. Horowitz, S. Sahni, Galgotia Publ.
3. *Data Structures using C*, A. S. Tanenbaum, PHI
4. Herbert Schild : *The Complete References to C++*, Osborne McGrawHill.
5. Bjarne Stroustrup: *The C++ Programming Language,* Addison Wesley

EL-202: Electrical Technology L-T-P-CH-CR: 3-0-1-5-4

Electrical machines: Principles of electromechanical energy conversion, DC machines;

AC machines: synchronous machines, synchronous condensers, three phase and single phase induction motors, applications of special types of motors (linear stepper, reluctance) ;

Transformers: Single phase and three phase transformers, parallel operations, autotransformers;

Power transmission and distribution: High-voltage AC (HV AC) and high-voltage DC (HV DC) transmissions, industrial and domestic loads, power factor improvement, safety and protection-fuses, circuit breakers, earthing, lighting rods, earth leakage detectors;

Power electronic devices: Thyristors, gate-turn-off thrysistor, insulated gate bi-polar transistor (IGBT), converters and inverters, electronic control of motors.

ELECTRICAL TECHNOLOGY LABORATORY

Open circuit and Load characteristics of D.C shunt generator, Load characteristic of the D.C shunt / compound motor and speed reversal, Regenerative braking of D.C series motor, Methods of starting and speed control of the 3-Phase induction motor, Parallel operation of 3-phase transformer, Synchronous motor V curves.

Textbooks/Referencess:

1. Cotton,H., *Advanced Electrical Technology*, CBS Publishers and Distributors, New Delhi, 1984.
2. Nagrath I.J. and Kothari, D.P., *Electrical Machines*, TMH, New Delhi, 2001.
3. Hambley, A.R., *Electrical Engineering: Principles and Applications*, 2nd Edition, Prentice Hall, 2002.
4. Yamayee,Z.A and Bala, JL, *Electromechanical Energy Devices an Power Systems*, John Wiley & Sons Inc., 1994.
5. Mohan, N., *Power Electronics: Converters, Applications & Design, John Wiley and Sons, 2003.*

Mechanical Engineering Courses

ME 201: Solid Mechanics L-T-P-CH-CR: 3-1-0-4-4

Stress and Strain: stress at point, Cauchy stress tensor, equilibrium equation, Analysis of deformation and strain components. Principal stresses and strain, stress and strain invariants. Mohr's circle representation;

Constitutive relations: true and engineering stress-strain curve. Material properties for isotropic materials and their relations. Theories of failures for isotropic materials. Shear Force and Bending Moment diagrams. Stresses and deflections due to transverse shears. Axially loaded members. Torsion of circular shafts;

Energy methods: Strain energy due to axial, torsion, bending and transverse shear. Castigliano's Theorem. Reciprocity Theorem.

Textbooks

1. I. H. Shames, *Introduction to Solid Mechanics*, Prentice Hall, 1989
2. S. P. Timoshenko, *Strength of Materials Vol. I and II*, CBS Publ., 1986
3. E. P. Popov, *Engineering Mechanics of Solids*, Prentice Hall, 1990

ME 202: Fluid Mechanics I L-T-P-CH-CR: 2-1-0-3-3

Definition and Types; Properties of fluids, fluid statics and fluid kinematics; integral relations for a control volume;

Reynolds transport theorem, conservation equation for mass, momentum and energy;

Differential relations for a fluid particle, conservation equations in differential form - stream function, vorticity;

Dimensional analysis and similitude; viscous flows in ducts; Boundary layer flows; inviscid incompressible flows

Textbooks

1. F. M. White, *Fluid Mechanics*, McGraw Hill, 1999
2. S. W. Yuan, *Foundations of Fluid Mechanics*, Prentice Hall, 1988

ME 203: Material Science L-T-P-CH-CR: 3-0-0-3-3

Crystal Systems and Lattices. Crystallography, crystals and types, Miller Indices for directions and planes, voids in crystals, packing density, crystal imperfections - point defects, line defects and surface defect ;

Characteristics of dislocations, generation of dislocation; bonds in solids and characteristics of metallic bonding. Deformation mechanisms and strengthening mechanisms in structural materials. Phase Diagrams; Principles and various types of Phase diagrams. Principles of solidification - structural evaluation during solidification of metals and alloys. Heat treatment of steels and CCT diagrams - Pearlitic, Martensitic, bianitic transformation in steel during heat treatment;

Hot working and cold working of metals - recovery, re-crystallization and grain growth. Fracture, fatigue and creep phenomenon in metallic materials. General classifications, properties and applications of alloy steel, stainless steel, cast iron and non-ferrous materials like copper based alloys, aluminum based alloys, nickel based alloys. Composites, ceramics ;

Electronic properties of materials.

Textbooks/Referencess:

1. W. D. Callister, *Material Science and Engineering - An Introduction*, Wiley, 2002.
2. V. Raghavan, *Materials Science and Engineering*, Prentice Hall, 1996
3. W. F. Smith, *Principles of Materials Science*, McGraw Hill, 1996
4. G. E. Dieter, *Mechanical Metallurgy*, McGraw Hill, 1988

ME 205: Thermodynamics L-T-P-CH-CR: 3-1-0-4-4

Definitions and concepts: SI Units, Thermodynamic systems, states, properties, processes, heat, work and energy;

Thermodynamic Equilibrium: Zeroth Law, Temperature Scale; First Law of Thermodynamics; Properties of pure substances and steam, Mollier Chart ;

Second Law of Thermodynamics; Carnot Cycle, Entropy; Corollaries of Second Law; Applications of First and Second Law to closed and open systems, non-flow and flow processes; steady state, steady flow and transient flow processes; Heat Engine and Heat Pumps / Refrigeration;

Irreversibility and availability, exergy analysis; thermodynamic relations; Properties of mixtures and ideal gases;

Thermodynamic Cycles: Otto, Diesel, Dual and Joule Cycle. Third Law of Thermodynamics;

Introduction to IC Engines;

Introduction to Power Cycle ◆Carnot, Rankine and Modified Rankine Cycle.

Textbooks/Referencess:

1. R. E. Sonntag, C. Dorgnakke and G. J. Van Wylen, *Fundamentals of Thermodynamics*, John Wiley, 003.
2. Y. A. Cengel and M. A. Boles, *Thermodynamics, An Engineering Approach* Tata McGraw Hill, 2003.
3. J. P. Howell and P. O. Buckius, *Fundamentals of Engineering Thermodynamics*, McGraw Hill, 1987

ME 206: Mechanical Engineering Laboratory I **L-T-P-CH-CR: 0-0-3-6-3**

Strength of Materials-Tensile testing, hardness testing, impact testing, torsion testing for normal and heat-treated specimen - comparison of mechanical properties;

Kinematics- Demonstration of different mechanisms, gear trains.

ME 207: Theory of Mechanisms & Machines **L-T-P-CH-CR: 3-1-0-4-4**

Kinematic pair, diagram and inversion. Mobility and range of movement. Displacement velocity and acceleration analysis of planar linkages;

Dimensional synthesis for motion: path and function generation. Cam profile synthesis and determination of equivalent mechanisms. Gears (spur, helical, bevel and worm) & gear trains;

Dynamic force analysis, flywheel, Inertia forces and balancing for rotating and reciprocating machines.

Textbooks:

1. J. E. Sighley and J. J. Uicker, *Theory of Machines and Mechanisms*, McGraw Hill, 1995
2. A. K. Mallik, A. Ghosh and G. Dittrich, *Kinematic Analysis and synthesis of Mechanisms,* CRC Press, 1994
3. A. G. Erdman and G. N. Sandor, *Mechanism Design, Analysis and Synthesis, Volume I*, Prentice Hall, 1997
4. T. Bevan, *Theory of Machines*, CBS Publishers and Distributors, 1994
5. J. S. Rao and R. V. Dukkipati, *Mechanism and Machine Theory*, New Age International, 1992
6. S. S. Ratan, *Theory of Machines*, Tata McGraw Hill, 1993

ME 208: Manufacturing Technology I **L-T-P-CH-CR: 3-0-0-3-3**

Introduction to manufacturing processes. Moulding materials and their requirements. Patterns: types and various pattern of materials;

Casting processes: various foundry casting methods: viz. sand casting, investment casting, pressure die casting, centrifugal casting, continuous casting, thin roll casting, single crystal growth. Solidification of casting and flow properties of molten metal; Gating and risering systems, directional solidification, use of chills and chaplets, Casting defects and their remedies;

Metal Joining Processes: brazing, soldering and welding; solid state welding methods: resistance welding, arc welding; submerged arc welding, inert gas welding; welding defects, Inspection;

Metal Forming Processes: Various metal forming techniques and their analysis, viz forging, rolling, extrusion and wire drawing, sheet metal working, spinning, swaging; super plastic deformation. Powder metallurgy and its applications.

Textbooks:

1. J. S. Campbell, *Principles of Manufacturing Materials and Processes*, Tata McGraw Hill, 1995.
2. A. Ghosh and A. K. Mallik, *Manufacturing Science*, Wiley Eastern, 1986
3. M. J. Rao, *Manufacturing Technology: Foundry, Forming and Welding*, Tata McGraw Hill, 1987

ME 204: Machine Drawing **L-T-P-CH-CR: 0-0-2-4-2**

Review of orthographic projection and sectioning of solids. IS and ISO Codes. Limits, tolerances and fits, surface finish, symbols for weldments, Process flow, Electrical and Instrumentation units;

Assembly and part drawings of simple assemblies and sub-assemblies of machine parts - couplings, clutches, bearings, gear assemblies, IC engine components, valves, machine tool parts, joints;

Introduction to solid modelers, use of standard software packages for assembly drawing.

Textbooks:

1. N. D. Bhatt, *Machine Drawing*, Charotar Book Stall, Anand, 1996.
2. N. Sidheswar, P. Kanniah and V. V. S. Sastry, *Machine Drawing*, Tata McGraw Hill, 1983
3. SP 46: 1988 *Engineering Drawing Practice for school and colleges*, Bureau of Indian Standards

ME 209: Fluid Mechanics II **L-T-P-CH-CR: 2-1-0-3-3**

Viscous flow and boundary layer flow, flow separation, turbulence;

Speed of sound; Adiabatic and isentropic steady flow - Mach-number relations, isentropic flow with area changes;
Normal-shock wave - Rankine-Hugoniot relations;
Mach waves, oblique shock wave, Prandtl Meyer expansion waves;
Performance of nozzles;
Fanno and Rayleigh flow;
Euler-equation for turbo-machines;
Impulse turbine - Pelton wheel;
Reaction turbine - Francis turbine, propeller turbine;
Centrifugal pump;
Cavitation;
Role of dimensional analysis and similitude;
Positive displacement pumps.

ME 210: Mechanical Engineering Laboratory II **L-T-P-CH-CR: 0-0-3-6-3**

Fluid Mechanics - Flow through orifice, Venturi, weirs and notches. Head loss in piping systems;

Dynamics - Static & Dynamic balancing of rotary systems - gyroscope, governors, shaft whirling, simple & compound pendulum, Determination of Moment of Inertia.

Third & Fourth Year

ME 301: Dynamics and Vibration of Machinery **L-T-P-CH-CR: 3-0-0-3-3**

Course Outline:

- 3D Motions of rigid bodies, kinematics and kinetics. Gyrodynamics;
- Vibrations of single, two and multiple degrees of freedom systems, free and forced vibrations. Tranverse and torsional vibrations of two and three rotor systems, critical speeds, vibration isolation and measurements, normal mode vibration, coordinate coupling, vibration absorber, vibration damper;
- Properties of vibrating systems, flexibility matrix, stiffness matrix, reciprocity theorem, eigen values and eigen vectors, orthogonal properties of eigen vectors, modal matrix;
- Time and frequency domain analysis.

Textbooks:

1. J. E. Shighley and J. J. Uicker, *Theory of Machines and Mechanisms*, McGraw Hill, 1995
2. T. Bevan, *Theory of Machines*, CBS Publ, 1984
3. W. T. Thomsom and M. D. Dahleh, *Theory of Vibration with Applications*, 5e, Pearson Education, 1999
4. J. S. Rao and R. V. Dukkipati, *Mechanisms and Machine Theory*, New Age International, 1992.

ME 302: Mechanical Measurements and Instrumentation **L-T-P-CH-CR: 3-0-0-3-3**

Course Outline:

- Fundamental of Measurement;

- Treatment of uncertainties: error classification, systematic and random errors, statistical analysis;
- Measurement of various physical quantities;
- Data acquisition and processing;
- Metrology.

ME 303: Manufacturing Technology II **L-T-P-CH-CR: 3-0-0-3-3**

Course Outline:

- Metal Cutting: mechanics, tools, geometry and chip formation, surface finish and machinability;
- Machine tool: generation and machining principles;
- Setting and Operations on m/cs : lathe, milling, shaping, slotting, planing, drilling, boring, broaching, grinding, thread rolling and gear cutting machines;
- Tooling: jigs and fixtures;
- Batch Production: capstan and turret lathe;
- CNC Machines;
- Finishing: microfinishing;
- Unconventional methods: electro-chemical, electro-discharge, utrasonic, LASER, electron beam, water jet machining, Rapid prototyping and rapid tooling.

ME-310: Mechanical Engineering Laboratory III **L-T-P-CH-CR: 0-0-3-6-3**

Course Outline:

- Metrology: Use of different tools, slip gauge, angle gauge, filler, taper, fillet and thread gauges;
- Turbomachinery: Centrifugal and positive displacement pumps, Pelton and Propellor Turbines;
- Vibration: Experiments on single and multi degree of freedom systems, modal and frequency response analysis;
- Signals and Systems: Time domain and spectral analysis with software such as MATLAB; Determination of FFT, PSD; Effects of sampling, windowing, leakage, averaging.

ME-304: Applied Thermodynamics I **L-T-P-CH-CR: 2-1-0-3-3**

Course Outline:

- Vapour Power Cycles: Carnot cycle, Rankine Cycle, regenerative cycle, steam cycles for nuclear power plant, back-pressure and extraction turbines and cogeneration. Low-temperature power cycles, ideal working fluid and binary/multi-fluid cycles;
- Steam Generator: subcritical and supercritical boilers, fluidized bed boilers, fire-tube and water-tube boilers, mounting and accessories;
- Condenser;
- Cooling Tower;
- Steam Turbine: Impulse and reaction stage, degree of reaction, velocity triangle, velocity and pressure compounding, efficiencies, reheat factor, governing, nozzles;
- Heat Pump and Refrigeration Cycles: Reversed Carnot cycle and performance criteria vapour compression and vapour absorption refrigerators, gas cycles, refrigerants;
- Air-conditioning;
- Reciprocating Air Compressors: work transfer, volumetric efficiency, isothermal efficieny, multistage compression with intercooling.

ME-305: Mechanical Design **L-T-P-CH-CR: 3-1-0-4-4**

Course Outline:

- Principles of mechanical design;
- Factor of safety, strength, rigidity, fracture, wear and material considerations;
- Stress concentrations; Design for fatigue; Limits and fits; Standardization;
- Design of riveted, bolted and welded joints;
- Rigid and flexible coupling;
- Belt and chain drives; Power screws; Shafts; Keys; Clutches; Brakes; Axles; Springs;
- Design of Gears;

- Lubrication and Wear consideration in design;
- Design and selection of Bearings: Hydrodynamic lubrication theory, Hydrostatic and Hydrodynamic bearings (e.g. Journal), Rolling element bearings.

ME-307: Applied Thermodynamics II **L-T-P-CH-CR: 2-1-0-3-3**

Course Outline:

- IC Engines: Classification - SI, CI, two-stroke, four-stroke; Operating characteristics; Air Standard Cycles - Otto, Diesel and Dual, Real air-fuel engine cycles;
- Thermochemistry of fuels - SI and CI engine fuels, self ignition, octane number, cetane number, alternate fuels etc;
- Combustion;
- Air and fuel injection: injector and carburetor, MPFI etc;
- Gas Power Cycles;
- Introduction to Axial Flow Gas Turbine;
- Introduction to Centrifugal and Axial-Flow Compressors;
- Combustion Chambers;
- Jet Propulsion; Rocket Propulsion; Direct Energy Conversion.

ME-306: Advance Workshop Practice **L-T-P-CH-CR: 0-0-3-6-3**

Course Outline:

- Manufacturing: Measurement of tool angles and radius of single point cutting tool. Determination of cutting forces, shear plane, chip thickness ratio;
- Machine Tools and Machining: Cutting tools, selection of cutting speeds and feed. Machining operations on Lathe, Shaping, Slotting, Milling and Grinding Machines;
- Gas and Arc Welding Processes, Soldering, Brazing;
- Manufacturing Automation: NC, CNC, CAM, FMS.

ME-308: Heat and Mass Transfer **L-T-P-CH-CR: 3-1-0-4-4**

Course Outline:

- Modes of Heat Transfer - Conduction; Convection; Radiation;
- Heat Exchangers: LMTD and NTU methods;
- Heat Transfer enhancement techniques;
- Special heat transfer processes like transpiration and film cooling, ablative cooling;
- Mass Transfer;
- Mass Transfer in boundary layer, flow over a flat plate.

ME-309: Systems and Control **L-T-P-CH-CR: 3-0-0-3-3**

Course Outline:

- Feedback Systems, Mathematical modelling of physical systems;
- Laplace Transforms, block diagrams, signal flow graphs, state-space models;
- Time domain analysis;
- Stability Analysis: Routh-Hurwitz stability criterion, relative stability;
- Proportional, Integral, PI, PD and PID Controllers;
- Lead, Lag and Lag-Lead compensators;
- Root-locus method;
- Frequency response method: Bode diagrams, Nyquist stability criterion, performance specifications, design;
- State-space methods: analysis, design;
- Physical realizations of controllers: Hydraulic, Pneumatic and Electronic controllers.

ME-401: Industrial Systems Engineering **L-T-P-CH-CR: 3-0-0-3-3**

Course Outline:

- Production Planning and Control, Product design, Value analysis and value engineering;
- Plant location and layout; Equipment selection, Maintenance planning;
- Job, batch and flow production method;.
- Group technology, Work study, Time and Motion study;
- Work/Job Evaluation, Inventory control;
- Manufacturing planning: MRP, MRP-II, JIT;
- Quality control;
- Total Quality Management, Taguchi's Quality Engineering;
- Forecasting, Scheduling and Loading, Line balancing, Break-even Analysis;
- FMS, CIMS, Network and Database Systems.

ME 471: Industrial Summer Training **L-T-P-CH-CR: 0-0-0-0-2**

Training will be of 12 weeks duration carried out during the summer break after the 6th semester.

The students will submit their reports in the 7th semester.

ME 481: Project I **L-T-P-CH-CR: 0-0-6-12-6**

The students will carry out project works in groups of 2 or 3 students each under the guidance of a faculty member. The project shall consist of research/ design/ development/ implementation work.

Semester VIII

ME 482: Project II **L-T-P-CH-CR: 0-0-12-24-12**

The students will carry out project works in groups of 2 or 3 students each under the guidance of a faculty member. The project shall consist of research/ design/ development/ implementation work. It may also be a continuation of the Project II work.

Management Courses

Core

BM 321: Fundamentals of Management **L-T-P-CH-CR: 3-0-0-3-3**

Part I

Meaning, Objectives and Scope of Management;

Functions of Management- Planning, Organizing, Staffing, Directing and Controlling;

Styles of Management.

Part II

Basics of Financial Managements; Marketing Management; Human Resource

Management; and Production Management

Textbooks:

1. L. M. Prasad : *Principles and Practice of Management,* Sultan Chand and Sons, New Delhi.
2. V. S. Ramaswamy and S. Namakumari : *Marketing Management*, Macmillan India, Pvt. Ltd., New Delhi.
3. S. S. Khanka : *Human Resource Management*, S. Chand & Company Pvt. Ltd., New Delhi.
4. P. Rama Murty : *Production and Operations Management,* New Age International Publishers, New Delhi.

BM 322: Social Responsibility and Professional Ethics in Engineering **L-T-P-CH-CR: 3-0-0-3-3**

Engineering and Society: What is Engineering ? The Engineering View, The Engineering Image; The Engineer's Challenge: Cost, Deadlines, and Safety;

Moral Dilemmas in Engineering: Engineering & Business;

Frameworks for Engineering Ethics: Moral Thinking and Moral Theories, Codes of Engineering Ethics, Support for Ethical Engineers;

Engineering Ethics and Public Policy: Risk Assessment and Communication, Product Liability, Engineering and Sustainable Development;

Intellectual property: Foundations of intellectual property, Copyrights, patents, and trade secrets, Software piracy, Software patents, Transnational issues concerning intellectual property;

Entrepreneurship: prospects and pitfalls, Monopolies and their economic implications, Effect of skilled labor supply and demand on the quality of computing products, Pricing strategies;

Case Studies in Engineering Ethics: Challenger Disaster, Hyatt Regency Walkway Collapse, The Pfizer Heart Valve Case, The Therac-25 Case etc.

Textbooks/Referencess:

1. *Computers, Ethics and Social Values*, Johnson & Nissenbaum, Prentice Hall.
2. *Social Issues in Computing : Putting Computing in Place*, Huff & Finholt, McGrawHill.
3. *A Gift of Fire : Social, Legal, and Ethical Issues in Computing*, Prentice Hall.
4. *Cyber Ethics : Morality and Law in Cyber Space*, Jones & Bartlett.