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

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<tr>
<th>Course No.</th>
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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:

References:

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

Prerequisite: Nil


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:**

**References:**

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.


**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:**
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:

References:

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.

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:
**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:**


**References:**


**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 trans-formation, 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:**


References:

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:

References:

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:

References:

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:**

**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:**

**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:

References:

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, Rouche's theorem and argument principle, residues, Cauchy's Residue theorem and applications, Mobius 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:

References:

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 vapore power cycles, refrigeration cycles.

Texts:
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:

References:

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


Texts:

References:

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,

Texts:

References:

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:

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:

References:

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., Injection moulding, Compression moulding, Vacuum moulding, Prepreg fabrication, Filament winding. Additive manufacturing. Powder metallurgy and its applications.

Texts:

References:

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:

References:
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:**

**References:**

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:

References:

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:

References:

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:

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

*Prerequisites: ME 212 Solid Mechanics I or Equivalent*


**Text:**

**References:**

**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:**

**References:**
**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

**References:**

**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:**

**References:**

**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; Queueing models.

**Texts:**
References:

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

Feedback systems, mathematical modeling 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; State-space methods: analysis, design; Physical realizations of controllers: hydraulic, pneumatic, and electronic controllers.

Texts:

References:

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.