

Course Structure & Syllabi for B.Tech. in Mechanical Engineering (From 2018 Batch)

Course No.	Course Name	L	T	P	C	Course No.	Course Name	L	T	P	C
Semester - 1						Semester - 2					
CH101	Chemistry	3	1	0	8	MA102	Mathematics - II	3	1	0	8
EE101	Basic Electronics	3	1	0	8	BT101	Introductory Biology	3	0	0	6
MA101	Mathematics - I	3	1	0	8	CS101	Introduction to Computing	3	0	0	6
PH101	Physics - I	2	1	0	6	CS110	Computing Lab	0	0	3	3
CH110	Chemistry Laboratory	0	0	3	3	ME101	Engineering Mechanics	3	1	0	8
ME110/ PH110	Workshop /Physics Laboratory	0	0	3	3	PH102	Physics – II	2	1	0	6
CE101	Engineering Drawing	2	0	3	7	ME110/ PH110	Workshop / Physics Laboratory	0	0	3	3
HS101	HSS English Communication (PP/NP)	2	0	2	0	EE102	Basic Electronics Laboratory	0	0	3	3
	Preparation to SA Courses	0	0	1	0	SA101	Student's Activity Course - 1	0	0	2	0
		15	4	12	43			14	3	11	43
Semester 3						Semester 4					
MA201	Mathematics - III	3	1	0	8	ME221	Fluid Mechanics – II	3	0	0	6
ME211	Thermodynamics	2	1	0	6	ME222	Manufacturing Technology - I	3	0	0	6
ME212	Solid Mechanics - I	2	1	0	6	ME223	Solid Mechanics - II	3	0	0	6
ME213	Engineering Materials	3	0	0	6	ME224	Kinematics of Machinery	2	1	0	6
ME214	Fluid Mechanics – I	2	1	0	6	HS1xx	HSS Elective - I	3	0	0	6
ME215	Machine Drawing	0	0	3	3	ME225	Mechanical Workshop	0	0	6	6
ME216	Mechanical Engg. Lab – I	0	0	3	3	ME226	Mechanical Engg. Lab - II	0	0	3	3
SA101	Student's Activity Course - 2	0	0	2	0	SA202	Student's Activity Course - 3	0	0	2	0
		12	4	8	38			14	1	11	39
Semester 5						Semester 6					
ME311	Heat Transfer	3	0	0	6	ME321	Applied Thermodynamics	3	0	0	6
ME312	Manufacturing Technology - II	3	0	0	6	ME322	Machine Design	2	0	2	6
ME313	Dynamics of Machinery	2	1	0	6	ME323	Mechanical Measurements	3	0	0	6
ME314	Design of Machine Elements	3	0	0	6	ME324	Industrial Engineering and Operations Research	3	0	0	6
EE380	Electrical Machines	3	0	0	6	ME325	Control Systems	3	0	0	6
HS 1xx	HSS Elective - II	3	0	0	6	ME326	Mechanical Engg. Lab - IV	0	0	3	3
ME315	Mechanical Engg. Lab - III	0	0	3	3	MEXXX	Dept. Elective I	3	0	0	6
ME398	BTP Phase I	0	0	3	3	ME399	BTP Phase II	0	0	3	3
		17	1	6	42			17	0	8	42
Semester 7						Semester 8					
HS2XX-2	HSS Elective III	3	0	0	6	HS2XX	HSS Elective - IV	3	0	0	6
EOXXX	Open Elective I	3	0	0	6	EOXXX	Open Elective - III	3	0	0	6
SOXXX	Open Elective - II	3	0	0	6	SOXXX	Open Elective - IV	3	0	0	6
MEXXX	Dept Elective - II	3	0	0	6	MEXXX	Dept Elective - IV	3	0	0	6
MEXXX	Dept Elective - III	3	0	0	6	ME499	BTP IV	0	0	12	12
ME498	BTP III	0	0	6	6			12	0	12	36
ME401	Summer Training (PP/NP)	0	0	0	0						
		15	0	8	38						

CH101 Chemistry (3-1-0-8)

Prerequisite: Nil

Structure and Bonding; Origin of quantum theory, postulates of quantum mechanics; Schrodinger wave equation: operators and observables, superposition theorem and expectation values, solutions for particle in a box, harmonic oscillator, rigid rotator, hydrogen atom; Valence Bond and Molecular Orbital Theories; Hydrogen Molecule; Hybridization; Molecular Symmetry; Electronic Spectroscopy and Lasers. Chemical Thermodynamics and Chemical Kinetics. Coordination compounds: ligand, stereochemistry, crystal field and molecular orbital theories; Bioinorganic chemistry and organometallic chemistry; Chemistry of materials. Stereochemistry of more than two stereo centers, R&S and E&Z nomenclature, Conformation of cyclohexane and 1,2-disubstituted cyclohexane; Pericyclic reactions; Bioorganic chemistry: proteins, enzymes, carbohydrates, nucleic acids and lipids; Natural products: classification and origin of terpenoids, alkaloids and steroids. Macro- molecules (polymers); Solid phase synthesis; Green chemical processes. Modern spectroscopic techniques in structural elucidation of organic compounds (UV-vis, IR, NMR).

Texts:

- [1] P. W. Atkins, Physical Chemistry, 5th edition, ELBS, 2009.
- [2] C. N. Banwell, and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th edition, Tata McGraw-Hill, 2017.
- [3] F. A. Cotton, and G. Wilkinson, Advanced Inorganic Chemistry, 6th edition, Wiley, 1999.
- [4] D. J. Shriver, P. W. Atkins, and C. H. Langford, Inorganic Chemistry, 3rd edition, ELBS, 2008.
- [5] S. H. Pine, Organic Chemistry, 5th edition, McGraw-Hill, 2006.

References:

- [1] I. A. Levine, Physical Chemistry, 4th edition, McGraw-Hill.
- [2] I. A. Levine, Quantum Chemistry, EE edition, Prentice Hall.
- [3] G. M. Barrow, Introduction to Molecular Spectroscopy, International Edition, McGraw- Hill.
- [4] J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry: Principle, structure and reactivity, 4th edition, Harper Collins.
- [5] L. G. Wade (Jr.), Organic Chemistry, Prentice Hall.

EE101 Basic Electronics (3-1-0-8)

Prerequisite: Nil

DC Analysis: Dependent and independent Voltage and current sources, Nodes, Paths, Loops and Branches, Nodal and Mesh Analysis, Superposition, Source Transformations, Thevenins and Nortons Theorems, Maximum Power Transfer. RL, RC and RLC Circuit. AC Circuit Analysis: Sinusoidal Forcing Function, Phasor Relationship for R, L and C, Impedance and Admittance, Phasor Diagrams. Instantaneous Power, Average Power, Complex Power, Apparent Power and Power Factor.

Logic Gates and Combinational Circuits: Number Systems and Binary Codes, Boolean Algebra and Logic Gates, De Morgans Theorems, Sum-of-Product and Product-of-Sum Forms, Algebraic Simplification, Karnaugh-Map Method, Combinational Logic Circuits, Binary Half and Full Adder, Parity Generator-Checker, Sequential Circuits, Storage Elements; NAND and NOR gate Latches, S-R Flip-Flop, J-K Flip Flop, D Flip-Flop, T Flip-Flop, Counters.

Polyphase Circuits: Balanced Three-phase Systems (Star (Y) & Delta ()), Three-phase Power Measurement, Magnetic Circuit: Amperes circuital law, Application of Amperes circuital law in magnetic circuit, Reluctance and permeance, Analysis of Series magnetic circuit, Analysis of Series-parallel magnetic circuit, Flux linkage, self and mutual inductance. Frequency Response: Low pass and High pass RC and RL circuits, Series and Parallel Resonance, Quality factor.

Diodes: Semiconductor Diode, V-I characteristics of Diode, Half-Wave and Full-Wave Rectifier Circuits, Wave Shaping Circuits, Clippers and Clampers, Zener Diodes. Transistors: Bipolar Junction Transistor, MOSFET: Biasing, Small Signal model, Amplifiers. Operational Amplifiers: Ideal Op-Amp, Application of Op-Amp: Comparator, Inverting and non-Inverting Amplifiers, Differential and Integral Amplifier, Adder-Subtractor.

Texts/ References:

- [1] W. H. Hayt, J. E. Kemmerly, and S. M. Durbin, Engineering Circuit Analysis, 8th edition, McGraw-Hill, 2013.
- [2] R. J. Smith and R. C. Dorf, Circuits, Devices and Systems, 5th edition, John Wiley India, 2007.
- [3] R. L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, 11th edition, Pearson, 2012.
- [4] N. S. Widmer, G. L. Moss, and R. J. Tocci, Digital Systems, 12th edition. Pearson, 2017.
- [5] V. D. Toro, Electrical Engineering Fundamentals, 2nd edition. PHI, 2014.

MA101 Mathematics I (3-1-0-8)

Prerequisite: Nil

Single variable Calculus: Convergence of sequences and series of real numbers; Continuity of functions; Differentiability, Rolle's theorem, mean value theorem, Taylor's theorem; Power series; Riemann integration, fundamental theorem of calculus, improper integrals; Application to length, area, volume and surface area of revolution.

Multivariable Calculus: Vector functions of one variable - continuity and differentiability; Scalar valued functions of several variables, continuity, partial derivatives, directional derivatives, gradient, differentiability, chain rule; Tangent planes and normals, maxima and minima, Lagrange multiplier method; Repeated and multiple integrals with applications to volume, surface area; Change of variables; Vector fields, line and surface integrals; Green's, Gauss' and Stokes' theorems and their applications.

Texts:

- [1] G. B. Thomas, Jr. and R. L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson Education India, 1996.

References:

- [1] R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd edition, Wiley India, 2005.
- [2] S. R. Ghorpade and B. V. Limaye, An Introduction to Calculus and Real Analysis, Springer India, 2006.
- [3] T. M. Apostol, Calculus, Volume-II, 2nd edition, Wiley India, 2003.
- [4] J. E. Marsden, A. J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer India, 2002.

PH101 Physics I (2-1-0-6)

Prerequisite: Nil

Calculus of variation: Fermats principle, Principle of least action, Euler-Lagrange equations and its applications.

Lagrangian mechanics: Degrees of freedom, Constraints and constraint forces, generalized coordinates, Lagrange's equations of motion, Generalized momentum, Ignorable coordinates, Symmetry and conservation laws, Lagrange multipliers and constraint forces.

Hamiltonian mechanics: Concept of phase space, Hamiltonian, Hamilton's equations of motion and applications.

Special Theory of Relativity: Postulates of STR. Galilean transformation. Lorentz transformation. Simultaneity. Length Contraction. Time dilation. Relativistic addition of velocities. Energy momentum relationships.

Quantum Mechanics: Two-slit experiment. De Broglie's hypothesis. Uncertainty Principle, wave function and wave packets, phase and group velocities. Schrodinger Equation. Probabilities and Normalization. Expectation values. Eigenvalues and eigenfunctions.

Applications in one dimension: Infinite potential well and energy quantization. Finite square well, potential steps and barriers - notion of tunnelling, Harmonic oscillator problem zero-point energy, ground state wavefunction and the stationary states.

Texts:

- [1] R. Takwale and P. Puranik, Introduction to Classical Mechanics, 1st Edition, Mc-Graw Hill Education, 2017.
- [2] John Taylor, Classical mechanics, University Science Books, 2005.
- [3] R. Eisberg and R. Resnick, Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, 2nd Edition, John-Wiley, 2006.

References:

- [1] Patrick Hamill, A Students Guide to Lagrangians and Hamiltonians, Cambridge University Press, 1st edition, 2013.
- [2] M. R. Spiegel, Theoretical Mechanics, Tata McGraw Hill, 2008.
- [3] R. P. Feynman, R. B. Leighton, and M. Sands, The Feynman Lectures on Physics, Volume I, Narosa Publishing House, 1998.
- [4] R. Resnick, Introduction to Special Relativity, John Wiley, Singapore, 2000.
- [5] S. Gasiorowicz, Quantum Physics, John Wiley (Asia), 2000.

ME110 Workshop I (0-0-3-3)

Prerequisite: Nil

Familiarization with workshop practice, safety, health and environmental issues, demonstrations in machine, carpentry, fitting, welding and foundry shops. Introduction to different welding processes, demonstration of gas, TIG, MAG and submerged arc welding processes, simple exercises in shielded metal arc welding. Introduction to wood working, hand tools and machines, simple exercises in wood working including making of a simple pattern for foundry. Introduction to foundry shop, exercises in green sand molding and CO₂ molding, demonstration of shell molding; familiarization with melting and pouring practices. Introduction to bench work and fitting, simple exercises involving filing, sawing, drilling and tapping. Assembly of the models of CNC machines and exposure to part programming. Practice on working with sheet-metal/ plastic/ glass/ composite.

Texts:

- [1] Department of Mechanical Engineering, IIT Guwahati, Workshop Practice Manual, Vidya Mandir, Guwahati, 2018.

References:

- [1] S. K. H. Choudhury, A. K. H. Choudhury and N. Roy, Elements of Workshop Technology, Volume I: Manufacturing Processes, Media Promoters, 2008.
- [2] H. Gerling, All About Machine Tools, 2nd Edition, New Age International, 2006.
- [3] W. A. J. Chapman, Workshop Technology, 4th Edition, Viva Books, 1998.
- [4] HMT, Mechatronics, McGraw Hill Education, New Delhi, 2017.

PH110 Physics Laboratory (0-0-3-3)

Prerequisite: Nil

Experiments on general physics: Mechanics (compound pendulum etc.), Optics (single slit, Newton's ring etc.), Fluids (Jaeger's method etc.), and Electricity and Magnetism (Magnetic field, LCR circuit, etc.).

Texts:

- [1] Department of Physics, IIT Guwahati, Laboratory Manual with details about the experiments.
- [2] F. A. Jenkins and H. E. White, Fundamentals of Optics, Tata McGraw-Hill, 1981.
- [3] D. Halliday and R. Resnick, Fundamental of Physics, Wiley India Pvt. Limited, 2008.
- [4] D. J. Griffiths, Introduction to Electrodynamics, 3rd Edition, Prentice Hall of India, 2005.

CE101 Engineering Drawing (2-0-3-7)

Prerequisite: Nil

Importance of engineering drawing; Conventions and standards: ISO; Orthographic projections: points, lines, planes and solids; Sections of solids; Isometric projections; Development of surfaces; Intersection of solids., Introduction to a Computer Aided Drafting software, basic commands of two-dimensional drafting. Application of orthographic and isometric Projections in the software.

References:

- [1] N. D. Bhatt and V. M. Panchal, Engineering Drawing Plane and Solid Geometry, 53rd Edition Charator Publishing House, 2014.
- [2] K. Venugopal and V. Prabhu Raja, Engineering Drawing+ AutoCAD, 5 th Edition, New Age International, 2011.
- [3] D. A. Jolhe, Engineering Drawing with an Introduction to AutoCAD, McGraw Hill Education 2017.

HS101 English Communication (2-0-2-0)

Only for students lagging language proficiency, Non-Credit Course, Grading: PP-Passed/ NP-Not Passed

Prerequisite: Nil

General proficiency in English and Communication skills.

Listening: What is listening, difference between listening and speaking, barriers to listening, effective listening strategies, comprehending social conversation, comprehending narrations and academic lectures; **Speaking:** Understanding accent (intelligibility, Indian and non-Indian accents), nuances of fluency; understanding effective speaking strategies, using language in various situations such as introducing oneself and others on formal and informal situations, asking for information and giving information, describing people, places and objects, narrating events, explaining processes and products, expressing opinions, arguing, giving instructions, taking part in conversation and group discussions understanding turn taking strategies, making short presentations.

Reading: Reading simple narratives and comprehending the gist, identifying topic sentences, identifying cohesive devices and their functions, comprehending texts of different genres and content matter.

Vocabulary: understanding different aspects of a word, learning various strategies to develop vocabulary, using a dictionary for developing vocabulary.

Grammar: Revising grammar already learnt - use of articles, quantifiers, punctuation, use of tenses, gerunds and infinitives, present participles, subject verb concord, adverbs, nouns, pronouns, prepositions, use of connectives, use of adjectives and adverbs, common errors.

Writing: Writing short paragraphs with the help of topic sentences, cohesive devices, writing narratives of minimum three paragraphs, developing information transfer skills, summarising and paraphrasing, note-taking, note- making, writing short reviews, writing short reports.

Texts:

- [1] John Eastwood, Oxford Practice Grammar. Oxford University Press, New Delhi, 1992.
- [2] O'Dell and McCarthy, English Vocabulary in Use. Cambridge University Press. New Delhi, 2002.
- [3] Jayashree Mohanraj, et al (Eds), Speak Well, First Edition, Orient Blackswan, 2012.

References:

- [1] Oxford Advanced Learners Dictionary of English, Ninth Edition, 2016.
- [2] Nitin Bhatnagar and Mamta Bhaatnagar, Communicative English for Engineers and Professionals, Pearson, 2010.

MA102 Mathematics II (3-1-0-8)

Prerequisite: Nil

Linear Algebra: Systems of linear equations, matrices, Gaussian elimination, echelon form, column space, null space, rank of a matrix, inverse and determinant; Vector spaces (over the field of real and complex numbers), subspaces, spanning set, linear independence, basis and dimension; Linear transformations, rank-nullity theorem, matrix of a linear transformation, change of basis and similarity; Eigenvalues and eigenvectors, algebraic and geometric multiplicity, diagonalization by similarity; Inner product spaces, Gram-Schmidt process, orthonormal basis; Orthogonal, Hermitian and symmetric matrices, spectral theorem for real symmetric matrices.

Ordinary Differential Equations: First order differential equations exact differential equations, integrating factors, Bernoulli equations, existence and uniqueness theorem, applications; Higher-order linear differential equations solutions of homogeneous and nonhomogeneous equations, method of variation of parameters, operator method; Series solutions of linear differential equations, Legendre equation and Legendre polynomials, Bessel equation and Bessel functions of first and second kinds; Systems of first-order equations, phase plane, critical points, stability.

Texts:

- [1] D. Poole, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole, 2005.
- [2] S. L. Ross, Differential Equations, 3rd Edition, Wiley India, 1984.

References:

- [1] G. Strang, Linear Algebra and Its Applications, 4th Edition, Brooks/Cole India, 2006.
- [2] K. Hoffman and R. Kunze, Linear Algebra, 2nd Edition, Prentice Hall India, 2004.
- [3] E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India, 1995.
- [4] E. L. Ince, Ordinary Differential Equations, Dover Publications, 1958.

BT101 Introductory Biology (3-0-0-6)

Prerequisite: Nil

Evolution of life: Origin of Life; Darwin's concepts of evolution; Biodiversity. Cell, the structural and functional unit of life: Three domains of life; cell types, cell organelles and structure; Basic biomolecules of cell.

Nutrients, bioenergetics and cell metabolism: Essential nutrients to sustain life; biological energy and laws of thermodynamics, basics of aerobic and anaerobic glycolysis and citric acid cycle.

Genes and chromosomes: DNA, DNA replication; Central dogma of molecular biology: Transcription and translation; Mendelian Genetics; Genetic engineering/Cloning and its applications.

Biological systems: Body systems required to sustain human physiology, special sense organs including hearing, taste, smell and visual receptors.

Texts:

- [1] J. L. Tymoczko, J. M. Berg and L. Stryer, Biochemistry, 8th Edition, W. H. Freeman & Co, 2015.
- [2] D. L. Nelson and M. M. Cox, Lehninger Principles of Biochemistry, 7th Edition, Macmillan Worth, 2017.

References:

- [1] N. Hopkins, J. W. Roberts, J. A. Steitz, J. Watson and A. M. Weiner, Molecular Biology of the Gene, 7th Edition, Benjamin Cummings, 1987.
- [2] C. R. Cantor and P. R. Schimmel, Biophysical Chemistry, Parts I, II and III, W.H. Freeman & Co., 1980.
- [3] C. C. Chatterjee, Human Physiology, Volumes 1 and 2, 11th Edition, Medical Allied Agency, 1987.
- [4] B. K. Hall, Evolution: Principles and Processes, 1st Edition, Jones & Bartlett, 2011.

CS101 Introduction to Computing (3-0-0-6)

Prerequisite: Nil

Introduction to Computers: the von Neumann architecture, low/high level language, compiler, interpreter, loader, linker, operating system, flowchart, programming environment.

Concepts of programming (using C): Data types, variables, operators, expressions, statements, control structures, functions, parameter passing, recursion, arrays and pointers, records (structures), memory management, files.

Program development lifecycle. Algorithms, efficiency, correctness, implementation, verification, assertions, pre/post conditions, invariants, testing.

Fundamental data structures: arrays, stacks, queues, linked lists. Searching and sorting. Introduction to object-oriented programming.

Texts:

- [1] A. Kelly and I. Pohl, A Book on C, 4th Edition, Pearson Education, 1999.

References:

- [1] Y. N. Patt and S. J. Patel, Introduction to Computing Systems: From Bits and Gates to C and Beyond, 2nd Edition, McGraw Hill, 2004.
- [2] B. Kernighan and D. Ritchie, The C Programming Language, 4th Edition, Prentice Hall of India, 1988.
- [3] M. A. Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson, 2002.
- [4] R. G. Dromey, How to Solve it by Computer, 1st Edition, Pearson Education, 2008.

CS110 Computing Laboratory (0-0-3-3)

Prerequisite: Nil

Programming Laboratory will be set in consonance with the material covered in CS101. This will include assignments in a programming language like C.

References:

[1] B. Gottfried and J. Chhabra, Programming With C, Tata McGraw Hill, 2005.

ME101 Engineering Mechanics (3-1-0-8)

Prerequisite: Nil

Equivalent Force Systems: concentrated and distributed force systems, simplest resultant (wrench), centre of pressure, centroid, and centre of gravity.

Equilibrium of Rigid Bodies: free body diagram, reactions, equations of equilibrium, static indeterminacy.

Analysis of Structures: analysis of trusses, method of joints and method of sections, analysis of frames and beams, shear force and bending moment, axial force and twisting moment.

Friction: concept of friction, applications of friction to simple machines; rolling resistance.

Virtual Work: principle of virtual work and its application to machines.

Moment of Inertia: moments of inertia of simple and composite bodies, moments of inertia under transformation of axes, principle axes and principle moments of inertia, Mohr's circle.

Kinematics of Particles and Rigid Bodies: rectilinear motion, curvilinear motion, velocity and acceleration in cylindrical and path coordinate system, relative and constrained motion, rate of change of a vector in a rotating frame, three-dimensional motion of a particle relative to a rotating frame, rigid body kinematics.

Kinetics of Systems of Particles and Rigid Bodies: linear and angular momentum of a system of particles and a rigid body, kinetic energy of a system of particle and a rigid body, linear and angular momentum principles, Euler equation of motion.

Impact of Rigid Bodies: linear and angular impulse, impulse-momentum principle, work-energy principle, central and eccentric impacts.

References:

[1] I. H. Shames, Engineering Mechanics: Statics and Dynamics, 4th Edition, PHI, 2002.

[2] F. P. Beer, E. R. Johnston Jr., D. F. Mazurek, P. J. Cornwell, S. Sanghi, Vector Mechanics for Engineers Statics and Dynamics, 10th Edition, McGraw Hill, 2013.

[3] J. L. Meriam, L. G. Kraige, Engineering Mechanics Statics, 7th Edition, John Wiley, 2012.

PH102 Physics II (2-1-0-6)

Prerequisite: Nil

Electrostatics: Gauss's law and its applications, Divergence and Curl of Electrostatic fields, Electrostatic Potential, Boundary conditions, Work and Energy, Conductors, Capacitors, Laplace's equation, Method of images, Boundary value problems in Cartesian Coordinate Systems, Dielectrics, Polarization, Bound Charges, Electric displacement, Boundary conditions in dielectrics, Energy in dielectrics, Forces on dielectrics.

Magnetostatics: Lorentz force, Biot-Savart and Ampere's laws and their applications, Divergence and Curl of Magnetostatics fields, Magnetic vector Potential, Force and torque on a magnetic dipole, Magnetic materials, Magnetization, Bound currents, Boundary conditions.

Electrodynamics: Ohm's law, Motional EMF, Faraday's law, Lenz's law, Self and Mutual inductance, Energy stored in magnetic field, Maxwell's equations, Continuity Equation, Poynting Theorem, Wave solution of Maxwell Equations.

Electromagnetic waves: Polarization, reaction and transmission at oblique incidences.

Texts:

[1] D. J. Griffiths, Introduction to Electrodynamics, 3rd Edition, Prentice Hall of India, 2005.

References:

[1] N. Eda, Engineering Electromagnetics, Springer, 2005.

[2] M. N. O. Sadiku, Elements of Electromagnetics, Oxford, 2006.

[3] R. P. Feynman, R. B. Leighton and M. Sands, The Feynman Lectures on Physics, Volume II, Narosa Publishing House, 1998.

[4] I. S. Grant and W. R. Phillips, Electromagnetism, John Wiley, 1990.

EE102 Basic Electronics Laboratory (0-0-3-3)

Prerequisite: Nil

Experiments based on the syllabus of EE101 Course.

MA201 Mathematics III (3-1-0-8)

Prerequisite: Nil

Complex analysis: Complex numbers and elementary properties; Complex functions limits, continuity and differentiation, Cauchy-Riemann equations, analytic and harmonic functions, elementary analytic functions, anti-derivatives and line (contour) integrals, Cauchy-Goursat theorem, Cauchy's integral formula, Morera's theorem, Liouville's theorem, Fundamental theorem of algebra and maximum modulus principle; Power series, Taylor series, zeros of analytic functions, singularities and Laurent series, Rouché's theorem and argument principle, residues, Cauchy's Residue theorem and applications, Möbius transformations and applications.

Partial differential equations: Fourier series, half-range Fourier series, Fourier transforms, finite sine and cosine transforms; First order partial differential equations, solutions of linear and quasilinear first order PDEs, method of characteristics; Classification of second-order PDEs, canonical form; Initial and boundary value problems involving wave equation and heat conduction equation, boundary value problems involving Laplace equation and solutions by method of separation of variables; Initial boundary value problems in non-rectangular coordinates.

Laplace and inverse Laplace transforms, properties, convolutions; Solution of ODEs and PDEs by Laplace transform; Solution of PDEs by Fourier transform.

Texts:

[1] J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7th Edition, McGraw Hill, 2004.

[2] I. N. Sneddon, Elements of Partial Differential Equations, McGraw Hill, 1957.

[3] E. Kreyszig, Advanced Engineering Mathematics, 10th Edition, Wiley, 2015.

References:

[1] J. H. Mathews and R. W. Howell, Complex Analysis for Mathematics and Engineering, 3rd Edition, Narosa, 1998.

[2] S. J. Farlow, Partial Differential Equations for Scientists and Engineers, Dover Publications, 1993.

[3] K. Sankara Rao, Introduction to Partial Differential Equations, 3rd Edition, Prentice Hall of India, 2011.

ME 211 Thermodynamics (2-1-0-6)

Thermodynamic systems; States, processes, Zeroth law; Properties of pure substances and steam, Mollier diagram; Heat and work transfer, First law and its applications to closed and open systems; Second law, Carnot cycle, entropy, corollaries of the second law; irreversibility and exergy analysis; Thermodynamic property relations; Properties of mixtures of ideal gases; and characteristic constants for mixture; Thermodynamic cycles: Air Standard cycles and vapour power cycles, refrigeration cycles.

Texts:

[1] Y. A. Cengel and M. A. Boles, Thermodynamics, An Engineering Approach, Tata McGraw Hill, 2003

[2] R. E. Sonntag, C Borgnakke and G. J. Van Wylen, Fundamentals of Thermodynamics, John Wiley, 2003.

[3] M. J. Moran and H N Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley, 1995

References:

- [1] J. P. Howell and P. O. Buckius, Fundamentals of Engineering Thermodynamics, McGraw Hill, 1992.
- [2] G. F. C. Rogers and Y. R. Mayhew, Engineering Thermodynamics Work and Heat Transfer, Pearson 2003.

ME 212 Solid Mechanics - I (2-1-0-6)

Prerequisite: ME 101 Engineering Mechanics or equivalent

Analysis of stresses in solids: 3D state of stress at a point, principal stresses, Mohr's circle representation, analysis of deformation of solids: 3D state of strains, principal strains; constitutive relations for isotropic materials, theories of failure for isotropic materials, axially loaded members, shear force and bending moment diagrams, stresses due to bending of beam elements, torsion of circular shafts, combined stresses in beam elements due to bending, torsion an axial loads, deflection of beam elements, stresses in thin cylinders and pressure vessels, buckling of columns.

Texts:

- [1] E. P. Popov, Engineering Mechanics of Solids, Prentice Hall, 1998.
- [2] F. P. Beer, E. R. Johnston (Jr.) and J.T. DeWolf, Mechanics of Materials, Tata McGraw Hill, 2005.

References:

- [1] S. H. Crandall, N. C. Dahl, and T. J. Lardner, An Introduction To The Mechanics Of Solids, 2nd Ed., Tata McGraw Hill, 2008.
- [2] S. P. Timoshenko, Strength of Materials, Vols. 1 & 2, CBS Publishers, 1986.
- [3] H. Shames and J. M. Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India, 2003.
- [4] J. M. Gere, Mechanics of Materials, Thomson Brooks/Cole, 2006.

ME 213 Engineering Materials (3-0-0-6)

Introduction to engineering materials. Introduction to atomic structure and bonding in solids. Crystallography: crystal systems and lattices, various types of crystal structure, simple cubic, FCC, BCC, HCP, Tetragonal, CsCl, NaCl, Zinc Blend, diamond cubic. Miller indices for directions and planes. Atomic packing density in crystals: planar density and volume density, voids in crystals. Crystal imperfections: point defects, line defects, dislocations, surface and volume defects, grain boundary, twin boundary, twist boundary, partial dislocations, stacking faults. Deformation mechanisms: critical resolved shear stress, strain hardening, Frank Read source of dislocation generation, Bauschinger effect, strain ageing. Strengthening mechanisms in metals. Basic principles of solidification and concept of critical radius. Phase diagrams: principles and types of phase diagrams, iron carbon equilibrium phase diagram, TTT and CCT diagrams: pearlitic, martensitic, and bainitic transformations. Various heat treatment processes and hardenability of steels. Hot working and cold working of metals. Recovery, recrystallization and grain growth phenomenon. Mechanical testing of metals: tensile test, compression test, hardness test, fatigue test, creep test, impact test; failure analysis. General classifications, properties and applications of different alloy systems steels: tool steels, stainless steels, cast irons, copper base alloys, aluminum base alloys, nickel base alloys. Introduction to composites, ceramics and polymers.

Texts:

- [1] G. E. Dieter, Mechanical Metallurgy, McGraw Hill, 3rd Ed., 2013.
- [2] W. D. Callister, Material Science and Engineering and Introduction, Wiley, 9th Ed., 2013.
- [3] V. Raghavan, Materials Science and Engineering, Prentice Hall India, 6th Ed., 2015.

References:

- [1] S. R. Askland and P.P. Phule, The Science and Engineering of Materials, 7th Ed., 2016.
- [2] V. Singh, Physical Metallurgy, Standard Publishers, 2010.
- [3] T.V. Rajan, C.P. Sharma and A. Sharma, Heat Treatments: Principles and Techniques, PHI, 2nd Ed., 2011.
- [4] J. F. Shackelford and M.K. Muralidhara, Introduction of Materials Science for Engineers, Pearson, 6th Ed., 2006.
- [5] W. F. Smith, Principles of Materials Science, McGraw Hill, 3rd Ed., 1996.
- [6] Michael F. Ashby, Engineering Materials 1: An Introduction to Properties, Applications and Design, Elsevier, 4th Ed., 2011.

ME 214 Fluid Mechanics - I (2-1-0-6)

Introduction; Basic ideas of continuum, fluid properties including viscosity, surface tension and vapour pressure, Fluid Statics: Hydrostatic pressure distribution, Manometry, Forces on submerged bodies,

Buoyancy and Floatation, Stability of floating bodies, Pressure distribution in rigid body motion, Fluid Kinematics: Lagrangian and Eulerian descriptions, Deformation of fluid element, Strain rates, Vorticity, Flow description using pathline, streamline and streak line, Conservation laws: Reynolds Transport Theorem, Integral form of conservation laws – mass, linear momentum, angular momentum and energy, Differential form of conservation laws, Elementary derivation of Navier-Stokes equations, Exact solution to Navier-Stokes equations: Couette flow and Poiseuille flow, Inviscid flows: Bernoulli equation and applications, overview of various losses. Plane potential flows: Streamfunction-velocity potential, superposition, source, sink, Doublet, Rankine half body, flow past a cylinder, circulation, D'Alembert's Paradox. Dimensional analysis: Buckingham Pi theorem, dimensionless groups, similitude laws and scaling, practical applications.

Texts:

- [1] F. M. White, Fluid Mechanics, Tata McGraw-Hill, 2008.
- [2] R. W. Fox, A.T. McDonald and P.J. Pritchard, Introduction to Fluid Mechanics, John Wiley, 2004
- [3] B. R. Munson, D. F. Young and T. H. Okhiishi, Fundamentals of Fluid Mechanics, Wiley India Edition, 2002.

References:

- [1] J. F. Douglas, J.M. Gasiorek, J. A. Swaffield and L.B. Jack, Fluid Mechanics, Pearson Education, 2008.
- [2] Y. A. Cengel and J.M. Cimbala, Fluid Mechanics, Tata McGraw-Hill, 2006.
- [3] M. C. Potter, D. C. Wiggert and B. H. Ramadan, Mechanics of Fluids, Cengage Learning, 2012.

ME 215 Machine Drawing (0-0-3-3)

Introduction to computer aided drafting, IS/ISO codes; Limits, tolerances and Fits, Surface finish; Important symbols in machine drawing. Assembly and part drawings of simple assemblies and sub-assemblies of machine parts viz., couplings, clutches, bearings, gear assemblies, I.C. Engine components, valves, machine tools, etc.

Texts:

- [1] N. D. Bhatt, Machine Drawing, Charotar Publishing House Pvt Ltd, 2016.
- [2] N. Sidheswar, P. Kanniah and V.V.S. Sastry, Machine Drawing, Tata McGraw Hill, 2001
- [3] SP 46: 1988 Engineering Drawing Practice for School & Colleges. Bureau of Indian Standards
- [4] K. R..Gopalakrishna, Machine Drawing, 9th Ed., Subhas Stores, Bangalore, 2005.

ME 216 Mechanical Engineering Laboratory I (0-0-3-3)

Strength of materials: Tensile testing, hardness, torsion, beam bending, photoelasticity, beam deflection, column buckling, thin cylinder, fatigue testing and impact testing.

Material Sc.: Microscopic techniques, determination of volume fraction of different phases in material including metals, estimation of grain sizes, study of heat affected regions in welded steel specimen, effect of different medium cooling on hardness, microstructure study of MS hardened through different medium cooling, Introduction to crystallography, measurement of residual stress, indentation creep, 3D printing.

Fluid Mechanics and hydraulics: Free and Forced Vortex, Head Losses in Piping System, Flow through restrictive passage such as Venturimeter/ Orificemeter etc., Air Flow Bench (Drag Force measurement on cylindrical bodies, Bernoulli's Equation applied to a Convergent-Divergent passage, Round Turbulent Jet, Flow around a bend in a duct).

ME 221 Fluid Mechanics II (3-0-0-6)

Pre-requisite: Fluid Mechanics I or Equivalent

Viscous flows– Demonstration of simple analytical approach, channel flow, entrance length, fully-developed flow, friction factor and head losses, Darcy-Weisbach equation, basic introduction to turbulent flows, Boundary Layer Theory; Derivation of Boundary Layer equation and thin shear layer approximation, Order of magnitude analysis, Displacement, Momentum and Energy thickness, Karman momentum-integral equation, Blasius boundary layer over flat plate, Effect of pressure gradients, flow separation and its application; Compressible Flow–Regimes of compressible flow, Definition of Mach number and speed of sound, Adiabatic and isentropic steady flow, Governing equations for 1 –D inviscid

flows, Stagnation properties, Isentropic flow with area change, convergent, divergent and convergent-divergent nozzles, Choked flow and effect of pressure ratio, Rankine-Hugoniot relations and introduction to shocks; Hydraulic Machines—Euler pump/turbine equation, classification of hydraulic machines, Impulse momentum principle, velocity triangles, efficiency, Centrifugal and Axial pumps, velocity triangles and analysis, effect of blade angle, cavitation, NPSH, priming and testing of pumps, specific speed, characteristic curves, series and parallel operations, system resistance and selection, Pelton turbines: working principle, velocity triangles, performance characteristics, effect of number of buckets and multi-jets, efficiency, Reaction turbine: Degree of reaction, Francis and Kaplan turbines, velocity triangles and analysis, draft tube, specific speed, efficiency, Positive displacement pumps: Working principle, indicator diagram, efficiencies, effect of air vessel, slip and characteristic curves.

Texts:

- [1] F. M. White, Fluid Mechanics, Tata McGraw-Hill, 2008.
- [2] R. W. Fox, A.T. McDonald and P.J. Pritchard, Introduction to Fluid Mechanics, John Wiley, 2004

References:

- [1] B. R. Munson, D.F. Young, and T.H. Okhiishi, Fundamentals of Fluid Mechanics, Wiley India Edition, 2002.
- [2] J. D. Anderson (Jr.), Modern Compressible Flow, McGraw-Hill, 1990.
- [3] Y. A. Cengel and J.M. Cimbala, Fluid Mechanics, Tata McGraw-Hill, 2006.
- [4] J. F. Douglas, J. M. Gasiorek, J. A. Swaffield and L. B. Jack, Fluid Mechanics, Pearson Education, 2008.
- [5] S. L. Dixon, and C. A. Hall, Fluid Mechanics and Thermodynamics of Turbomachinery, Elsevier, 2014.

ME 222 Manufacturing Technology 1 (3-0-0-6)

Introduction to manufacturing processes: Moulding materials and mould design; Pattern types and design. Casting processes: sand casting, investment casting, pressure die casting, centrifugal casting, continuous casting; Casting analysis; Casting defects and their remedies. Metal forming Processes: Various metal forming techniques and their analysis, viz., forging, rolling, extrusion, wire drawing, sheet metal working; Super plastic deformation; Metal forming defects. Metal joining processes: brazing, soldering, welding: Solid state welding; resistance welding; arc welding; gas welding; Welding defects. Polymer fabrication methods viz., Injection moulding, Compression moulding, Transfer moulding, Thermoforming. Composite fabrication methods viz., Compression moulding, Vacuum moulding, Prepreg fabrication, Filament winding. Additive manufacturing. Powder metallurgy and its applications.

Texts:

- [1] A. Ghosh and A. K. Mallik, Manufacturing Science, Wiley Eastern, 2010
- [2] P. N. Rao, Manufacturing Technology: Foundry, Forming And Welding, Tata McGraw Hill, 2017.
- [3] M. P. Groover, Introduction to Manufacturing Processes, Wiley, 2011

References:

- [1] J. S. Campbell, Principles of Manufacturing Materials and Processes, Tata McGraw Hill, 1995.
- [2] M. C. Flemings, Solidification Processing, Tata McGraw Hill, 1982.
- [3] P. C. Pandey and C. K. Singh, Production Engineering Sciences, Standard Publishers Ltd., 2013.
- [4] S. Kalpakjian and S. R. Schmid, Manufacturing Processes for Engineering Materials, Pearson education, 6th edition, 2016.

ME 223 Solid Mechanics - II (3-0-0-6)

Prerequisite: ME 212 Solid Mechanics – I or Equivalent

Review on 3D state of stress in solids; review on 3D state of strain in solids; Saint-Venant's principle; principle of superposition; boundary value problems: stress formulation, displacement formulation, Beltrami-Michell equations, Navier's equations; methods of solution; plane problems: plane stress and plane strain problems; solution of plane problems using Airy stress function: straight beams, curved beams; unsymmetrical bending of beam elements; shear centre and shear flow in thin-walled beams; axisymmetric problems: thick-walled cylinders, rotating disk and cylinders; stress analysis of a plate with a circular/non-circular hole, torsion of non-circular bar; energy methods: principle of virtual work, minimum potential energy.

Texts:

- [1] S. P. Timoshenko and J. N. Goodier, Theory Of Elasticity, McGraw Hill International, 2010.
- [2] L. S. Srinath, Advanced Mechanics Of Solids, Tata McGraw -Hill, 2008.

References:

- [1] M. H. Sadd, Elasticity: Theory, Applications and Numerics, Elsevier, 2005.

- [2] S. H. Crandall, N. C. Dahl and T. J. Lardner, An Introduction to the Mechanics of Solids, TMH, 2008.
- [3] S. P. Timoshenko, Strength of Materials, Vols. 1 and 2, CBS Publishers, 1986.
- [4] H. Shames and J. M. Pitarresi, Introduction to Solid Mechanics, Prentice Hall of India, 2003.
- [5] A. C. Ugural and S. K. Fenster, Advanced Strength and Applied Elasticity, 3rd Ed., Prentice Hall, 1994.
- [6] A. P. Boresi, R. J. Schmidt and O. M. Sidebottom, Advanced Mechanics Of Materials, John Wiley, 1993.
- [7] Y. C. Fung, Foundations of Solid Mechanic

ME 224 Kinematics of Machinery (2-1-0-6)

Prerequisite: ME 101 Engineering Mechanics or equivalent

Introduction to kinematics, planar mechanisms, pairs, kinematic chain, kinematic inversion, mobility (Kutzbach and Grubler's criterion) and range of movements (Grashof's law); Displacement, velocity and acceleration analysis of planar mechanisms by graphical, analytical and computer aided methods; Dimensional synthesis for motion; function and path generation; Miscellaneous mechanisms: approximate and exact straight line generating mechanisms, intermittent motion mechanism; Introduction to Cam, Classification of followers and cams, Analysis of follower motion, Graphical and analytical approaches for cam profile synthesis; Gears: spur, helical, bevel and worm; gear trains: simple, compound and epicyclic.

Texts:

- [1] K. J. Waldron and G. L. Kinzel, Sunil K. Agrawal, Kinematics, Dynamics and Design of Machinery, 3rd Ed., Wiley Student Edition, 2016.
- [2] A. Ghosh and A. K. Mallik, Theory of Mechanisms, and Machines, 3rd Ed., East West Press Pvt Ltd, 2009.
- [3] J. J. Uicker (Jr), G. R. Pennock and J. E. Shigley, Theory of Machines and Mechanisms, 3rd Ed., Oxford International Student Edition 2003.

References:

- [1] H. H. Mabie and C. J. Reinholtz, Mechanisms and Dynamics of Machinery, John Wiley & Sons; 4th Edition edition 1987.
- [2] S. S. Rattan, Theory of Machines, 4th Ed., Tata McGraw Hill, 2014.
- [3] R. L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2017.
- [4] J. S. Rao, R. V. Dukkipati, Mechanism and Machine Theory, 2nd Ed., New Age International, 2008.
- [5] A. G. Erdman, G. N. Sandor and Sridhar Kota, Mechanism Design, Analysis and Synthesis Volume 1, 4th Edition, Pearson, Inc., 2001.
- [6] T. Bevan, Theory of Machines, 3rd Ed., CBS Publishers and Distributors, 2005.

ME 225 Mechanical Workshop (0-0-6-6)

Workshop practice Introduction to machine tools and machining processes; Types of cutting tools; Selection of cutting speeds and feed; Simple machining operations on lathe, shaping, slotting, milling and grinding machines; Modern trends in manufacturing, automation, NC/CNC, FMS, CAM and CIM.

Machining processes: Measurement of tool angles and radius for single point cutting tool, determination of cutting forces, shear plane, chip thickness ratio, profile estimation.

ME 226 Mechanical Engineering Laboratory II (0-0-3-3)

Kinematics: Demonstration of various mechanisms, gear systems, screw jack, jib crane, worm and worm & worm wheel, building of mechanism;

Data acquisition: Use of data acquisition systems, programming a virtual instrument using standard interfaces.

Turbomachinery: Propeller Turbine, Impulse (Pelton) and Reaction Turbine, Centrifugal Pump (Series and Parallel Pump), Positive Displacement Pump (Plunger Pump).

ME 311 Heat Transfer (3-0-0-6)

Pre-requisite: ME 211 Thermodynamics or Equivalent

Modes of heat transfer; Conduction: 1-D and 2-D steady conduction; 1-D unsteady conduction-Lumped capacitance and analytical methods; Fins, Convection: fundamentals, order of magnitude analysis of momentum and energy equations; hydrodynamic and thermal boundary layers; dimensional analysis; free and forced convection; external and internal flows; heat transfer with phase change, Radiation:

Stefan-Boltzmann law; Planck's law; emissivity and absorptivity; radiant exchange between black surfaces, Heat exchangers: LMTD and NTU methods.

Texts:

- [1] F. P. Incropera and D. P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley and Sons, 2009.
- [2] J. P. Holman, Heat Transfer, McGraw Hill, 2007.

References:

- [1] M. N. Ozisik, Heat Transfer-A Basic Approach, McGraw Hill, 1985.
- [2] A. Bejan, Convective Heat Transfer, John Wiley and Sons, 2004.
- [3] F. Kreith and M. S. Von, Principles of Heat Transfer, Brook and Cole Publication, 2001.

ME 312 Manufacturing Technology - II (3-0-0-6)

Metal cutting: mechanics, tools (geometry: single and multi-point, nomenclature and tool signature, material, temperature, wear, and life considerations), chip formation; cutting fluids and surface finish; economics of machining; Machine tool: Generation and machining principles; Basic machining operations: lathe, milling, shaping, drilling, boring, grinding (cylindrical, surface, centreless), thread cutting, gear cutting; CNC machines; Finishing: microfinishing (honing, lapping), nano-finishing; Unconventional methods: electro-chemical, electro-discharge, ultrasonic, LASER, electron beam, water jet machining etc.; Tooling: Jigs and fixtures, principles of location and clamping; Rapid manufacturing and rapid tooling; Basic concepts of CAD/CAM and CAPP.

Texts:

- [1] A. Ghosh and A. K. Mallik, Manufacturing Science, East West Press, Second Edition, 2010.
- [2] G. K. Lal, Introduction to Machining Science, New Age International Pvt Ltd., 2007.
- [3] W. A. Knight and G. Boothroyd, Fundamentals of Metal Machining and Machine Tools, CRC Press, 2006.

References:

- [1] Production Technology HMT, Tata McGraw Hill, 2001.
- [2] M. C. Shaw, Metal Cutting Principles, Second Edition, Oxford University Press, 2005.
- [3] P. K. Mishra, Nonconventional Machining, Narosa Publishing House, 2007
- [4] C. Donaldson, G. H. LeCain, V C Goold and J Ghose, Tool Design 4e (SIE), 4th Edition, TMH, 2012.
- [5] M. P. Groover, Fundamentals of Modern Manufacturing, Materials, Processes and Systems, Second Edition, Wiley India, Reprint 2007.

ME 313 Dynamics of Machinery (2-1-0-6)

Prerequisite: ME224 Kinematics of Machinery or equivalent

Static and dynamic force analysis; Flywheel; inertia forces and their balancing for rotating and reciprocating machines; Gyroscope and gyroscopic effects; Governors: types and applications; Vibrations of one degree of freedom systems; Free and Force vibrations; Transverse and torsional vibrations of two and three rotor systems; critical speeds; Vibration isolation and measurements; two-degree of freedom systems; Geared system; Introduction to Multi-degree of Freedom System :normal mode vibration, coordinate coupling, forced harmonic vibration, vibration absorber (tuned, and centrifugal pendulum absorber), vibration damper; Properties of vibrating system, flexibility matrix, stiffness matrix, reciprocity theorem, eigenvalues and eigenvectors, orthogonal properties of eigenvectors, modal matrix, Rayleigh damping, Normal mode summation.

Texts:

- [1] J. J. Uicker (Jr), G. R. Pennock, and J. E. Shigley, Theory of Machines and Mechanisms, 3rd Ed., Oxford International Student Edition, 2014
- [2] J S Rao and R V Duddipati, Mechanism and Machine Theory, 2nd Ed., New Age Intl., 2008

References:

- [1] S. S. Rattan, Theory of Machines, 3rd Ed., Tata McGraw Hill, 2009.
- [2] T. Bevan. Theory of Machines, CBS Publishers and Distributors, 1984.
- [3] L. Meirovitch, Elements of Vibration Analysis, McGraw Hill, 1998.
- [4] W. T. Thomsom and M.D. Dahleh, Theory of Vibration with Applications, 5th Ed., Pearson Education, 1999.
- [5] Kenneth J. Waldron, Gary L. Kinzel, Sunil K. Agarwal, Kinematics, Dynamics, and Design of Machinery, 3rd Edition, John Wiley & Sons, Ltd., 2016.
- [6] Robert L. Norton, Kinematics and Dynamics of Machinery, 2nd Edition, McGraw Hill, 2013.

ME 314 Design of Machine Elements (3-0-0-6)

Prerequisites: ME 212 Solid Mechanics I or Equivalent

Principles of mechanical design: Strength, Rigidity, Fracture, Wear, Material considerations, Standardization, Limits and Fits. Factor of safety. Stress concentrations. Design for static and fatigue strength. Design of shafts, axles, keys, riveted joints, bolted joints, welded joints, springs, brakes and clutches. Couplings and power screws.

Text:

[1] Richard G Budynas and J Keith Nisbett, Shigley's Mechanical Engineering Design, 10th Ed., McGraw Hill, 2015.

References:

- [1] V. B. Bhandari, Design of Machine Elements, 4th Ed., McGraw Hill, 2016.
- [2] M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram, and C. V. Venkatesh, Design of Machine Elements, 8th Ed., Person Education, 2006.
- [3] Faculty of Mechanical engineering, PSG College of Technology, Design Data Book of Engineers, KalaikathirAachagam Publishers, Coimbatore, 2009.
- [4] A. H. Burr and J. B. Cheatham, Mechanical Analysis and Design, 2nd Ed., Prentice Hall, 1995.
- [5] R. C Juvinall and K. M Marshek, Fundamentals of Machine Component Design, 3rd Ed., Wiley Student Edition, 2000.
- [6] O. P. Grover, Maleev& Hartman's Machine Design 5th Ed., CBS Publishers, 2011.

ME 315 Mechanical Engineering Laboratory III (0-0-3-3)

Vibration: Experiments on single and multi-degree of freedom systems, modal and frequency response analysis, acoustics measurement, Time domain and spectral analysis with software such as LabView; determination of FFT, PSD; effects of sampling, windowing, leakage, averaging, Dynamic rotor balancing.

Theory of machines: Static and dynamic balancing (multi-plane) of rotary systems, gyroscope, governors, whirling of shafts, simple and compound pendulums, determination of moment of inertia using trifilar suspension, torsional vibration;

Metrology: Use of various metrological tools like slip, angle gauge, feeler, taper, fillet, thread gauges, estimation of internal dimensions, use of various metrology equipment namely Coordinate measuring machine, non-contact profilometer, optical profilometer, laser scanner.

ME 321 Applied Thermodynamics (3-0-0-6)

Pre-requisite: Thermodynamics

Steam Power Plant – Reheat, regenerative steam power cycles, low temperature power cycles, ideal working fluid and binary/multi-fluid cycles; Types of boilers and their attachments, Steam Turbine types and analysis using velocity triangles, Properties of moist air: psychrometry and psychrometric charts, condensers and cooling towers; IC Engines – SI, CI, two- and four-stroke engines, MEP, efficiency and specific fuel consumption, conventional and alternative fuels, pressure-crank angle diagram, carburettor and fuel injection systems; Gas Turbine Engines – Types of gas turbine engines, reheat, intercooling and regenerative cycles, combined cycles, introduction to jet propulsion; Compressors and Turbines – Reciprocating air compressors: work transfer, volumetric efficiency, isothermal efficiency, multistage compression with intercooling, centrifugal compressor, axial flow compressors, axial flow turbines.

Texts:

- [1] G. F. C Rogers and Y. R. Mayhew, Engineering Thermodynamics Work and Heat Transfer, Pearson, 2003.
- [2] T. D. Eastop and A. McConkey, Applied Thermodynamics for Engineering Technologists, Pearson, 2003.

References:

- [1] M. M. El-Wakil, Power Plant Technology, McGraw Hill International, 1992.
- [2] P. K. Nag, Powerplant Engineering, Tata McGraw Hill, 2002.
- [3] W. W. Pulkrabek, Engineering Fundamentals of the Internal Combustion Engine, PHI, 2002.
- [4] H. I. H Saravanamuttoo, G. F. C. Rogers and H. Cohen, Gas Turbine Theory, Pearson, 2003.

ME 322 Machine Design (2-0-2-6)

Prerequisite: ME 314 or equivalent

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; Systems Approach to Design: Decision Making, Simulation of mechanical systems using CAD tools, Sensitivity analysis of design parameters, Value Analysis and Value Addition to designed components and systems; Exercises of mechanical systems design with examples; Overview of Optimization in Design; Reliability and Robust Design; Communicating the Design.

Texts:

- [1] Design Data Book of Engineers, Compiled by Faculty of Mechanical Engineering, PSG College of Technology, Publisher Kalaikathir Achchagam, Coimbatore, 2009
- [2] J. E. Shigley, Mechanical Engineering Design, McGraw Hill, 1989

References:

- [1] G. M. Maitra Handbook of gear Design Second Edition, Tata McGraw Hill, New Delhi, 1994.
- [2] D.W. Dudley, Handbook of Practical Gear Design, CRC Press, 2009
- [3] M.F. Spotts, T.E. Shoup, L. E. Hornberger, S. R Jayram and C. V. Venkatesh, Design of Machine Elements, 8th Ed., Person Education, 2006.
- [4] V. B. Bhandari, Design of Machine Elements, 2nd Ed., Tata McGraw Hill, 2007.
- [5] R. C. Juvinall and K. M Marshek, Fundamentals of Machine Component Design, 3rd Ed., Wiley, 2007.
- [6] V. Ramamurti, Computer Aided Mechanical Design and Analysis, 3rd Ed., Tata McGraw Hill, 1996.
- [7] A. H. Burr and J. B. Cheatham, Mechanical Analysis and Design, 2nd Ed., Prentice Hall, 1997.
- [8] J. R. Dixon, Design Engineering: Inventiveness, Analysis and Decision Making, TMH, New Delhi, 1980.

ME 323: Mechanical Measurements (3-0-0-6)

Fundamentals of Measurement: Elements of a generalized measurement system, standards, and types of signals ; Static performance characteristics. Dynamic performance, instrument types - zero, first and second order instruments, transfer function representation, system response to standard input signals - step, ramp, impulse, and frequency response; Treatment of uncertainties: error classification, systematic and random errors, statistical analysis of data, propagation and expression of uncertainties; Measurement of various physical quantities: Linear and angular displacement, velocity, force, torque, strain, pressure, flow rate and temperature; Transfer functions of some standard measuring devices; Data Acquisition and processing: Digital methods, digitization, signal conditioning, interfacing, standard methods of data analysis - quantities obtainable from time series; Fourier spectra, DFT, FFT; Data acquisition parameters - sampling rate, Nyquist sampling frequency, aliasing & leakage errors; Metrology: measurement of angles, threads, surface finish, inspection of straightness, flatness and alignment, gear testing, digital readouts, coordinate measuring machine.

Texts:

- [1] E.O. Doebelin, Measurement systems-Applications and Design, 4th Ed., Tata McGraw-Hill, 1990.
- [2] T. G. Beckwith, R.D. Marangoni and J.H. Lienhard, Mechanical Measurements, Addison Wesley, 1993.

References:

- [3] R. S. Figiola and D. E. Beasley, Theory and design for mechanical measurements, 2nd Ed., John Wiley, 1995.
- [4] J. W. Dally, W.F. Riley and K.G.McConnell, Instrumentation for engineering measurements, 2nd Ed., John Wiley & Sons, 1993.
- [5] E. O. Doebelin, Engineering Experimentation, McGraw-Hill, 1995.
- [6] Connie L Dotson, Fundamentals of Dimensional Metrology, Cengage Learning, 2015

ME 324 Industrial Engineering and Operations Research (3-0-0-6)

Introduction, Production Planning and Control, aggregate production planning, Product design, Job, batch, and flow production methods; Work study, Time and motion study; Inventory management, Manufacturing planning: MRP, MRP-II, JIT, Supply chain management; Quality control, Statistical process control, Acceptance sampling, Total quality management; Forecasting, Scheduling and loading, Line balancing, Break-even analysis. Industry 4.0. Internet of things (IoT). Data analytics. Introduction to operations research, linear programming, Graphical method, Simplex method, Dual problem, dual simplex method, Concept of unit worth of resource, sensitivity analysis; Transportation problems, Assignment problems; Integer and Dynamic programming; Network flow models, CPM and PERT; Queuing models.

Texts:

- [1] S. L. Narasimhan, D. W. McLeavey, and P. J. Billington, Production, Planning and Inventory Control, Prentice Hall, 1997.
- [2] J. L. Riggs, Production Systems: Planning, Analysis and Control, 3rd Ed., Wiley, 1981.
- [3] J. K. Sharma, Operations Research, Macmillan, 1997.

References:

- [1] Muhlemann, J. Oakland and K. Lockyer, Productions and Operations Management, Macmillan, 1992.
- [2] H. A. Taha, Operations Research - An Introduction, Prentice Hall of India, 1997.

ME 325 Control Systems (3-0-0-6)

Feedback systems, mathematical modelling of physical systems; Laplace transforms, block diagrams, signal flow graphs, state-space models; Time domain analysis: performance specifications, steady state error, transient response of first and second order systems; Stability analysis: Routh-Hurwitz stability criterion, relative stability; proportional integral, PI, PD, and PID controllers; Lead, lag, and lag-lead compensators; Root-locus method: analysis, design; Frequency response method: Bode diagrams, Nyquist stability criterion, performance specifications, design; Statespace methods: analysis, design; Physical realizations of controllers: hydraulic, pneumatic, and electronic controllers.

Texts:

- [1] K. Ogata, Modern Control Engineering, 4th Ed., Pearson Education Asia, 2015.
- [2] B. C Kuo and F. Golnaraghi, Automatic Control Systems, 8th Ed., John Wiley, 2013.

References:

- [3] M. Gopal, Control Systems: Principles and Design, 2nd Ed., Tata McGraw-Hill, 2012
- [4] M Gopal, Modern Control System Theory, 2nd Ed., New Age International, 1993.
- [5] R. C. Dorf and R. H. Bishop, Modern Control Systems, 8th Ed., Addison Wesley, 1998.
- [6] P. Belanger, Control Engineering: A modern approach, Saunders College Publishing, s1995.

ME 326 Mechanical Engineering Laboratory IV (0-0-3-3)

Tribology: Performance of air bearings, normal bearings, friction and wear testing under different operating conditions, optical viscometry, scratch testing;

Thermal Science: Experiments in conduction, free and forced convection, heat exchangers, cooling tower, refrigeration, boiling heat transfer; Calibration of Thermocouple, Thermal Radiation; IC engine: petrol and diesel engine.

Instrumentation and control: Proportional, integral, PI, PD, and PID controllers, lead, lag, and lag lead compensators, hydraulic, pneumatic, and electronic controllers, experiment on microprocessor;

ME 401 Summer Training (PP/NP) (0-0-0-0)

Training for a minimum period of 6-8 weeks in a reputed industry / R&D lab / academic institution except IIT Guwahati. The student is expected to submit a report and present a seminar after the training.