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Syllabus

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

Rolles theorem, Cauchy's mean value theorem (Taylor's and Maclaurin theorems with remainders, indeterminate forms, Concavity and convexity of a curve, points of inflexion. Asymptotes and curvature;

Limit, continuity and differentiability of functions of several variables, partial derivatives and their 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 - Language's method of multipliers;

First order differential equations-exact, linear and Bernoulli's form, second order differential equations with constant coefficients, Euler's equations, system of differential equations;

Limit, continuity, differentiability and analyticity of functions Cauchy-Riemann 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;

Fundamental theorem of integral calculus, mean value theorems, evaluation of definite integrals-reduction formulae;

Textbooks
1. Piskunov, N. *Differential and Integral Calculus Vol-I & II*, Mir Publications, Moscow, 1996.
2. Grewal, B.S. *Engineering Mathematics*, S. Chand & Co., New Delhi, 2014.

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, magneto statics, 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. Griffiths, D.J. *Introduction to Electrodynamics*, Prentice Hall of India Pvt. Ltd., New Jersey, 2013.
2. Mahajan, A.S. & Rangwala, A.A. *Electricity and Magnetism,* Tata McGraw Hill Publishing Co. Ltd., 1988.
3. Ghatak, A.K. *Optics,* Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2014.

Reference Books
1. Main, I.G. *Vibrations and Waves in Physics*, Cambridge University Press, Cambridge, 1993.
2. Halliday, D. & Resnick, R. *Fundamentals of Physics*, John Wiley Publication, United Kingdom, 1974.

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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 Fe^{2+}
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.   Rakshit, P.C. *Physical Chemistry*, Sarat Book Distributors, India, 2014.
2.   Dutta, R.L. *Inorganic Chemistry*, New Book Stall, India, 1983.
3.   Finar, I.L. *Organic Chemistry*, Pearson India, India, 1973.

Reference Books
1.   Samuel, *G. Text Book of Physical Chemistry*, D. Van Nostrand Company, New York, 1946.
2.   Lee, J.D. *Concise Inorganic Chemistry*, Oxford University Press, Oxford, 2014.

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.

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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 writings, 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. Longman, O. *English for Engineers and Technologists: A Skill Approach Vol 182*, Anna University, Madras, 1990.
2. Collins, H. *Collins Cobuild English Grammar*, Thomson Learning, India, 1990.
3. Graves, G. *Foundation English for Science Students,* Oxford University Press, Delhi, 1975.

Reference Books
1. Deuter, M., Bradber, J. & ennifer, Turnbull J. *Oxford Advanced Learner's Dictionary (with CD-ROM) 7th ed.*, OUP Oxford, Oxford, 2005.
2. Thomson, A.J. and Martinet, A.V. *A Practical English Grammar*, Oxford University press, 1991.
3. Sudarsanam, K. *Understanding Technical English*, Sterling Publishers Pvt. Ltd., New Delhi, 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 Organization – 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 Disorganization : 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;

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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. Sachdeva, D.R. & Bhusan, V. *An Introduction of Sociology*, Kitab Mahal, Allahabad, 1997.
2. Saksena, S.C. *Business Administration and Management*, Sahitya Bhawan, Agra, 2008.
3. Sarma, R.N. *Principle of Sociology*, Asia Publishing House, Bombay, 1968.

Reference Books
1. Huneryager, S.G. & Hechkmann, I.L. *Human Relation in Management*, South-Western Publishing Company, Cincinnati, 1967.

CE-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. Narayana, K. L. & Kannaaiah, P. *Engineering Graphics*, Tata McGraw Hill, New Delhi, 1988.
2. Bhatt, N. D. *Elementary Engineering Drawing*, Charotar Publishing House, Anand, 2006.

Reference Books
1. Chandra, A. M. & Chandra, S. *Engineering Graphics*, Alpha Science International Ltd., 2003.
2. Venugopal, K. *Engineering Drawing and Graphics + AutoCAD*, New Age International, New Delhi, 1992.

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. Hayt, W.H. & Kemmerly, J.E. *Engineering Circuit Analysis*, McGraw-Hill, 1993.
2. Toro, V.D. *Electrical Engineering Fundamentals*, PHI, New Delhi, 1994.
3. Smith, R.J. & Dorf, R.C. *Circuits, Devices and Systems*, John Wiley & Sons, 1992.

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Reference Books

1. Helfrick, A.D. & Cooper, W.D. *Modern Electronic Instrumentation and Measuring Techniques*, PHI, London, 1990.
2. Golding & Widdis. *Electrical Measurements and Measuring Instruments*, A.H. Wheeler & Company, Calcutta, 1993.
3. Cotton, H. *Advanced Electrical Technology*, Issac Pitman & Sons, London, 1967.
4. Kothari, D.P. & Nagrath, I.J. *Basic Electrical Engineering 2nd Ed*, Tata McGraw-Hill, New Delhi, 2002.

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.

Textbooks
1. Begeman, M. L. & Amstead, B. H. *Manufacturing Process*, John Wiley & Sons Ltd., New York, 1969.
2. Chapman, W.A.J. & Arnold, E. *Workshop Technology Vol. I & II*, Viva Low Priced Student Ed., 1998.
3. Raghuwanshi, B.S. *Workshop Technology Vol. I & II,* Dhanpat Rai & Sons, Delhi, 1998.

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

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

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;

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

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

Textbooks
1. Kreyszig, E. *Advance Engineering Mathematics*, Wiley, 2010.
2. Krishnamurthy, V. Mainra, V.P. & Arora, J.L. *An Introduction to Linear Algebra,* Affiliated East West Press (P) Ltd., New Delhi, 2015.
3. Grewal, B.S. *Engineering Mathematics*, Khanna Publishers, New Delhi, 2014

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.

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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 Beiser, A. *Concepts of Modern Physics*, McGraw-Hill, 2009.
2 Resnick, R. *Introduction to Special Relativity*, John Wiley & Sons, 1979.

Reference Books
1 Kittel, C. *Introduction to Solid State Physics VII Ed.*, Wiley Eastern Ltd, 1995.
2 Schiff L.S. *Quantum Mechanics* , Tata McGraw Hill, New Delhi, 1968.
3 Ghatak, A & Lokanathan, S. *Quantum Mechanics,* Springer Science & Business Media, 2004.

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 Balaguruswamy, E. *Programming in ANSI C*, McGraw-Hill, New Delhi, 2012.
2 Kanetkar, Y. *Let us C*, BPB, New Delhi, 2013.
3 Gottfreid, B.S. *Programming in C*, McGrawHill, 1996.

Reference Books
1. Rajaram, V. & Adabala, M. *Fundamentals of Computers*, PHI Learning Private Limited, New Delhi, 2014.
2. Kerningham, B. W. *The Elements of Programming Style*, McGraw-Hill, New Delhi, 978.
3. Yourdon, E. *Techniques of Program Structures and Design*, Later Printing Ed., 1976.
4. Schied, F.S. *Theory and Problems of Computers and Programming*, McGraw-Hill, New York, 1982.
5. Kerningham, B.W. & Ritchie, D.M. *The C Programming Language*, Prentice Hall, 1988.

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

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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. Kernighan, B.W. & Plauger, P.J. *The Elements of Programming Style*, McGraw Hill, 1978.
2. Kernighan, B.W. & Ritchie, D.M. *The C Programming Language*, Prentice Hall, 1998.
3. Balaguruswamy, E. *Programming in ANSI C*, McGraw-Hill, New Delhi, 2012.

References Books
1. Kanetkar, Y. *Let us C*, BPB, New Delhi, 2013.
2. Gottfreid, B.S. *Programming in C*, McGraw-Hill, 1996.

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. Boylestad, R.L. & Nashelsky, L. *Electronic Devices and Circuit Theory 6th Ed.*, PHI, 2001.
2. Tocci, R.J. *Digital Systems 6th Ed.*, PHI, 2001.
3. Malvino, A.P. *Electronic Principles*, Tata McGraw-Hill, New Delhi, 1993.

Reference Books
1. Millman, J. & Grabel, A. *Micro Electronics 2nd Ed.*, McGraw-Hill, New York 1987.
2. Gayakward, R.A. *Op. Amps and Linear Integrated Circuits*, PHI, New Delhi, 2002.

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

Force systems: Force, moment of a force about a point and about an axis, couple moment as a free vector, equivalent force systems
Equilibrium: Free body diagram, equations of equilibrium; problems in two and three dimensions,
Structural Mechanics: Simple truss, method of joints, method of sections, frames and simple machines
Friction: Laws of coulomb friction, angle of friction, applications to wedge, belt-pulley, power screw, journal bearing, brakes and clutches
Distributed Force System: Centre of mass, centre of gravity, moment of inertia of an area, product of inertia of an area, mass moment of inertia, product of inertia of a mass
Energy Methods: Principle of virtual work, principle of minimum potential energy
Kinematics and Kinetics of particles: Particle dynamics in rectangular coordinates and in terms of path variables; Newton's law for rectangular coordinates, Newton's law for path variables, central force motion
Energy and Momentum Methods for Particle: Conservative force field, principle of work and energy, principle of impulse and momentum, impact.
Kinematics and Kinetics of rigid body: Translation and rotation of rigid body, motion relative to rotating axes, Coriolis acceleration, equations of motion for a rigid body

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Energy and Momentum Methods for Rigid Body: Principle of work and energy for a rigid body, principle of impulse and momentum for the plane motion of a rigid body, introduction to gyroscope

Textbooks
1. Beer, F.P. & Johnston, F.R. *Mechanics for Engineering*, Tata McGraw Hill, New Delhi, 1986.
2. Shames, I.H. *Engineering Mechanics*, Prentice Hall India, New Delhi, 1997.
3. Timoshenko & Young. *Engineering Mechanics 5th Ed.*, McGraw Hill, New Delhi, 2010.

References Books
1. Hibbler, R.C. *Engineering Mechanics 3rd Ed.*, McMillan, 2012.
2. Kumar, K.L. *Engineering Mechanics 4th Ed.*, Tata McGraw Hill, New Delhi, 2010.

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

Reference Books

1. Guyton, *Human Physiology,* Elsevier, 2011.

ES-101: Environmental Science   L-T-P-CH-CR: 4-0-0-4-4

Unit 1 : Multidisciplinary nature of environmental studies
Definition, scope and importance, need for public awareness. (2 lectures)
Unit 2 : Natural Resources :
Renewable and non-renewable resources :
Natural resources and associated problems.
a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources : World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.
• Role of an individual in conservation of natural resources.

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• Equitable use of resources for sustainable lifestyles. (8 lectures)

Unit 3 : Ecosystems
• Concept of an ecosystem.
• Structure and function of an ecosystem.
• Producers, consumers and decomposers.
• Energy flow in the ecosystem.
• Ecological succession.
• Food chains, food webs and ecological pyramids.
• Introduction, types, characteristic features, structure and function of the following ecosystems :-
a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) (6 lectures)

Unit 4 : Biodiversity and its conservation (8 lectures)
• Introduction – Definition: genetic, species and ecosystem diversity.
• Biogeographical classification of India
• Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values
• Biodiversity at global, National and local levels.
• Inida as a mega-diversity nation
• Hot-sports of biodiversity.
• Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
• Endangered and endemic species of India
• Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit 5 : Environmental Pollution (8 lectures)
Definition
• Cause, effects and control measures of :-
a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards
• Solid waste Management : Causes, effects and control measures of urban and
industrial wastes.
• Role of an individual in prevention of pollution.
• Pollution case studies.
• Diaster management: floods, earthquake, cyclone and landslides.

Unit 6 : Social Issues and the Environment (7 lectures)
• From Unsustainable to Sustainable development
• Urban problems related to energy
• Water conservation, rain water harvesting, watershed management
• Resettlement and rehabilitation of people; its problems and concerns. Case
Studies
• Environmental ethics: Issues and possible solutions.
• Climate change, global warming, acid rain, ozone layer depletion, nuclear
accidents and holocaust. Case Studies.
• Wasteland reclamation.
• Consumerism and waste products.
• Environment Protection Act.
• Air (Prevention and Control of Pollution) Act.
• Water (Prevention and control of Pollution) Act
• Wildlife Protection Act
• Forest Conservation Act
• Issues involved in enforcement of environmental legislation.
• Public awareness.

Unit 7 : Human Population and the Environment (6 lectures)
• Population growth, variation among nations.
• Population explosion – Family Welfare Programme.
VII
• Environment and human health.
• Human Rights.
• Value Education.

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• HIV/AIDS.
• Women and Child Welfare.
• Role of Information Technology in Environment and human health.
• Case Studies.

Unit 8 : Field work
• Visit to a local area to document environmental assets river/ forest/grassland/hill/mountain
• Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
• Study of common plants, insects, birds.
• Study of simple ecosystems-pond, river, hill slopes, etc. (Field work Equal to 5 lecture hours)

Textbooks
1. Agarwal, K.C. *Environmental Biology,* Nidi Publ. Ltd., Bikaner, 2001.
2. De, A.K. *Environmental Chemistry*, Wiley Eastern Ltd., New Delhi, 1993.

Reference Books
1. Erach, B, *The Biodiversity of India*, Mapin Publishing Pvt. Ltd., Ahmedabad, 1989.
2. Brunner, R.C., *Hazardous Waste Incineration*, McGraw-Hill, 1989.
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. *Environmental Encyclopedia*, Jaico Publ. House, Mumabai, 2001.

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 diffraction, 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 determination, Solid solution, eutectics, peritectics, eutectoids, peritectoid reactions;

Mechanical Properties: Elastic and plastic behaviour contrasted 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. Shakleford, J.F. *Introduction to Material Science and Engineering 8th Ed.,* Prentice Hall, New Delhi, 2014.
2. Callister, W.D. *Material Science and Engineering - An Introduction*, Wiley, 2002.
3. Raghavan, V. *Materials Science and Engineering - A First Course 5th* ed., PHI, New Delhi, 2010.

References Books
1. Smith, W.F. *Principles of Materials Science*, McGraw Hill, 1996.
2. Dieter, G.E. *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;

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- 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. Bethea, R., Duran B. S. & Boullion T. L. *Statistical Methods for Engineers and Scientists*, 3rd ed., revised and expanded, Marcell Dekker Inc., 1995.
2. Frank, H. & Altheon, S. C. *Statistics: Concepts and Applications*, Cambridge Low Priced Edition, 1994

Reference Books
1. Spiegel, M. R. *Theory and Problems of Probablity and Statistics*, Schaum's Outline Series, Tata McGraw-Hill edition, 2005
2. Papoulis, A. & Unnikrishna, S. *Probability, Random Variables, and Stochastic Processes,*4th ed.*,* McGraw-Hill, 2002

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;

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- 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. Aho, A. V., Hoppcroft, J. E & Ullman, J. E. *Data Structures and Algorithms*, Addision Wesley,1983
2. Horowitz, E. & Sahni, S. *Fundamentals of Data Structures,* Computer Science Press, 1983
3. Tanenbaum, A. S. *Data Structures using C*, Pearson Education India,1990

Reference Books
1. Schild, H. *The Complete References to C++*, Osborne McGraw-Hill, 2003
2. Stroustrup, B. *The C++ Programming Language,* 4th ed.,Addison Wesley, 2013

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
1. Cotton,H., *Advanced Electrical Technology*, CBS Publishers and Distributors, New Delhi, 2004.
2. Nagrath I.J. & Kothari, D.P., *Electrical Machines*, TMH, New Delhi, 2006.
3. Hambley, A.R., *Electrical Engineering: Principles and Applications*, 6th ed., Prentice Hall, 2014.

Reference Books

1. Yamayee,Z.A & Bala, J.L. *Electromechanical Energy Devices an Power Systems*, John Wiley & Sons Inc., 1994.
2. Mohan, N. *Power Electronics: Converters, Applications & Design,* 3rd ed., *John Wiley and Sons, 2003.*

Mechanical Engineering Courses

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

Prerequisites: **ME 102**

Simple Stress and Strain: Introduction, Stress at a point, Types of stress, Strain, Shear and Normal strain. Stress-strain diagram, True stress and True strain, Hooke's law, Poisson's ratio, Material properties for isotropic materials and their relations, Generalized Hooke's law, Stress-strain relationship. Statically indeterminate systems, Stresses induced in compound bars, Thermal stresses and strains.

Transformations of Stress and Strain: Components of stress, Stresses on an inclined plane or Transformation of plane stress, Principal stress and Principal planes, Maximum shearing stress and plane of maximum shearing stress, Mohr's circle for plane stress, Stresses in thin-walled sections, Principal strains, Direction of principal strains and maximum shearing strain, Mohr's circle for plane strain.

Shear Force and Bending Moment diagrams: Axial loaded members, beams, relation between load, shear force and bending moment, drawing of shear force and bending moment diagram for different loading condition of beams.

Torsion: Introduction, circular shaft under torsion, stepped shaft and shaft of varying sections, shafts in series and parallel. Bending Stress in Beams: Stresses due to bending: pure Bending, transverse shear.

Bending of Beams: Pure Bending; Neutral axis; Theory of simple bending (Bending Equation of beam); Section modulus; Combined stresses due to bending, torsion and axially loading;

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Deflection of Beams: Introduction, elastic curve, slope and deflection at a point - double integration method, principle of superposition, Macaulay's method, area moment method.

Energy Methods: Strain energy; Toughness; Resilience; Strain energy due to axial, torsion, bending and transverse shear; Castigliano's theorem; Reciprocity theorem, Principle of virtual work; Minimum potential energy; statically indeterminate systems.

Column: Introduction to buckling, Euler critical (buckling) load for long columns, effective or equivalent length, slenderness ratio.

Miscellaneous topics: Unsymmetrical bending, shear center and shear flow.

Textbooks
1. Beer, F. P. & Jhonston, E. R. Jr. et al. *Mechanics of Materials*, 5th ed., Tata McGraw Hill, New Delhi, 2009
2. Ramamruthan, S. and Narayanan, R. *Strength of Materials*, 18th ed., Dhanpat Rai Publishing Company, New Delhi, 2014

Reference Books
1. Pytel, A. & Singer, F. L. *Strength of Materials*, 4th ed., 1st ISE Reprint, Addision Wesley (AWL), 1999.
2. Rattan, S. S. *Strength of Materials,* 2nd Reprint, Tata McGraw Hill, New Delhi, 2009.
3. Timoshenko, S. *Strength of Materials,* Vol. I and II, 3rd ed., CBS Publ., New Delhi, 2004.
4. Subramanian, R. *Strength of Materials*, 2nd ed., Oxford University Press, New Delhi, 2010.
5. Shames, I. H. & Pitarresi, J. M. *Introduction to Solid Mechanics*, 3rd ed., PHI Learning, 2009.
6. Srinath, L.S*. Advanced Mechanics of Solids*, 2nd ed., Tata McGraw-Hill Publishing Co. Ltd. New Delhi, 2006
7. Popov, E. P. *Engineering Mechanics of Solids*, 2nd ed., PHI, New Delhi, 2009.

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

Prerequisites: **ME 102**

Introduction: Definition of fluid, concept of fluid continuum, fluid properties (viscosity, surface tension, vapour pressure and compressibility etc.), types of fluid, Newton's Law of viscosity, power law model for non Newtonian fluid

Fluid Statics: Forces on fluid element (body force and surface force), pressure force on a fluid element, units and scales in pressure measurement, pressure measurement by Barometer, pressure/vacuum gauges and manometers, hydrostatic forces on plane and curved surfaces, Buoyancy and stability of submerged and floating bodies

Fluid kinematics: Velocity field, description of fluid motion by Lagrangian and Eulerian method, steady and unsteady, uniform and non uniform flow, laminar and turbulent, material derivative, streamline, path line streak line, translation, deformation and rotation of fluid element

Governing equations and its application: Conservation of mass, momentum and energy, governing equations in differential and integral form, Reynolds transport theorem, application of momentum theorem for determination of forces on plane and curved surf aces due to impact of liquid jet and on pipe bends due to flow of fluid, Euler's equation and Bernoulli's equation, Application of Bernoulli's equation, measurement of flow through pipes using venturimeter, orificemeter and pitot tube, flow through orifice and mouthpiece

Physical similarity and dimensional analysis: Importance, geometric, kinematic and dynamic similarity, dimensional analysis, Buckingham's Pi-theorem with applications, Important dimensionaless numbers

Potential flow theory: Stream function, vorticity, velocity potential, uniform flow, source flow; sink flow, vortex flow, superposition of elementary flows, Rankine half body, doublet, and flow past a cylinder

Viscous incompressible flow in duct: Stokes law and determination of viscosity, Navier stokes equations in Cartesian and polar coordinates; exact solution of Navier stokes equations, parallel flow in straight channels, Couette flow and Hagen Poiseuille flow, major and minor loss, friction factor, turbulent pipe flow, Moody's diagram, pipe network analysis of multiple pipe system, Hardy- Cross method

Textbooks
1. Massey, B.S. *Mechanics of fluids*, 7th ed., Taylor and Francis, 2006
2. White, F. M. *Fluid Mechanics*, 7th ed., Tata McGraw Hill, 2010
3. Chakrabarty, S. K. Som and G. Biswas, Introduction to Fluid mechanics and fluid machines, 3rd edition, Tata McGraw Hill, 2012

Reference Books
1. Streeter, V.L., Wylie E.B. & Bedford K. W. *Fluid Mechanics*, 9th ed., Tata McGraw Hill, 2010

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

Classification and Properties of Engineering Materials: Bonds in solids and characteristics of metallic bonding, General classifications, properties and applications of alloy steel, stainless steel, cast iron and non-ferrous materials like copper-aluminum- and nickel- based alloys.

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Introduction to Ceramic, Polymeric and Composites materials

Crystal Systems and Imperfections: Crystallography, Miller Indices for directions and planes, Voids in crystals, Packing density, Crystal imperfections: point, line, surface and volume defects.

Dislocations: Characteristics, Types and generation of dislocations, Deformation mechanisms and strengthening mechanisms in structural materials.

Phase Diagrams and Phase Rules: Principles and various types of phase diagrams, Fe- Fe3C diagram, TTT and CCT diagrams, Heat treatment in Steels, Pearlitic, bainitic and martensitic transformations.

Hot working and cold working of metals: Recovery, re-crystallization and grain growth.

Material testing: Tensile (stress-strain diagrams and related terminologies), Hardness, and Impact testing.

Failure of metallic materials: Creep fatigue and fracture phenomena.

Basic Ideas of Materials Selection and Design.

Textbooks:
1. Callister, W. D. *Material Science and Engineering - An Introduction*, 8th ed., Wiley, 2009.
2. Raghavan, V. *Materials Science and Engineering*, 6th ed., Prentice Hall, 2015

Reference Books
1. Smith, W. F. *Principles of Materials Science*, McGraw Hill, 2003
2. Dieter, G. E. *Mechanical Metallurgy*, 3rd ed., McGraw Hill, 1988
3. Smith, W. F. & Hashemi, J. *Foundations of Materials Science and Engineering*, 5th ed., McGraw-Hill, 2003

ME 211: Basic Thermodynamics   L-T-P-CH-CR: 3-0-0-3-3

Introduction and basic concepts: Basic definitions, thermodynamic systems and control volumes, properties, states, thermodynamic equilibrium, change of state, processes and cycles

Temperature: Zeroth law, thermometers and thermocouple, international temperature scale

Energy transfer: Work transfer, pdV and other types of work transfer, heat transfer, specific heat at constant pressure and volume, latent heat, comparison of heat and work

First law of thermodynamics: First law for a closed system undergoing a cycle and change of state , internal energy, enthalpy, PMM-I, limitations of first law, non-flow and flow processes; steady state, steady flow and transient flow processes; application of first law to steady flow process, steady flow energy equation(SFEE)

Second law of thermodynamics: Kelvin Plank statement, Claussius statement, Irreversibility, Carnot Cycle, Corollaries of Carnot's theorem, Applications of Second Law to closed and open systems, heat engine, heat pump and refrigerator, PMM-II, entropy,Claussius theorem, Claussius inequality, T-ds Relations, entropy principle and its application, entropy generation in closed and open system, absolute entropy and third law of thermodynamics

Availability: Definition, quality concept of energy, Reversible work and irreversibility, Exergy balance in closed and open system, Second law efficiency, Guoy Stodola theorem

Properties of pure substance: Definition, p-v, T-s and h-s diagram of pure substance (water), properties of steam, use of steam tables and charts (Mollier diagram)

Properties of gases and gas mixtures: Ideal gas, Equation of state, ideal gas equation, law of corresponding staes, other equations of state, properties of gas mixture

Thermodynamic property relations: Maxwell relations, T-ds equations, Clausius Clapeyron equation, General relations for change in internal energy, enthalpy, entropy, C_p, C_v etc., Gibbs phase rule.

Textbooks:
1. Cengel, Y. A. and Boles, M. A. *Thermodynamics, an Engineering Approach*, 8th ed., McGraw-Hill Education, 2014.
2. Nag, P.K. *Basic and applied thermodynamics*, 2nd ed., Tata McGraw Hill, 2010.

Reference Books
1. Borgnakke, C. Sonntag, R.E. *Fundamentals of Thermodynamics*, 8th ed., John Wiley & Sons, 2014
2. Moran,M.J., Shapiro,H.N., Boettner,D.D. & Bailey, M.B. *Principles of Engineering Thermodynamics, S.I. version*, 7th ed., John Wiley & Sons, 2011

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

Prerequisites: ME 103

Strength of Materials-Ultimate Tensile and Compression tests on materials, Hardness testing (Rockwell, Vickers and Brinell hardness test), Impact testing (Charpy and Izod impact test), torsion and fatigue 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**

Prerequisites: ME 102

Mechanisms: Kinematics pairs, Degree of freedom, Kinematics chains, Four-link planer mechanisms, Kinematics Inversion, Mobility and range of motion – Grubler's criterion, Grashof's criterion, various types of mechanisms and their applications.

Kinematics analysis of planer mechanisms: Displacement, Velocity and Acceleration analysis, Instantaneous centers, Kennedy theorem of three centers, Coriolis components.

Kinematics synthesis: Classical synthesis technique, Analytical synthesis for four line mechanism and planer mechanisms. Dimensional synthesis, three position synthesis for function generation, path generation.

Cams: Classifications, Cams terminology, Analysis of follower motion, Cam profile, Pressure angle

Gears and Gear trains: Classifications, Gear terminology, Law of gearing, Introduction to Spur, Bevel, Helical and Worm; Simple, Compound and Epicyclic gearing

Static and dynamics force analysis: D' Alembert's principle, Engine force analysis, Dynamically equivalent system, Turning moment diagram and Flywheel, Inertia force in reciprocation parts

Balancing: Balancing of reciprocating and rotary machines, Balancing of single cylinder, multi cylinder, inline, radial & V-engines

Governors: Types of governors; Watt, Porter, Proell, Hartnell and governors, Effort and power of governors

Gyroscope and gyroscopic effects

Textbooks:
1. Ratan, S.S. *Theory of Machines*, 4th ed., Reprint, Tata McGraw Hill, New Delhi, 2014
2. Ghosh, A. & Mallik, A.K. *Theory of Mechanisms and Machines*, 3rd ed., Reprint, Affiliated East-West Press Pvt. Ltd., New Delhi, 2014

References Books
3. Uicker, J. J., Pennock, G. R. & Shighley, J. E. *Theory of Machines and Mechanisms*, 4th ed., Oxford University Press, 2010
4. Bevan, T. *The Theory of Machines*, 3rd ed., Pearson, New Delhi, 2014
5. Erdman, A.G. and Sandor, G.N. *Advanced Mechanism Design: Analysis and Synthesis, Vol-I*, Prentice-Hall Inc., New Jersey, 1997
6. Rao, J.S. and Dukkipati, R. V. *Mechanism and Machine Theory*, 2nd ed., Reprint, New Age Int. Publ., New Delhi2014

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

Prerequisites: ME 203

Introduction to manufacturing processes

Casting processes: Types and stages of casting processes, Various foundry casting techniques viz. sand casting, die casting, continuous casting, centrifugal casting and investment casting, Types and properties of molding materials, pattern materials and core materials, Flow properties of molten metal, Gating and rising systems, Use of chills and chaplets; Principles of solidification of molten metal during casting, Directional solidification, Casting defects and their remedies, Quality assurance.

Joining Processes: Principles and applications of welding, brazing, soldering and solid-state joining processes, Weldability of different materials and their metallurgical and mechanical aspects, Welding defects and inspection.

Metal Forming / working Processes: Principles, analysis and application of various metals forming techniques viz. forging, rolling, extrusion, drawing, sheet metal forming, super plastic deformation, Forming defects and their remedies.

Powder metallurgy and its Applications

Textbooks:
1. Campbell, J. S. *Principles of Manufacturing Materials and Processes*, 1st ed., Tata McGraw Hill, 1995.

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2. Kalpakjian,S. & Schmid,S.R. *Manufacturing Engineering and Technology*, 7th ed., Pearson/Prentice Hall, 2013

Reference Books

1. Ghosh, A. & Mallik, A. K. *Manufacturing Science*, 2nd ed., East West Press, 2010
2. Rao, M. J. *Manufacturing Technology: Foundry, Forming and Welding*, 2nd ed., Tata McGraw Hill, 2009

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

Prerequisites: CE 101

Review of Orthographic Projections and Sectional Views

Screw Threads and Screwed Fastenings: Introduction, Screw thread terminology, Conventional representation of screw threads, Bolts and Nuts, Washers, Drawing of Hexagonal bolt and nuts, Drawing of Square head bolt and nuts, Locking arrangements of nuts.

Riveted joints and Welded joints: Introduction, Riveting, Forms of rivet heads, Different types of Lap joints, Different types of Butt joints, Symbolic representation of weld, Dimensions of welds.

Joints: Introduction, Different types of Keys, Socket and Spigot Cotter Joint, Strap joint with Gib and cotter, Pin or Knuckle joint.

Couplings and Clutches: Introduction; Rigid couplings; Flanged couplings - Unprotected type and Unprotected type; Flexible couplings - Universal coupling, Oldham's coupling; Loose or Disengaging couplings or clutches - Claw coupling or clutch, conical friction coupling or cone friction clutch.

Pipe Joints: Introduction, Flanged pipe joint, Expansion Joints, Pipe Fittings

Limits, Fits and Tolerances: Introduction; Terminology; International Tolerance Grade (IT Grade); Fundamental Tolerances – Letter symbol for holes, Letter symbols for shafts; Systems of fits – Hole basis and Shaft basis; Types of fits,

Bearings: Introduction, Bushed bearing, Plummer block or Pedestal bearing

Assembly Drawing (Heat engine parts, Machine parts, Valves): Introduction, Stuffing boxes, Connection rod, Cross-head, Non-return valve, Screw Jack,

I**ntroduction to solid modelers, use of standard software packages for assembly drawing (Pro-Engineering)**

Textbooks:

1. Bhat, N. D. & Panchal, V. M. *Machine Drawing*, 49th ed., Charotar Publishing House, Court Road, Anand, India, 2014
2. Gopala Krishna, K. R. *Machine Drawing*, 20th ed., Subhas Stores (Book Corner) # 72 Avenue Road, Bamgalore-2, India, 2007

Reference Books

1. John, K. C. *Textbook of Machine Drawing*, PHI, New Delhi, 2010
2. Bhattacharyya,B. *Machine Drawing (Includes AutoCAD Supplements)*, Oxford University Press, New Delhi, 2011
3. Singh,A. *Machine Drawing (Includes AutoCAD)*, Tata McGraw-Hill, New Delhi, 2009
4. Junnarkar, N. D. *Machine Drawing*, Pearson Education, 2009
5. Gill, P. S. *Machine Drawing*, 18th ed., S. K. Kataria & Sons, Delhi, 2013

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

Prerequisites: ME 202

Introduction to Boundary Layer concepts: Boundary layer flow, Boundary layer equations, the flat plate boundary layer, definition of boundary layer, displacement, momentum and energy thickness, Blasius similarity solution, Von karman momentum integral equation, separation of boundary layer. Flow past immersed bodies.

Turbulent flow: Laminar turbulent transition, derivation of Governing equations for turbulent flow, turbulent boundary layer equation, Prandtl's mixing length hypothesis, Universal velocity distribution law, and friction factor correlation

Compressible flow: Introduction, Speed of sound; adiabatic and isentropic steady flow, Mach-number relations, isentropic flow with area changes, Normal-shock wave, Rankine-Hugoniot relations, performance of nozzles, Fanno and Rayleigh flow

Turbo machinery: Euler-equation for turbo-machines, impulse turbine and reaction turbine, Pelton wheel, Francis turbine, Kaplan/propeller turbine, water hammer and surge tank, Rotodynamic and positive displacement pumps, working principle of reciprocating pump, air vessel, Centrifugal pump, its components and working principle,

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performance characteristics of centrifugal pump vis-à-vis system characteristics, dimensionless terms, specific speed, Cavitation and net positive suction head.

Textbooks:
1. Massey, B.S. *Mechanics of fluids*, 7th edition, Taylor and Francis, 2006
2. Chakrabarty, S., Som, S. K. & Biswas, G. I*ntroduction to Fluid mechanics and fluid machines*, 3rd ed., Tata McGraw Hill, 2012
3. Streeter, V.L., Wylie E.B. & Bedford K. W. *Fluid Mechanics*, 9th ed., Tata McGraw Hill, 2010

Reference Books
1. White, F. M. *Fluid Mechanics*, 7th ed., Tata McGraw Hill, 2010
2. Kundu, P.K. Cohen, I.M. & Dowling, D.R. *Fluid Mechanics*, 5th edition, Elsevier, 2012

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

Prerequisites: ME 206 & ME 209

Fluid mechanics Laboratory:

1. Study of the flow characteristics through weirs with rectangular and V- shape neckline.

2. Demonstration of Bernoulli's Theorem

3. Energy losses in pipelines: Determination of minor losses and loss co-efficient in pipe elbows (short and long), valve, sudden expansion and sudden contraction etc.

4. Flow meter demonstration: Determination of discharge coefficients of flow meters (Venturimeter and Orificemeter).

5. Study of Impact of jet on flat, curved and semispherical surfaces.

6. Discharge through Orifice (To determine the flow co-efficient C_c, C_v and C_d)

Theory of Machine laboratory:

1. Study on influence of inertia upon velocity and acceleration.

2. Study of Gyroscope.

3. Study of whirling of shaft phenomena.

4. Study of Centrifugal governor apparatus.

5. Study of static and dynamic balancing of unbalanced system

Reference

1. Chakrabarty, S. K. Som and G. Biswas, Introduction to Fluid mechanics and fluid machines, 3rd edition, Tata McGraw Hill, 2012

ME 209: Partial Differential Equations and Numerical Methods   **L-T-P-CH-CR: 2-1-1-5-4**

Partial Differential Equations: What are partial differential equations 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, Fourier method for Laplace equation in 3 dimensions, Numerical methods for Laplace and Poisson's equation.
Numerical Methods: Truncation errors and the Taylor Series, Gauss elimination, LU decomposition and matrix inversion Gauss Seidel iterative method, Numerical differentiation and integration, Numerical solution of ODE and PDE.
Programming of Numerical Methods: Newton-Raphson, Gauss elimination, Numerical differentiation using Newton's difference formulae, Numerical integration using Simpson's rule, Gauss-Legendre and Runge-Kutta method, Software packages for ODE, PDE and curve fitting.

Textbooks:
1. Chapra, S.C. and Canade, R. P. *Numerical Methods for Engineers*, 6th ed., Tata McGraw-Hill, 2009
2. O'Neil, P. *Advanced Engineering Mathematics*, 7th ed., Cengage Learning, 2011
3. Mathews, J. H. & Fink, K. D*. Numerical Methods using Matlab*, 4th ed., Pearson, 2010

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Reference Books
1. Gerald, C. F. & Wheatley, P. O. *Applied Numerical Analysis*, Addison-Wesley, 2003
2. Riley, K. F., Hobson, M.P. & Bence, S. J. *Mathematical Methods for Physics and Engineering*, Cambridge University Press, 2006
3. Kreyszig, E. *Advanced Engineering Mathematics*, John Wiley & Sons, Australia, 2006

Third & Fourth Year

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

Prerequisites: ME 207

Rigid Body Dynamics: Plane kinematics and kinetics, 3D motions of rigid bodies, Gyrodynamics

Free Response of Single Degree of Freedom System: Small motions about equilibrium, Nature of equilibrium, Response of first-order and second-order systems, Logarithmic decrement, Coulomb damping

Forced Response of Single Degree of Freedom System: Response of first order and second order systems to harmonic excitation, Whirling of rotating shaft, Harmonic motion of support, Response to periodic excitation, Response to arbitrary excitation, Vibration measurement, Time domain and frequency domain analysis

Two Degree of Freedom Systems: Equations of motion using Newton's law, Lagrange's Equation of motion, Free vibration of undamped systems, Orthogonality of modes, Response to initial excitation, Response to harmonic excitation, Undamped vibration absorber.

Multi Degree of Freedom Systems: Influence coefficients, Properties of stiffness and inertia coefficients, Linear transformations, Eigenvalue problem, Orthogonality of modal vectors, Modal analysis.

Continuous Systems: Axial, torsional and flexural vibration of shafts/beams, Boundary value problems-natural frequencies and mode shapes, Orthogonality of mode shapes, Forced vibration solution of continuous system using mode superposition method

Textbooks
1. Uicker, J. J., Pennock, G. R. & Shighley, J. E. *Theory of Machines and Mechanisms*, 4th ed., Oxford University Press, 2010
2. Meirovitch, L. *Elements of Vibration Analysis*, McGraw-Hill India, 2006

Reference Books
1. Rao, S. S. *Mechanical Vibrations*, 5th ed., Prentice Hall, 2010
2. Bevan, T. *The Theory of Machines*, 3rd ed., Pearson, New Delhi, 2014

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

Prerequisites: EL 202

Introduction: Metrology: General concepts, Definition of terms, metrology and methods of measurement, Classification of standards, Accuracy of Measurements Precision, Accuracy, Sensitivity, Calibration, Readability, Repeatability, Magnification; Errors in measurements, Limits, Fits and Tolerances, Interchangeability

Mechanical measurements: Linear measurements, Angular and Taper measurements, Screw thread measurements, Gear measurements, circularity measurements, surface finish, straightness/flatness measurements

Assessing Experimental Data: Static performance characteristics: Errors in measurements: Types and sources of errors, methods of elimination or reduction of error, sensitivity, linearity, resolution etc of instruments. Uncertainty analysis

Statistical analysis of Experimental Data: Gaussian distribution of error, least square method of fiiting data, linear regression method

Dynamic Performance Characteristics: Zero, first and second order instruments, Signal conditioners: bridge circuit, amplifiers, filters etc.

Sensors and Transducers: types, detail description of important transducers.

Measurements: Displacement Measurements, Pressure measurements, Force measurements, Acceleration, Torque measurements, Flow measurements, Temperature measurements, Strain measurements

Textbooks
1. Rajput, R.K. *Mechanical Measurments and Instrumentation*, S. K. Kataria & Sons, New Delhi, 2012
2. Nakra, B.C. & Chaudhury, K.K. *Instrumentation Measurement and Analysis*, 3rd ed., Tata McGraw Hill, New Delhi, 2009.

Reference Books

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1. Beckwith, T.G., Marangoni, R.D. & Lienhard J.H. *Mechanical Measurements*, 6th ed., Pearson Prentice Hall, 2007.
2. Holman, J.P. *Experimental Methods for Engineers*, 6th ed. Tata Mc-Graw Hill, New Delhi, 2001.
3. Jain, R.K. *Engineering Metrology*, 19th ed., Khanna Publishers, New Delhi, 2005.

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

Prerequisites: ME 208

Metal Cutting: Classification of metal removal processes, Mechanics, Chip formation, Surface finish and Machinability, Heat generation and cutting temperature, Cutting fluids.
Cutting Tools: Tool geometry, Tool materials and properties, Tool wear and tool life, Tooling: jigs and fixtures
Setting and Operations on m/c: Lathe, milling, shaping, slotting, planning, drilling, boring, broaching, reaming, grinding, thread rolling and gear cutting machines, Gear hobbing, Super finishing processes, Batch production
CNC Machines: NC, CNC, DNC and FMS
Unconventional Machining: Electro-chemical, Electro-Discharge, Ultrasonic, LASER machining, Electron Beam, Water Jet, Abrasive Jet, Rapid prototyping and rapid tooling

Textbooks
1. Lal, G.K. *Introduction to machining science*, 3rd ed., New Age International Publishers, New Delhi, 2015
2. Hazra Choudhury, S.K., Hazra Choudhury, A.K. & Roy, N. *Elements of Workshop Technology*, 16th ed., Media Promoters & Publishers Pvt. Ltd., Mumbai, 2013.

Reference Books
1. Ghosh, A. & Mallik, A.K., *Manufacturing Science*, East-West Press, New Delhi, 1998.
2. Boothroyd, G. & Knight, W.A. *Fundamentals of Metal machining and Machine Tools*, 3rd ed., CRC press, Boca Raton, 2005
3. Kalpakjian S, & Schmid ,S.R. *Manufacturing Engineering and Technology*, 4th ed., Pearson Education, New Delhi, 2001.

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

Prerequisites: ME 211

Brief review on basic knowledge of thermodynamics
Power cycles: Basic components of vapour power plant, impracticability of Carnot cycle in vapor power systems, Rankine cycle, deviations of actual cycle from ideal cycle, effects of boiler pressure, condenser pressure, superheating on Rankine cycle performance (e.g., efficiency, work output, boiler heat input, etc.) and, modifications of ideal Rankine cycle (e.g., regeneration, reheating), ideal working fluid and binary/multi-fluid cycles, cogeneration, Nuclear power plants, different types and their working, Basic components of Gas Turbine plant, Brayton cycle, deviations of actual cycle from ideal cycle, modifications of ideal Brayton cycle, reheating with inter-cooling, regeneration, combined cycle, low temperature power cycles
Steam Generator (Boiler): Fire-tube and Water-tube boilers, Mountings and Accessories, Sub-critical and Super-critical Boilers, Fluidized Bed Boilers
Condenser: Types of Condensers and their working principle
Steam turbine: Impulse and reaction turbine, compounding of steam turbine, velocity triangle, efficiencies, degree of Reaction, reheat factor, governing of steam turbine
Heat Pump and Refrigeration Cycles: Reversed Carnot cycle, vapor compression and vapor absorption refrigeration cycle, gas cycle refrigeration (reversed Brayton cycle), refrigerants and their properties, innovative refrigeration cycles
Air Conditioning: Properties of atmospheric air, basic definitions, and psychometric processes
Cooling tower: Types (Atmospheric, Natural Draught and Induced Draught Cooling Towers) and their working principle

Textbooks
1. Cengel, Y.A. & Boles, M.A. *Thermodynamics, An Engineering Approach*, 5th ed., Tata McGraw Hill, New Delhi, 2006
2. Nag, P.K. *Basic and applied thermodynamics*, 2nd ed., Tata McGraw Hill, New Delhi, 2010.
3. Nag, P.K. *Power plant Engineering*, Tata McGraw Hill, New Delhi, 2008.

Reference Books
1. Borgnakke, C. & Sonntag R.E. *Fundamentals of Thermodynamics*, 8th ed., John Wiley & Sons, 2013.
2. Moran, M.J. Shapiro, H.N., Boettner, D.D. & Bailey, M.B., *Principles of Engineering Thermodynamics*, S.I. version, 7th ed., John Wiley & Sons, 2014.

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ME-311: Machine Design I   **L-T-P-CH-CR: 2-1-0-3-3**

Introduction to Mechanical Engineering design: Overview of machine design, Need of design, Design procedure, Stress-strain, Strength, Rigidity, Engineering materials, Material considerations in design.
Design against static load: Mode of failure, Factor of safety, Design of Cotter and Knuckle joints, Theories of failure: Maximum normal-stress theory, Maximum shear-stress theory and Distortion-energy theory; Factor of safety,
Design against fluctuating load: Fluctuating stresses, Fatigue failure, Endurance limit, Stress concentration, Notch sensitivity, Soderberg, Goodman and Gerber diagrams, Fatigue design under combined stresses.
Design of Shafts, Keys and Couplings: Shaft design for stresses (axial, bending & torsional) and combined loading, Shaft materials; Introduction to Axle; Types of Keys, Design of Keys; Design of Rigid and Flexible couplings
Joints: Permanent and detachable joints, Design of Welded, Bolted and Riveted joint
Belt and Chain Drives: Flat and V-belts, Belt slip and creep, Stresses in the belts, Belt materials, Chain drives.
Mechanical springs: Helical springs, Leaf springs, spring materials, Design against static and fluctuating load.
Manufacturing Considerations: Standardization, Limits, Fits and Tolerance

Textbooks
1. Bhandari, V.B., *Design of Machine Elements*, 3rd ed., McGraw-Hill Edu. (India) Pvt. Ltd., New Delhi, 2014.
2. Gope, P.C. *Machine Design: Fundamentals and Applications*, PHI Learning Pvt. Ltd., New Delhi, 2012.

Reference Books
1. Bhandari, V.B., *Machine Design: Data book, McGraw-Hill Edu. (India)* Pvt. Ltd., New Delhi, 2014.
2. Sharma, P.C. & Aggarwal D.K., *A Textbook of Machine Design*, 12th ed., S. K. Kataria & Sons, New Delhi, 2014.
3. Spotts, M.F. Shoup,.T.E, Hornberger,.L.E, Jayram,.S.R., Venkatesh, C.V. *Design of Machine Elements*, 8th ed., Pearson Education, New Delhi, 2006.
4. Norton, R.L. *Machine Design – An Integrated Approach*, Pearson, 2nd ed., New Delhi, 2012.
5. Shigley, J.E. Mischke, C.R. Budynas, R.G. & Nisbett, K.J. *Mechanical Engineering Design*, Tata McGraw-Hill, New Delhi, 2008.

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

Prerequisites: ME 210

Metrology: Use of different tools such as external micrometer, indicating micrometer, inside tubular micrometer, plunger and lever type dial indicator, universal bevel protractor, depth gauges (micrometer and digital), sine vice and slip gauge, radius gauge, pitch gauge, filler gauge, sine bar, V-block, C-clamp etc.
Turbomachinery: Demonstration of Centrifugal pump: (i) Introduction to pump characteristic, (ii) Introduction to scaling (dimensional analysis), (iii) Effect of inlet head on pump performance, (iv) System characteristic analysis (determination of operating point)
Demonstration of Plunger pump: (i) Determination of pump characteristics (ii) pressure volume diagram of plunger pump (iii) Determination of volumetric efficiency
Demonstration of Pelton Turbine: (i) Determination of Pelton turbine performance characteristics at various load and speed (ii) Comparison of Pelton wheel performance using spear and throttle valve
Demonstration of Propeller Turbine: (i) Determination of Propeller turbine performance characteristics at various load and speed
Vibration: Compound Pendulum, Kater's pendulum, centre of percussion, bifilar suspension, spring mass system, free vibration of cantilever beam, forced vibration of cantilever beam, undamped vibration absorber, modal and frequency response analysis
Signals and Systems: Time domain and spectral analysis with software such as MATLAB and Labview; Determination of FFT, PSD; Effects of sampling, windowing, leakage, averaging

Textbook
1. Rajput,, R.K. *Mechanical Measurements and Instrumentation*, S. K. Kataria & Sons, New Delhi, 2012.
2. Thomson, W.T. Theory of Vibration with Applications, 4th ed., Prentice Hall, New Jersey, 1988.
3. Massey, B.S. *Mechanics of fluids*, 7th ed., Taylor and Francis, 2006.

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

Prerequisites: ME 303

Manufacturing: Measurement of tool angles and radius of single point cutting tool, Determination of cutting forces and surface roughness with variation of cutting parameters, shear plane, and chip thickness ratio.
Machine Tools and Machining: Cutting tools, Selection of cutting speeds and feeds, Machining operations on lathe, shaping, slotting, milling and grinding machines.
Gas and Arc Welding Processes, Soldering, and Brazing
Manufacturing Automation: NC, CNC, CAM, FMS, NC part programming, Simulation and manufacturing

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Textbooks
1. Chapman, W.A.J. *Workshop Technology Vol. I & II*, 5th ed., Arnold publishers, New Delhi, 1972.
2. Raghuwanshi, B.S. *Workshop Technology Vol. I & II*, 10th ed., Dhanpat Rai & Sons, New Delhi, 2009.

Reference Books
1. Hazra Choudhury, S.K. Hazra Choudhury A.K. & Roy N. *Elements of Workshop Technology*, 12th ed., Media Promoters & Publishers Pvt. Ltd., Mumbai, 2007.
2. Ghosh, A & Mallik, A.K., *Manufacturing Science*, 2nd ed., East-West Press, New Delhi, 1998.
3. Boothroyd, G & Knight, W.A. *Fundamentals of Metal machining and Machine Tools*, 3rd ed., CRC press, Boca Raton, 2005.
4. Kalpakjian, S & Schmid, S.R., Manufacturing Engineering and Technology, 4th ed., Pearson Education, New Delhi, 2001.

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

Prerequisites: ME 304

IC Engines: definition, classifications, various engine components and their working, engine design and operating parameters and its effect on engine performance, air standard cycles: Otto, Diesel and Dual cycle, air fuel engine cycles, analysis of actual cycle and various losses, Important SI and CI engine fuel properties , alternate fuels (LPG, CNG, alcohols, biodiesel, hydrogen, batteries, fuel cell etc.) and their behavior in engine, combustion stoichiometry, Ignition systems, fuel injection systems
Reciprocating air compressor thermodynamics: Process representation in p-V plane, calculation of work done, volumetric and isothermal efficiency, multistage compression with intercooling, optimum pressure ration, advantages of multistage compression with intercooling, work savings through multistage compression
Centrifugal and Axial-Flow Compressors: Centrifugal and axial flow compressor components, working principles, applications, differences between Centrifugal and Axial-Flow compressors
Centrifugal and Axial-Flow Gas Turbines: Centrifugal and axial flow gas turbine components, working principles, applications, differences between Centrifugal and Axial-Flow Gas Turbines
Jet and Rocket Propulsion: Jet propulsion system, thrust, propulsive power, efficiency, turboprop, turbojet, bypass ratio, ramjet, basic theory of rockets and its propulsion
Direct energy conversion devices: Magneto hydrodynamic, thermionic, thermoelectric power generation, working principle of basic hydrogen fuel cell, types of fuel cell, fuel cell thermodynamics

Textbooks
1. Ganesan, V. *Internal combustion Engines*, 3rd ed., Tata McGraw Hill, New Delhi, 2008.
2. Nag ,P.K. *Basic and applied thermodynamics*, 2nd ed., Tata McGraw Hill, New Delhi, 2010.

Reference Books
1. Mathur R.P. & Sharma, M.L. *Internal combustion Engines*, 2nd ed., Dhanpat Rai Pub., New Delhi, 2005.
2. Saravanamuttoo, H.I.H., Rogers G.F.C. & Cohen H. *Gas Turbine Theory*, 4th ed., Pearson, New Delhi, 2003.
3. Fergusan, C.R. & Kirkpatrick, A.T., *Internal Combustion Engines*, John Wiley & Sons, 2001.
4. Srinivasan, S. *Fuel cells: From Fundamentals to Applications*, Springer, US, 2006.

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

Prerequisites: ME 211

Introduction: Modes of heat transfer, Conduction; Convection; Radiation, steady and unsteady heat transfer
Conduction: Fourier law of heat conduction, general heat conduction equation, 1-D and 2-D steady state conduction, conduction though plane and composite wall, critical thickness of insulation, conduction with heat generation, 1-D unsteady conduction-Lumped capacitance and analytical methods
Extended surface heat transfer: Fins, generalized equation for fins, fin performance and design considerations, heat flow through various types of fins (e.g. circular, rectangular and triangular fins)
Convection: Fundamentals, free and forced convection; external and internal flows; laminar and turbulent flow; Forced convection through pipe and over cylinder, order of magnitude analysis of momentum and energy equations; hydrodynamic and thermal boundary layers; dimensional analysis, Nusselt number; Prandtl number, Stanton number, Reynolds-Colburn analogy, Free convection from a vertical, horizontal and inclined plate, Free convection from vertical and horizontal cylinders; heat transfer with phase change (boiling and condensation).
Radiation: Stefan-Boltzmann law; Planck's law; emissivity and absorptivity; radiation heat exchange between black and gray surfaces, Electric network approach for radiation heat exchange, view factor
Heat exchangers: Parallel and counter flow heat exchangers, LMTD and effectiveness-NTU methods of heat exchanger design; correction factor for multipass arrangement, heat transfer enhancement techniques.

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Mass transfer: Molecular diffusion; Fick's law; analogy between heat and mass transfer; evaluation of mass transfer coefficients by dimensional analysis

Textbooks
1. Incropera, F.P. & Dewitt D.P. *Fundamentals of Heat and Mass Transfer*, 5th ed., John Wiley and Sons, 2009.
2. Holman, J.P. *Heat Transfer*, 9th ed., McGraw Hill, 2007.

Reference Books
1. Ozisik, M.N. *Heat Transfer-A Basic Approach*, McGraw Hill, 1985.
2. Bejan, A. *Convective Heat Transfer*, 3rd ed., John Wiley and Sons, New York, 2004.
3. Kreith, F. & Von, M.S. *Principles of Heat Transfer*, 6th ed., Brook and Cole Publication, 2001.

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

Prerequisites: ME 302

Introduction: Linear time invariant systems, Feedback systems, Mathematical modelling of physical systems, Laplace transforms, Block diagrams, Signal flow graphs, State-space models

Time Domain Analysis: First order systems, second order systems, Steady state error

Stability Analysis: Routh-Hurwitz stability criterion, Relative stability

Root-locus Method: Control system design using root locus, Proportional, integral, PI, PD and PID Controllers, Lead, lag and lag-lead compensators

Frequency Response Method: Bode diagrams, Nyquist stability criterion, Performance specifications, design

State-space Methods: State space representation of control system, Analysis and design

Physical Realizations of Controllers: Hydraulic, pneumatic and electronic controllers.

Textbooks
1. Nise, N.S. *Control System Engineering*, 6th ed., Wiley, 2012.
2. Gopal, M. *Control Systems: Principle and Design*, 4th ed., Tata McGraw Hill, New Delhi, 2012.

Reference Books
1. Ogata, K, *Modern Control Engineering*, 5th ed., PHI Learning, New Delhi, 2011.
2. Golnaraghi, F & Kuo, B.C. *Automatic Control Systems*, 9th ed., PHI Learning, New Delhi, 2009.

ME-312: Machine Design II   L-T-P-CH-CR: 3-0-0-3-3

Prerequisites: ME 311

Introduction to design process, morphology of design, designing methods
Brakes: Types of brakes, Energy absorbed by the brakes, Design of Block, Band and Disc brakes (Internal and external shoe) ; Absorption, Transmission and Torsion Dynamometer;
Clutches: Classification, application and design of friction clutches, Disc or Plate clutches, Cone clutches
Power Screw: Forms of thread, I.S.O. Metric screw thread, bolted joint in tension, Torque required for bolt tightening, Stresses in screw, Efficiency of screw.
Design of Gears: Design of Spur gears, Helical gears, Bevel gears and Worm gears, Lewis equation, Lewis form factor, design based on strength dynamic and wear loads.
Design of Gear boxes
Design of Flywheel and Pulleys
Bearings: Types of bearings, Ball and Roller bearings, Static and dynamic load carrying capacity, Load life relationship, Taper roller bearing, bearing materials
Lubrications: Basic mode of lubrication, Hydrodynamic lubrication theory, Hydrostatic and Hydrodynamic bearings (e.g. Journal)
Overview of design of IC engine components
Introduction to the Computer Aided Design, use of design software like pro-E and Ansys

Textbooks:
1. Bhandari, V.B. *Design of Machine Elements*, 3rd ed., McGraw-Hill Edu. (India) Pvt. Ltd., New Delhi, 2014.
2. Gope,P.C., *Machine Design: Fundamentals and Applications*, PHI Learning Pvt. Ltd., New Delhi, 2012.

Reference Books:
1. Bhandari, V.B. *Machine Design: Data book*, McGraw-Hill Edu. (India) Pvt. Ltd., New Delhi, 2014.
2. Faculty of Mechanical Engineering – PSG College of Technology, Design Data (Data book of Engineering), 8th

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ed., Published by Kalaikathir Achchagam, 2007.
3. Shigley, J.E., Mischke, C.R., Budynas, R.G., & Nisbett, K.J. *Mechanical Engineering Design*, Tata McGraw-Hill, New Delhi, 2008.
4. Ramamurti, V. *Computer Aided Mechanical Design and Analysis*, 3rd ed., Tata McGraw Hill, New Delhi, 1996.
5. Burr, A.H. & Cheatham, J.B. *Mechanical Analysis and Design*, 2nd ed., Prentice Hall Inc., 1997
6. Dixon, J.R. *Design Engineering: Inventiveness, Analysis and Decision Making*, Tata McGraw-Hill, New Delhi, 1980.

ME-402: Industrial Engineering & Operation Research   **L-T-P-CH-CR: 3-1-0-4-4**

Industrial Engineering: Introduction, Production Planning and Control, Product design, Value analysis and value engineering, Plant location and layout, Equipment selection, Concepts of maintenance and its philosophy (Breakdown maintenance, preventive maintenance, predictive maintenance, total productive maintenance, world class maintenance), Maintenance planning, Concept of TPM and TQM, Job, batch, and flow production methods, Group technology, Work study, Time and motion study, Incentive schemes, Work/job evaluation, Inventory control-deterministic model only, Manufacturing planning: MRP, MRP-II, JIT, CIM, Quality control - Statistical process control, Acceptance sampling, Total quality management, Taguchi's Quality engineering; Forecasting, Scheduling and loading, Line balancing, Break-even analysis
Operation research: Introduction to operations research, linear programming, Graphical method, Simplex method, Dual problem -statement, Transportation problems and Network models: CPM and PERT, Queuing theory – basic concepts and a simple model

Textbooks
1. Narasimhan, S.L. McLeavey, D.W. & Billington, P.J. *Production, Planning and Inventory Control*, Prentice Hall, 1997
2. Riggs, J.L., *Production Systems: Planning, Analysis and Control*, 3rd ed., Wiley, 1981.

Reference Books
1. Muhlemann, Oakland, J & Lockyer, K. *Productions and Operations Management*, Macmillan, New Delhi, 1992.
2. Taha, H.A., *Operations Research - An Introduction*, Prentice Hall of India, New Delhi, 1997
3. Sharma, J.K. *Operations Research*, Macmillan, New Delhi, 1997.

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

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Management; and Production Management

Textbooks
1. Prasad, L.M. *Principles and Practice of Management,* Sultan Chand and Sons, New Delhi, 2005.
2. Ramaswamy, V.S. & Namakumari S. *Marketing Management*, Macmillan India, Pvt. Ltd., New Delhi, 2009.
3. Khanka, S.S. *Human Resource Management*, S. Chand & Company Pvt. Ltd., New Delhi, 2003.

Reference Books
1. Murty, P.R. *Production and Operations Management,* New Age International Publishers, New Delhi, 2009.

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
1. Johnson, D.G. & Nissenbaum, H. *Computers, Ethics and Social Values*, Prentice Hall, Upper Saddle River, 1995.
2. Huff, C. & Finholt, T. *Social Issues in Computing: Putting Computing in Place*, McGraw-Hill, New York, 1994.
3. Baase, S. *A Gift of Fire: Social, Legal, and Ethical Issues in Computing*, Prentice Hall, Upper Saddle River, 1997.

Reference Books
4. Spinello, R.A. *Cyber Ethics: Morality and Law in Cyber Space*, Jones & Bartlett, USA, 2010.