

## Chapter-3

### Course Structure for Undergraduate Program of Industrial & Production Engineering

Year-1 / Semester-1				
Subject Code	Subject Name	T-S	Credits	
ME 1103	Introduction to Mechanical and Industrial Engineering	3-0	3.00	
Math 1107	Mathematics-I	3-0	3.00	
Phy 1105	Physics	3-0	3.00	
Chem 1107	Chemistry	3-0	3.00	
Hum 1107	Critical Thinking and Communication	3-0	3.00	
		<b>Sub Total=</b>	<b>15.00</b>	<b>15.00</b>
IPE 1110	Machine Shop Practice-I	0-3	1.50	
Phy 1106	Physics Sessional	0-3	1.50	
Chem 1108	Chemistry Sessional	0-3	1.50	
Hum 1108	English Language Sessional	0-3	1.50	
		<b>Sub Total=</b>	<b>12.00</b>	<b>6.00</b>
		<b>Total=</b>	<b>27.00</b>	<b>21.00</b>

Year-1 / Semester-2				
Subject Code	Subject Name	T-S	Credits	
EEE 1287	Basic Electrical Engineering	3-0	3.00	
CSE 1287	Computer Programming	3-0	3.00	
Math 1207	Mathematics-II	3-0	3.00	
Hum 1207	Sociology and Accounting	3-0	3.00	
Hum 1209	Society, Ethics & Technology (SET)	3-0	3.00	
		<b>Sub Total=</b>	<b>15.00</b>	<b>15.00</b>
IPE 1210	Machine Shop Practice-II	0-3	1.50	
EEE 1288	Electrical Engineering Sessional	0-3	1.50	
CSE 1288	Computer Programming Sessional	0-3	1.50	
		<b>Sub Total=</b>	<b>9.00</b>	<b>4.50</b>
		<b>Total=</b>	<b>24.00</b>	<b>19.50</b>

Year-2 / Semester-1				
Subject Code	Subject Name	T-S	Credits	
IPE 2101	Manufacturing Processes	3-0	3.00	

ME 2101	Basic Thermodynamics	3-0	3.00	
EEE 2187	Electrical Machines	3-0	3.00	
Math 2107	Mathematics-III	3-0	3.00	
Hum 2107	Engineering Economy	3-0	3.00	
		<b>Sub Total=</b>	<b>15.00</b>	<b>15.00</b>
IPE 2102	Manufacturing Processes Sessional	0-3	1.50	
ME 2102	Basic Thermodynamics Sessional	0-1.5	0.75	
ME 2110	Mechanical Drawing-I	0-3	1.50	
EEE 2188	Electrical Machines Sessional	0-1.5	0.75	
		<b>Sub Total=</b>	<b>9.00</b>	<b>4.50</b>
		<b>Total=</b>	<b>24.00</b>	<b>19.50</b>

Year-2 / Semester-2				
Subject Code	Subject Name	T-S	Credits	
ME 2201	Mechanics of Materials	3-0	3.00	
ME 2203	Engineering Materials	3-0	3.00	
EEE 2285	Introduction to Analog and Digital Electronics	3-0	3.00	
Math 2207	Numerical Analysis and Statistics	3-0	3.00	
Hum 2207	Industrial Law and Safety Management	3-0	3.00	
		<b>Sub Total=</b>	<b>15.00</b>	<b>15.00</b>
ME 2202	Mechanics of Materials Sessional	0-1.5	0.75	
ME 2204	Engineering Materials Sessional	0-1.5	0.75	
ME 2210	Mechanical Drawing-II	0-3	1.50	
EEE 2286	Analog and Digital Electronics Sessional	0-3	1.50	
		<b>Sub Total=</b>	<b>9.00</b>	<b>4.50</b>
		<b>Total=</b>	<b>24.00</b>	<b>19.50</b>

Year-3 / Semester-1				
Subject Code	Subject Name	T-S	Credits	
ME 3131	Fluid Mechanics and Machinery	3-0	3.00	
IPE 3101	Measurement, Instrumentation and Control	3-0	3.00	
IPE 3103	Product Design and Development	3-0	3.00	
IPE 3105	Modern Machining Processes	3-0	3.00	
IPE 3107	Operations Research	3-0	3.00	
		<b>Sub Total=</b>	<b>15.00</b>	<b>15.00</b>
ME 3132	Fluid Mechanics and Machinery Sessional	0-3	1.50	
IPE 3102	Measurement, Instrumentation and Control Sessional	0-3	1.50	
IPE 3104	Product Design and Development Sessional	0-3	1.50	
		<b>Sub Total=</b>	<b>9.00</b>	<b>4.50</b>
		<b>Total=</b>	<b>24.00</b>	<b>19.50</b>

Year-3 / Semester-2			
Subject Code	Subject Name	T-S	Credits
IPE 3201	Ergonomics and Productivity Engineering	3-0	3.00
IPE 3203	Material Handling and Maintenance Engineering	3-0	3.00
IPE 3205	Production Planning and Control	3-0	3.00
IPE 3207	Robot and Computer Controlled Machines	3-0	3.00
IPE 3209	Metal Forming and Sheet Metalworking	3-0	3.00
		<b>Sub Total=</b>	<b>15.00 15.00</b>
IPE 3202	Ergonomics and Productivity Engineering Sessional	0-3	1.50
IPE 3204	Material Handling and Maintenance Engineering Sessional	0-3	1.50
IPE 3210	Metal Forming and Sheet Metalworking Sessional	0-3	1.50
		<b>Sub Total=</b>	<b>9.00 4.50</b>
		<b>Total=</b>	<b>24.00 19.50</b>

Year-4 / Semester-1			
Subject Code	Subject Name	T-S	Credits
IPE 4101	Machine Tools and Machining	3-0	3.00
IPE 4103	Operations and Project Management	3-0	3.00
IPE 4105	Supply Chain Management	3-0	3.00
IPE 4107	Business Law	3-0	3.00
IPE xxxx	Optional-I	3-0	3.00
		<b>Sub Total=</b>	<b>15.00 15.00</b>
IPE 4102	Machine Tools and Machining Sessional	0-3	1.50
IPE 4000	Project and Thesis	0-6	3.00
		<b>Sub Total=</b>	<b>9.00 4.50</b>
		<b>Total=</b>	<b>24.00 19.50</b>

Year-4 / Semester-2			
Subject Code	Subject Name	T-S	Credits
IPE 4201	Computer Integrated Manufacturing	3-0	3.00
IPE 4203	Industrial and Business Management	3-0	3.00
IPE xxxx	Optional-II	3-0	3.00
IPE 4205	Quality Management	3-0	3.00
		<b>Sub Total=</b>	<b>15.00 12.00</b>
IPE 4206	Industrial Simulation Sessional	0-3	1.50
IPE 4208	Business Communication Seminar	0-3	1.50

IPE 4000	Project and Thesis	0-6	3.00
		<b>Sub Total=</b>	<b>9.00 6.00</b>
		<b>Total=</b>	<b>24.00 18.00</b>
		<b>Total Credit Hours =</b>	<b>156.00</b>

Optional Courses			
Subject Code	Subject Name	T-S	Credits
IPE 4011	Advanced Materials and Processes	3-0	3.00
IPE 4013	Micro-manufacturing	3-0	3.00
IPE 4015	Emerging Trends in Manufacturing Technology	3-0	3.00
IPE 4017	Intelligent Manufacturing	3-0	3.00
IPE 4019	Process Dynamics and Adaptive Control	3-0	3.00
IPE 4021	Energy and Environment Management	3-0	3.00
IPE 4023	Marketing Management	3-0	3.00
IPE 4025	Technology Management	3-0	3.00
IPE 4027	Entrepreneurship Development and Micro-Industries	3-0	3.00
IPE 4029	Organizational Behavior	3-0	3.00
IPE 4031	Total Quality Management	3-0	3.00

## Chapter-4

### Course Contents for Undergraduate Program of Industrial & Production Engineering

**ME 1103: Introduction to Mechanical and Industrial Engineering 3-0**  
Study of sources of energy: conventional and renewable, environmental pollution; study of steam generation units with their accessories and mountings; Introduction to: steam turbine with their accessories, internal combustion engines and gas turbines with their accessories, automobiles; introduction to pumps, blowers and compressors, refrigeration and air conditioning systems.

Evolution of industrialization; Involvement of Industrial and Production Engineering in the entire life cycle of a product; Design of product; Basic processes for product manufacturing; Machineries for manufacturing; Computer in manufacturing; Managing manufacturing system; Improvement of systems—optimization, quality management, ergonomics, safety, organizational behavior etc.

**IPE 1110: Machine Shop Practice-I 0-3**  
Foundry Technology: The practice-cum-experiments to impart an understanding on the various steps in metal casting including pattern design, sand preparation, molding and melting:

- Study on various types of patterns and pattern materials
- Layout of a pattern
- Study on sand preparation
- Study on variation of mould properties with different molding machines
- Study on the effect of molding parameters on the properties of moulds
- Study of melting furnace and melting of ferrous and non ferrous alloys including degasification.

Welding: Practical classes designed with the objective of imparting hands on training as well as understanding of welding technology. Suggested exercises are:

- Understanding of welding machine characteristics and controls, electrode specifications, selection of electrode size and current, laying of beads.
- Study of joint configuration and specification, required edge preparations; practice on preparing both side square groove butt weld; grinding of weld crown to make bead flush with plate surface; visual inspection of defects and reporting.
- Study of various types of oxy-acetylene flames; practice on flame adjustment, gas welding/brazing.
- Study and practice on different types of welding methods.

**Math 1107: Mathematics I 3-0**

Differential Calculus; Rolle's Theorem, Cauchy's mean value theorem (Lagrange's mean value theorem as a special case), Taylor's and Maclaurin's 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 - Lagrange's method of multipliers.

Integral Calculus: Fundamental theorem of integral calculus, mean value theorems, evaluation of definite integrals - reduction formulae.

Solid Geometry: System of co-ordinates, distance between two points; section formula; Projection, direction cosine; Equations of planes and lines.

**Phy 1105: Physics 3-0**

Waves and Oscillations: Simple harmonic motion, Differential equation of simple harmonic oscillator, total energy and average energy, combination of simple harmonic oscillations, spring mass system, torsional pendulum; two body oscillation, reduced mass, damped oscillation, forced oscillation, resonance, vibrations of membranes and columns, progressive wave, power and intensity of wave, stationary wave, energy calculation of

progressive and stationary wave, group and phase velocities, sound waves- Doppler Effect, Sabine's formula, architectural acoustics.

Optics: Defects of images: Spherical aberration, astigmatism, coma, distortion, curvature, chromatic aberration, theories of light, Huygen's principle; Interference of light: Young's double slit experiment, displacement of fringes and its uses, Fresnel biprism, interference in thin film, Newton's rings, interferometers; Diffraction: Diffraction by single slit, diffraction from a circular aperture, resolving power of optical instruments, diffraction at double slit and N-slits, diffraction grating; Polarization: production and analysis of polarized light, Brewster's law, Malus law, polarization by double refraction, Nicol prism, optical activity, polarimeters, optics of crystal optical effect in crystal, laser, nonlinear optics.

Modern Physics: Galilean relativity and Einstein's special theory of relativity; Lorentz transformation equations, Length contraction, time dilation and mass-energy relation, photoelectric effect, Compton effect, De Broglie matter waves.

Nuclear Physics: Constituent of atomic nucleus, Nuclear binding energy, different types of radioactivity, radioactive decay law; Nuclear reactions, nuclear fission, nuclear fusion.

**Phy 1106: Physics Sessional** 0-3  
Sessional works compatible to Phy 1105.

**Chem 1107: Chemistry** 3-0  
Atomic Structure, quantum numbers, Pauli's exclusion principle, electronic configuration, periodic table, properties and uses of noble gases, different types of chemical bonds and their properties, molecular structures of compounds, selective organic reactions. Different types of solutions and their compositions. Phase rule, phase diagram of monocomponent system. Properties of dilute solutions. Thermochemistry, chemical kinetics, chemical equilibrium. Ionization of water and pH concept. Electrical properties of solution.

**Chem 1108: Chemistry Sessional** 0-3  
Sessional works compatible to Chem 1107.

**Hum 1107: Critical Thinking and Communication** 3-0

Objective: The aim of this foundational course is to help the second language learners acquire fluency in both spoken and written English to communicate messages with clarity, precision and confidence in the workplace. The course will have three components: Language, Speaking and Writing. The skills required in these areas will be imparted through Lectures and Sessionals. While lectures will introduce learners to the basic concepts in communication, sessionals will provide hands-on experience. It is hoped that after commanding the skills required in spoken and written English, learners will be able to communicate better.

Lecture topics:

- Introduction to communication
- Language and grammar skills
- Speaking skills
- Writing skills

**Hum 1108: English Language Sessional** 0-3

Building Vocabulary, Building sentences, Grammar, Pronunciation drills, Phonetics, vowels, Diphthongs, consonants, Stress, Rhythm and intonation, Conversational skills, Meta Language, The writing process, Writing with a thesis, Writing topic sentences, Writing a paragraph, Linking paragraph.

**IPE 1210: Machine Shop Practice-II** 0-3

Machining:

- Facing, drilling, boring, turning-straight, taper, eccentric, grooving, thread cutting, forming etc. in center lathes
- Surfacing, making regular polygons and cutting gear teeth in milling machines
- Gear teeth generation in gear shaping machine and hobbing machine
- Part programming and machining in CNC machining center
- Setting and operation of EDM, ECM, etc.
- Finishing by grinding
- Measurement of dimensions, forms and surface finish of machined products.

Bulk Deformation Processes and Sheet Metalworking:

- Bulk deformation processes in metal working
  - Rolling
  - Forging
  - Extrusion
- Sheet metal working

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**EEE 1287: Basic Electrical Engineering** **3-0**

Sources of energy: General structure of electrical power systems, Power transmission and distribution via overhead lines and underground cables, Steam, Hydraulic, Gas and Nuclear power generation.

DC Networks: Kirchoff's laws, node voltage and mesh current methods, Delta-star and star-delta conversion, Superposition principle, Thevenins and Norton's theorems.

Single phase AC Circuits: Single phase EMF generation, average and effective values of sinusoids, solution of R,L,C series circuits, the j operator, complex representation of impedances, phasor diagram, power factor, power in complex notation, solution of parallel and series, parallel circuits.

Three phase AC Circuits: Three phase EMF generation, delta and Y connections, line and phase quantities, solution of three phase circuits, balanced supply voltage and balanced load, phasor diagram, measurement of power in three phase circuits, Three phase four wire circuits.

Magnetic Circuits: Ampere's circuital law, B-H curve, solution of magnetic circuits, hysteresis and eddy current losses, relays, an application of magnetic force, basic principles of stepper motor.

Transformers: Construction, EMF equation, ratings, phasor diagram on no load and full load, equivalent circuit, regulation and efficiency calculations, open and short circuit tests, auto-transformers.

Induction Motor: The revolving magnetic field, principle of orientation, ratings, equivalent circuit, Torque-speed characteristics, starters for cage and wound rotor type induction motors.

DC Machines: Construction, EMF and Torque equations, Characteristics of DC generators and motors, speed control of DC motors and DC motor starters.

Electrical Measuring Instruments: DC PMMC instruments, shunt and multipliers, multimeters, moving iron ammeters and voltmeters, dynamometer, wattmeter, AC watt-hour meter, extension of instrument ranges.

**EEE 1288: Electrical Engineering Sessional** **0-3**  
Sessional works compatible to EEE 1287.

**CSE 1287: Computer Programming** **3-0**  
Introduction to the Digital Computer ; Introduction to Programming Variables, Assignment; Expressions; Input/Output; Conditionals and Branching; Iteration; Functions; Recursion; Arrays; Introduction to Pointers; Structures; Introduction to Data-Procedure Encapsulation; Dynamic allocation; Linked structures; Introduction to Data Structure, Stacks and Queues; Search Trees; Time and space requirements. (A programming language like C/C++ may be used as a basis language. The same language must be used for the laboratory).

**CSE 1288: Computer Programming Sessional** **0-3**  
Sessional works compatible to CSE 1287.

**Math 1207: Mathematics II** **3-0**  
**Vector Analysis:** Linear dependent and independent vector, product of vectors; Differentiation and integration of vectors together with elementary application; Line, surface and volume integral; gradient of a scalar function, divergence and curl of a vector function; Physical significance of gradient, divergence and curl; Integral forms of gradient, divergence and curl; Divergence theorem, Stokes theorem, Green theorem and Gauss's theorem.

**Matrices:** Algebra of Matrices; transpose, adjoint and inverse of a matrix; Rank and elementary transportation of matrix; Quadratic forms, matrix polynomial; Normal and canonical forms.

**Ordinary Differential Equations:** First order differential equations - exact, linear and Bernoulli's form, second order differential equations with

constant coefficients, method of variation of parameters, general linear differential equations with constant coefficients, Euler's equations, system of differential equations.

**Hum 1207: Sociology and Accounting** 3-0  
Sociology of architecture, Society, groups and sub-groups, group formation and dynamics, culture, elements of culture, cultural systems and sub-systems, lag, Institutions, social, political and economic; formal Organizational & bureaucracy, Stratification, Status and Role, Social Policy and Planning.

Basic concepts of accounting; Accounts transaction, accounting procedure; Financial statement and their analysis.

Cost terms and classification; Costing methods – overhead costing, job-order costing, process costing; Cost-volume-profit analysis; Variable costing; Standard costing; Relevant cost and profitability analysis for decision making.

**Hum 1209: Society, Ethics and Technology (SET)** 3-0  
Historical Perspectives of Technology, Social Perspectives of Technology, Ethical Perspectives of Technology, Economics, Globalization and Human Rights, Information Systems Technology, Biomedical Technology, Population and The Environment

**IPE 2101: Manufacturing Processes** 3-0  
Classification of manufacturing processes, casting processes for ferrous and non-ferrous metals; sand, die, centrifugal, slush, plaster mold, loam mold, precision investment casting etc. casting defects, design of moulds, riser, gate sprue and core, cost analysis.

Joining methods: Soldering, brazing, welding, conventional welding processes: Gas, arc, TIG, MIG, Submerged, Resistance, Thermit, LASER, Electron beam etc.

Different machining processes: Various operations, cutting tools and their analyses in turning, milling, drilling, shaping, grinding, broaching etc.: Product design considerations for sound and economic machining.

Processes for plastic products; Injection molding, compression molding, blow molding, transfer molding, compounding, extrusion, vacuum forming, thermo-forming etc.

**IPE 2102: Manufacturing Processes Sessional** 0-3  
Sessional works compatible to IPE 2102.

**ME 2101: Basic Thermodynamics** 3-0  
Fundamental concepts-heat, work and energy; Thermodynamic System-state, process and cycle; Kinetic theory of gasses; Properties of gases and vapors; Non-flow and flow processes; Laws of thermodynamics and their corollaries. Second law of thermodynamics: availability, irreversibility and entropy. Ideal gases and their power cycles: vapor power cycles and gas power cycles; refrigeration cycles and reciprocating compressors. Equations of state; Mixtures of gases and vapors; Real gases; Psychrometrics; Fuels and combustion.

**ME 2102: Basic Thermodynamics Sessional** 0-1.5  
Sessional works compatible to ME 2101.

**ME 2110: Mechanical Drawing I** 0-3  
Introduction; Instruments and their uses; First and third angle projections; Orthographic drawings; Isometric views; Missing lines and views; Sectional views and conventional practices; Auxiliary views.

**EEE 2187: Electrical Machines** 3-0  
Transformer: Constructional features, equivalent circuit and phasor diagram -regulation and efficiency, parallel operation. Three phase transformer connections; Harmonic in transformers; Testing; Inrush current; Phase conversion; Autotransformer.

D.C Machines: Construction, armature windings, armature voltage and torque equations, classification. D.C generators' performance characteristics; D.C motors- torque/speed characteristics, speed control and braking. Testing and efficiency.

Induction machines: Constructional features and rotating magnetic field. Circuit model and phasor diagram. Steady state characteristics. Testing.

starting and speed control. Time harmonics and space harmonics. Single phase induction motors - classification and equivalent circuit. Universal motors.

Synchronous machines: Constructional features; synchronous generators and motors; equivalent circuit and phasor diagram; power and torque characteristics and capability curves. Parallel operation. Salient pole synchronous machine - phasor diagram and determination of synchronous reactances; starting and speed control of synchronous motors.

**EEE 2188: Electrical Machines Sessional** 0-1.5  
Sessional works compatible to EEE 2188.

**Math 2107: Mathematics III** 3-0  
Laplace Transform: Definition of Laplace Transform, Linearity property, condition for existence of Laplace Transform; First & Second Shifting properties, Laplace Transform of derivatives and integrals; Unit step functions, Dirac delta-function. Differentiation and Integration of transforms, Convolution Theorem, Inversion. Periodic functions. Evaluation of integrals by L.T., Solution of boundary value problems.

Fourier Transform: Fourier Integral formula, Fourier Transform, Fourier sine and cosine transforms. Linearity, Scaling, frequency shifting and time shifting properties. Self reciprocity of Fourier Transform. Convolution theorem. Application to boundary value problems. Brief Introduction of Z-Transform and Wavelet Transform.

Partial Differential Equations: Linear and non-linear first order equations; Standard forms; Linear equation of higher order; Second order equations with variable coefficient.

**Hum 2107: Engineering Economy** 3-0  
Money management: Engineering economic decisions; Time value of money; Market and effective interest rates; Equivalence calculation under inflation.

Evaluating business and engineering assets: Present worth, annual equivalence and rate-of-return analysis; Resolution of multiple rates of return.

Development of project cash flow: Accounting for depreciation and income taxes; Project cash flow analysis; Handling project uncertainty. Replacement decisions; Benefit-cost analysis.

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**ME 2201: Mechanics of Materials** 3-0

Stress analysis: statically indeterminate axially loaded member, axially loaded member, thermal and centrifugal stresses; Stresses in thin and thick walled cylinders and spheres.

Beams: shear force and bending moment diagrams; Various types of stresses in beams; Flexure formula; Deflection of beams: integration and area moment methods; Introduction to reinforced concrete beams and slabs.

Torsion formula; Angle of twist; Modulus of rupture; Helical springs; Combined stresses: principal stress, Mohr's Circle; Columns: Euler's formula, intermediate column formulas, the Secant formula; Flexure formula of curved beams.

Introduction to experimental stress analysis techniques; Strain energy; Failure theories.

**ME 2202: Mechanics of Materials Sessional** 0-1.5  
Sessional works compatible to ME 2201.

**ME 2203: Engineering Materials** 3-0

Introduction: Engineering materials, materials cycle, application and selection criteria of materials. Atomic structure & bonding: Elementary particles, electronic distribution and atomic size/structure, bonding-primary and secondary, effect of bonding on material properties. Structure of solids: Crystallinity in metals, ceramics, semiconductors and polymers; crystal system/lattice/structure, crystallographic indexing of planes & directions, atomic aggregates and their structure, significance of microstructure; crystalline defects: dimensions, origin and their effect on properties; amorphous structure.

Phase diagrams: Origin, construction, interpretation and application of binary phase diagrams with reference to a few important metallic and

ceramic systems. Properties of materials: physical, mechanical, chemical, electrical, semi/super conducting, magnetic, optical, thermal properties of solids; units and testing.

Engineering materials: Structure, properties, processing, fabrication and application of—metals and alloys, ceramics, rubber, plastics, semiconductors, and composites.

**ME 2204: Engineering Materials Sessional** 0-1.5  
Sessional works compatible to ME 2203.

**ME 2210: Mechanical Drawing-II** 0-3  
Review of orthographic projections; Fasteners, gears, keys and springs; Sectional views and conventional practices; Auxiliary views; Specifications for manufacture; Working drawings; Plan and elevation of building; Computer Aided Drawing; Computer Aided Design.

**EEE 2285: Introduction to Analog and Digital Electronics** 3-0  
Equivalent circuits using transconductance parameter for low and high frequency operation of BJTs and FETs, Ebers-Moll model view ; design and analysis of single / multistage amplifiers, wideband / narrowband amplifiers ; differential amplifiers ; current mirror- different configurations, feedback amplifiers, oscillators and waveform generators ; power amplifiers- class AB/classB push-pull/class C ; op-amp design: different stages of op-amp-a case study ; active filter design, switched capacitor circuits ; ADC , DAC

Switching algebra, minimizing functions using maps, different logic families, TTL, ECL, NMOS , CMOS, pass transistor logic, combinational logic circuits:- adders / subtractor , demultiplexers, encoders , decoders , ROMs , PLAs etc. sequential logic circuits:- flip flops and latches , shifters, counters, finite state machine, state transition diagrams and state transition tables. Memory elements: - ROM, PROM, RAM-SRAM, DRAM. Case studies: a simple computer, RTL micro-instruction, instruction decoders timing and controller circuits, data path unit.

**EEE 2286: Analog and Digital Electronics Sessional** 0-3  
Sessional works compatible to EEE 2285.

**Math 2207: Numerical Analysis and Statistics** 3-0  
Errors in computations; Roots of equation-bracketing method, open method, roots of polynomial; Linear algebraic equations-Gauss elimination, decomposition and matrix inversion; Curve fitting-interpolation and Fourier approximation; Numerical differentiation and integration; Ordinary differential equation-Runge Kutta method, stiffness and multistep method, boundary value and eigen value problems; Partial differential equations-finite difference for elliptic and parabolic equations, finite element method.

Probability: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem, and independence. Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation. Special Distributions: Discrete uniform, Binomial, Geometric, Poisson, Exponential, Gamma, Normal distributions. Sampling Distributions: The Central Limit Theorem, Confidence interval, Chi-Square, t and F distributions; hypothesis testing; regression analysis.

**Hum 2207: Industrial Law and Safety Management** 3-0  
Principles of law of contract; Company law: Law regarding formation, incorporation, management and winding up of companies; Labor law: Law in relation to wage hours, health, safety and other work conditions; The trade union legislation arbitration; The policy of the state in relation to labor; The Factory Act; Law of compensation.

Safety Management: Evolution of modern safety concepts; Industrial hazard, safety and risk management; Worker health and safety; Proactive techniques for safety management; Safety standard and regulation for engineering works.

**ME 3131: Fluid Mechanics and Machinery** 3-0  
Fluid statics: basic hydrostatic equation, pressure variation in static incompressible and compressible fluids; Forces on plane and curved surfaces. Continuity, momentum and energy equations; Introduction to inviscid incompressible flow to include two dimensional basic flows. Dimensional analysis and similitude; Fundamental relations of



compressible flow. Real fluid flow; Frictional losses in pipes and fittings. Introduction to boundary layer theory. Introduction to open channel flow

Types of fluid machinery; Rotodynamic and positive displacement machines; Impulse and reaction turbines; Centrifugal and axial flow pumps; Dimensional analysis applied to fluid machinery: specific speed, unit power, unit speed, unit discharge; Performance and characteristics of turbines and pumps; Cavitation; Reciprocating pump, gear and screw pumps; Fans, blowers and compressors; Hydraulic transmission: fluid coupling and torque converter.

**ME 3132: Fluid Mechanics and Machinery Sessional** 3-0  
Sessional works compatible to ME 3131.

**IPE 3101: Measurement, Instrumentation and Control** 3-0

Sources of error in measurement–Abbey's principle of alignment; Measurement of small linear and angular displacement–mechanical, electrical, optical and pneumatic comparators; Indirect methods of linear and angular measurement; Straightness, flatness and roundness measurement; Measurement of surface texture; Limits, fits and tolerances; Gauges and gauge design–Taylor's principle; Gear and thread measurement; Non-destructive testing.

Sensors for measuring stress, strain, pressure, temperature, position, velocity etc.; Signal conditioning techniques using Wheatstone bridge, Operational amplifiers, digital-to-analog converter, analog-to-digital converter etc.; Actuators–hydraulic, pneumatic, electrical etc.; Programmable Logic Controller–components, inputs, outputs and programming with Ladder Diagram; Generalized measurement systems; Modeling of systems; Dynamic characteristics of open and closed loop systems.

**IPE 3102: Measurement, Instrumentation and Control Sessional** 0-3  
Sessional works compatible to ME 3102.

**IPE 3103: Product Design and Development** 3-0

Value engineering; Identification of customer needs; Establishing product functions; Specification development; Concept generation and evaluation.

Designing machine parts for strength, deflection, stiffness, fatigue, impact etc.; Design of shafts, keys, power screw, couplings, clutches and brakes.

Reverse engineering; Design for assembly, disassembly, reliability and environment; Standardization. Design of gears, bearings, springs, welded joints and screwed joints.

**IPE 3104: Product Design and Development Sessional** 3-0  
Sessional works compatible to IPE 3104.

**IPE 3105: Modern Machining Processes** 3-0

Modern machining processes: ultrasonic machining, abrasive jet machining, abrasive flow machining, orbital grinding, water jet cutting, electrochemical machining, electrical discharge machining, electron beam machining, laser beam machining, plasma arc machining, chemical machining; working principles of the related machines.

**IPE 3107: Operation Research** 3-0

Introduction and scope of Operations Research, Introduction to Mathematical Modeling: Different kinds of modeling and their characteristics.

Linear programming: Simplex algorithm, duality, sensitivity analysis; Transportation and Assignment algorithm; Game theory.

Integer programming; Dynamic Programming–deterministic and probabilistic; Queuing models. Simulation, Markov chain, non-linear optimization.

**IPE 3201: Ergonomics, Safety and Productivity Engineering** 3-0

Ergonomics: Man-machine-material aspects in manufacturing systems; Physical and cognitive aspects; Musculoskeletal system and biomechanics; Human muscular effort during manual handling, lifting and carrying; Avoidance of musculoskeletal disorders; Anthropometry; Workstation organization and design; Design of hand tools, controls and displays; Human vision and illumination; Hearing and noise; Work climate.

Safety Management: Evolution of modern safety concepts; Industrial hazard, safety and risk management; Worker health and safety; Proactive techniques for safety management; Safety standard and regulation for engineering works.

Productivity Engineering: Productivity factors – internal and external; Productivity analysis – labour-time method, financial method, Kurosawa approach, Lawlor's approach, method study and work measurement; Productivity improvement techniques – technical and human approaches.

**IPE 3202: Ergonomics, Safety and Productivity Engineering** 0-3  
**Sessional**  
Sessional works compatible to IPE 3201.

**IPE 3203: Material Handling and Maintenance Engineering** 3-0  
Fundamental issues material handling: Analysis of material handling problems; Classification of materials – unit load, bulk loads; Study of material handling systems and their efficiency.  
Product handling: Design system configuration conforming to various kinds of product features and layout characteristics; Plant layout; Selection of material conveying equipment.

Designing concepts of common handling and transfer equipments: Different types of conveyors such as belt, screw, chain, flight, bucket elevators, pneumatic, hydraulic, cranes, forklifts etc.

Automatic packaging devices; Testing procedure of packages – vibration test, drop test, performance limits and testing machines. Design of warehouse facilities appropriate for relevant handling and transfer device. Algorithms to design and analyze discrete parts storage and flow system.

Concept of maintenance and maintenance management; Types of maintenance – Fixed time replacement, condition based maintenance, preventive and corrective maintenance; Reliability centered maintenance; Replacement strategies.  
Condition monitoring of machine components; Various methods of condition monitoring – vibration, temperature, acoustic emission etc. and interpretation of the results and their practical applications.

**IPE 3204: Material Handling and Maintenance Engineering** 0-3  
**Sessional**  
Sessional works compatible to IPE 3204.

**IPE 3205: Production Planning and Control** 3-0  
Elements of production control; Types of production systems. Product development and design-product analysis; break even point and P/V ratio; Relation between original planning and supplementary planning. Forecasting: Coordination between sales, manufacturing and purchase departments; Techniques of forecasting. Manufacturing economics, cost reduction and cost control. Inventory: Purchase models and production models. Scheduling: Basic concept and different techniques-Gantt Charts, Index method: Line of balancing etc. plant location; Plant layout: Principles and common problems; Evaluation of layout; Plant budgetary control; Time and motion study; Machine capacity; Design of Production system.

**IPE 3207: Robot and Computer Controlled Machines** 3-0  
Robot: Drive systems of robots, Electrical and hydraulic systems, AC and DC drives, Servo drives using voltage control, current control and direct torque control, PID control systems and performance issues. Feedback systems. Single loop and multi-loop, DSP based motion control systems. Sensors for industrial robots, encoders, resolvers, hall-effect sensors, acoustic sensors, ultrasonic and optical/infrared sensors, Elements of robot vision, Integration using PLCs. Digital motion planning systems.

Computer Control Machines: Introduction, classification, design features and control features of CNC machines; Programming: G & M Code programming, Offline (APT-like) programming; Free form surface machining: Isoparametric, Isoplanar and Isoscallop machining strategies

**IPE 3209: Metal Forming and Sheet Metalworking** 3-0  
Fundamental of Metal Forming: Overview of metal forming, material behavior in metal forming, temperature in metal forming, friction and lubrication in metal forming.

Bulk Deformation Processes in Metal Working: Rolling and Other deformation processes related to rolling, Forging and Other deformation processes related to forging, Extrusion and Other deformation processes related to forging.

Sheet Metal Working: Cutting operations, bending operations, drawing, Other sheet metal forming operations, precision forming processes;

various features of different types of metal forming dies; principles of powder forming.

**IPE 3210: Metal Forming and Sheet Metalworking Sessional** 0-3  
Sessional works compatible to IPE 3209.

**IPE 4101: Machine Tools and Machining** 3-0  
Machine Tools: Concept and definition of machining and machine tools. History of developments of machine tools. Concept of producing geometrical surfaces by generatrix and directrix. Kinematic systems and structures of conventional machine tools. Electromechanical and hydraulic drives and control of machine tools. Machine tool automation. Classification and specification of machine tools. Construction, working principle and application of various semi-automatic and automatic lathes. Flexible automation need, principle and advantages. Basic constructional features, working principle and application of CNC machine tools, machining center and FMS.

Machining: Tool geometry, mechanism of chip formation. Mechanics of machining. Cutting temperature; causes, effects, estimation, measurement and control. Cutting fluid applications. Failure modes, wear and life of cutting tools. Cutting tool materials. Role of geometrical and process parameters and cutting fluid on machinability. Mechanics of grinding. Economy of machining and grinding. Special techniques and advanced technology of machining and grinding.

**IPE 4102: Machine Tools and Machining Sessional** 0-3  
Sessional works compatible to IPE 4201.

**IPE 4103: Operations and Project Management** 3-0  
Concepts of production systems; Forecasting; Capacity planning; Probabilistic Inventory models, Aggregate planning; Master production scheduling.

Push and pull production systems; Material requirements planning – inputs, outputs, procedure, lot sizing etc., MRPII, ERP; Just-in-time production system – goals, implementation, Kanban; The push-pull interface; Comparison of push and pull systems.

Parameters and performance of production systems; Efficiencies of performance; Line balancing. Production scheduling; Shop floor control;

Facility location; Facility layout. Project planning and control; CPM and PERT; Project organization; Scheduling; Resource allocation.

**IPE 4105: Supply Chain Management** 3-0  
Basic concepts of supply chain management; Customer service management; Order fulfillment process; Supply chain planning and sourcing. Procurement–supplier selection, optimal procurement policy etc.; Distribution strategies–centralized vs decentralized control, direct shipment, cross-docking, transshipment, central vs local facilities, push-based vs pull-based supply chain, warehouse location, customer allocation etc.; Strategic alliances–supplier relationship, third party logistics, distributor integration etc.; Implementing supply chain–GSCF and SCOR framework; Supply chain performance matrices; Global issues in decisions–planning under uncertainty, real time monitoring and control, integrated scheduling etc.

**IPE 4107: Business Law** 3-0  
Principles of law of contract; Company law: Law regarding formation, incorporation, management and winding up of companies; Labor law: Law in relation to wage hours, health, safety and other work conditions; The trade union legislation arbitration; The policy of the state in relation to labor; The Factory Act; Law of compensation.

**IPE 4000: Project and Thesis** 0-6  
In this course, students are required to undertake a major project in engineering analysis, design development of research. The objective is to provide an opportunity to develop initiative, self reliance, creative ability and engineering judgment. The results must be submitted in a comprehensive report with appropriate drawings, charts, bibliography, etc. along with products if any. Use of locally available materials in manufacturing and feasibility study of local industrial units will be emphasized.

**IPE 4201: Computer Integrated Manufacturing (CIM)** 3-0  
Hardware components of computer controlled manufacturing systems; PLC, AGV, ASRS, Robots etc. Software components: CAD, CAM and their integration.

Product data management: Direct translation between CAD systems; CAD/CAM data exchange. Production process system; Flexible

manufacturing cells; Planning and layout of flexible manufacturing system; Agile manufacturing; Lean production system; Reconfigurable manufacturing system.

Process planning; Process design and planning; Computer aided process planning; Group technology and cellular manufacturing; Concurrent engineering. Shop floor communication; Data logging and acquisition; Integration through information system; Networking and data communication.

**IPE 4203: Industrial and Business Management** 3-0  
Business and Management process, managerial function of business and then relative importance, managerial skills and development.

Emergence of management thought and the patterns of management analysis scientific management and Taylorism, Modern operational-management theory, emergence of the behavioral sciences, recent contributors to management thought.

Management and Society: the external environment, social responsibility and ethics. Organization and management: system approach to organization, organization theory and organizing practices, basics of organizing.

Personnel and human resource management in business human factors and motivation, leadership, group decision making and communication, Job gradation, process of performance appraisal and reward systems.

Managing information for decisions and management information systems. Managing the marketing of goods and service, total marketing activity, marketing mix, some selected topics of marketing such as, Industrial and consumer selling, advertising, new product strategy and decisions.

Management in the international setting, challenges for management in the twenty-first century. Entrepreneurship and Entrepreneurial Management.

**IPE 4205: Quality Management** 3-0  
Concepts of quality; Contemporary philosophies of quality; Quality costs. Analysis of variance, Design of experiment.

Statistical process control; PDCA cycle; Cause-effect analysis; Stratification analysis; Checksheet; Histogram; Scatter diagram; Pareto analysis; Control charts for attributes and variables; Process capability analysis.

Acceptance sampling plan; Operating characteristic curves; Single, double, sequential and rectifying sampling plans; AOQ, AOQL etc.

Quality standards and compliance; ISO 9000. Different tools and philosophies of TQM. Introduction to quality function deployment (QFD), reliability, failure mode and effect analysis, design of experiment and Taguchi methods.

**IPE 4206: Industrial Simulation Sessional** 0-3  
Simulating industrial problems by using different software (viz. MS Excel, Arena etc.) for both manufacturing and service industries.

**IPE 4208: Business Communication Seminar** 0-3  
It includes technical report writing, CV writing, business plan, technical paper presentation and seminar.

**IPE 4000: Project and Thesis** 0-6  
In this course, students are required to undertake a major project in engineering analysis, design development of research. The objective is to provide an opportunity to develop initiative, self reliance, creative ability and engineering judgment. The results must be submitted in a comprehensive report with appropriate drawings, charts, bibliography, etc. along with products if any. Use of locally available materials in manufacturing and feasibility study of local industrial units will be emphasized.

**IPE 4011: Advanced Materials and Processes** 3-0  
Super alloys; Metal matrix composites, Ceramic matrix composites, other composites; Polymers; Biodegradable plastics; Ceramics; Electronic materials. Powder metallurgy and particulate materials

**IPE 4013: Micro-Manufacturing** 3-0  
Microelements: design and fabrication; Basics of micro-fabrication technology: thin film growth and deposition, photolithography, X-ray

lithography, wet and dry chemical etching, electrochemical machining, ultrasonic machining, plasma machining and laser machining.

**IPE 4015: Emerging Trends in Manufacturing Technology** 3-0

Surface engineering and High speed grinding: Application of advanced coatings in high performance cutting tools and high performance super-abrasive grinding wheels. Application of surface coating in metal-ceramic joining. Ultra high speed grinding with monolayer CBN grinding wheel. Machining and grinding under cryogenic environment. Micro and nano machining of glasses and ceramics in ductile regime using diamond cutting tool and diamond grinding wheel.

Rapid prototyping: Need for Rapid Prototyping, Basic Principles and advantages of RP, Classifications of different RP techniques with examples, Introduction to three Representative RP techniques: Fused deposition modeling, Laminated Object Manufacturing and Stereolithography

MEMS: Introduction, history, development and need of micro-electro-mechanical systems. IC fabrication processes used for MEMS; MEMS sensors and actuators; Mechanical process techniques and process models for micro-machining; Fabrication processes and design of the process sequences; Agile prototyping; Reliability and process control of micro manufacturing processes; Introduction to nano-technology processes.

**IPE 4017: Intelligent Manufacturing** 3-0

AI Technologies and expert system: components and features, knowledge system, knowledge engineer, domain expert, knowledge engineering languages. Artificial neural network and fuzzy logic

Expert manufacturing systems: CIM, manufacturing communication system and intelligent manufacturing, flexible manufacturing system, case study of EMS.

**IPE 4019: Process Dynamics and Adaptive Control** 3-0

State space approach to control systems. State transition equations. Linear Time invariant and nonlinear systems. Controllability and Observability of systems. Pole placement design. Design of control

systems. Elements of optimal control. Digital control and time delay control systems. Basic concepts of estimation and identification in automatic control systems. Adaptive control of complex process control systems as in automated machining and welding processes, energy based systems and processes. Nonlinear control and related topics using neuro, fuzzy or genetic algorithms. Case studies and descriptions for automated industrial process control applications inclusive of advanced topics in processes for the high tech industry.

**IPE 4021: Energy and Environment Management** 3-0

Energy Systems: commercial-noncommercial, rural-urban, renewable-non-renewable energy; Energy planning, Energy generation and distribution systems management; generation mix, dispatch system Energy policy: national energy policy and tariff policy.

Environmental impact assessment of projects. Source of degradation of earth's eco-system technological development, green-house gases, ozone layer depletion, toxic gases and industrial wastes, Montreal protocol, remedies Noxout China-sun refrigerant technologies and use of catalysts, Environmental economics and accounting system.

**IPE 4023: Marketing Management** 3-0

Marketing concepts: market orientation, relationship marketing, market segmentation and measurement, buyer behavior; Marketing planning and budgeting.

Concept of marketing mix: product, price, place and promotion; Strategic and tactical decisions; New product planning processes; Global marketing; Case studies.

**IPE 4025: Technology Management** 3-0

Introduction to technology; Growth of technology; Types and components of technology; Technology and environment; Technology forecasting; Technology assessment, Transfer of technology; Technological development and planning.

**IPE 4027: Entrepreneurship Development and Micro-Industries** 3-0

Entrepreneurship: definition and importance and its role; Characteristics and skills of entrepreneurs; Entrepreneurial

process; Self assessment; Managers, leader, innovators and entrepreneurs.

Small Business: nature and importance, methods for generating ideas, creativity process, product planning and development process; Merger, acquisition & joint venture; Business plan; Marketing plan; Market research; Financial plan; Organizational and human resource plan; Production plan; Financing the business, Managing early operations and growth.

**IPE 4029: Organizational Behavior** 3-0  
 Behavior of individuals in organizations; values and attitudes, motivation; Group and group processes; group dynamics, communication, power & conflict; Organizational system; structure, job design, appraisal of performance; Processes of organizational change and development.

**IPE 4031: Total Quality Management** 3-0  
 TQM definition; Origins and growth of TQM; Benefits of TQM; Philosophies of TQM: quality circle approach, Deming's approach, Juran's approach, Philip Crosby's approach. Planned implementation of TQM: Planning and commitment, participation, continuous improvement

## Chapter-5

### Course Structure for Undergraduate Program of Mechanical Engineering

Year-1 / Semester-1				
Subject Code	Subject Name	T-S	Credits	
ME 1103	Introduction to Mechanical and Industrial Engineering	3-0	3.00	
Math 1107	Mathematics-I	3-0	3.00	
Phy 1105	Physics	3-0	3.00	
Chem 1107	Chemistry	3-0	3.00	
Hum 1107	Critical Thinking and Communication	3-0	3.00	
<b>Sub Total=</b>			<b>15.00</b>	<b>15.00</b>
IPE 1110	Machine Shop Practice-I	0-3	1.50	
Phy 1106	Physics Sessional	0-3	1.50	
Chem 1108	Chemistry Sessional	0-3	1.50	
Hum 1108	English Language Sessional	0-3	1.50	
<b>Sub Total=</b>			<b>12.00</b>	<b>6.00</b>
<b>Total=</b>			<b>27.00</b>	<b>21.00</b>

Year-1 / Semester-2				
Subject Code	Subject Name	T-S	Credits	
EEE 1287	Basic Electrical Engineering	3-0	3.00	
CSE 1287	Computer Programming	3-0	3.00	
Math 1207	Mathematics-II	3-0	3.00	
Hum 1207	Sociology and Accounting	3-0	3.00	
Hum 1209	Society, Ethics & Technology (SET)	3-0	3.00	
<b>Sub Total=</b>			<b>15.00</b>	<b>15.00</b>
IPE 1210	Machine Shop Practice-II	0-3	1.50	
EEE 1288	Electrical Engineering Sessional	0-3	1.50	
CSE 1288	Computer Programming Sessional	0-3	1.50	
<b>Sub Total=</b>			<b>9.00</b>	<b>4.50</b>
<b>Total=</b>			<b>24.00</b>	<b>19.50</b>

Year-2 / Semester-1				
Subject Code	Subject Name	T-S	Credits	
IPE 2101	Manufacturing Processes	3-0	3.00	

ME	2101	Basic Thermodynamics	3-0	3.00
EEE	2187	Electrical Machines	3-0	3.00
Math	2107	Mathematics-III	3-0	3.00
Hum	2107	Engineering Economy	3-0	3.00
<b>Sub Total=</b>			<b>15.00</b>	<b>15.00</b>
IPE	2102	Manufacturing Processes Sessional	0-3	1.50
ME	2102	Basic Thermodynamics Sessional	0-1.5	0.75
ME	2110	Mechanical Drawing-I	0-3	1.50
EEE	2188	Electrical Machines Sessional	0-1.5	0.75
<b>Sub Total=</b>			<b>9.00</b>	<b>4.50</b>
<b>Total=</b>			<b>24.00</b>	<b>19.50</b>

Year-2 / Semester-2				
Subject Code	Subject Name	T-S	Credits	
ME	2201	Mechanics of Materials	3-0	3.00
ME	2203	Engineering Materials	3-0	3.00
EEE	2285	Introduction to Analog and Digital Electronics	3-0	3.00
Math	2207	Numerical Analysis and Statistics	3-0	3.00
Hum	2207	Industrial Law and Safety Management	3-0	3.00
<b>Sub Total=</b>			<b>15.00</b>	<b>15.00</b>
ME	2202	Mechanics of Materials Sessional	0-1.5	0.75
ME	2204	Engineering Materials Sessional	0-1.5	0.75
ME	2210	Mechanical Drawing-II	0-3	1.50
EEE	2286	Analog and Digital Electronics Sessional	0-3	1.50
<b>Sub Total=</b>			<b>9.00</b>	<b>4.50</b>
<b>Total=</b>			<b>24.00</b>	<b>19.50</b>

Year-3 / Semester-1				
Subject Code	Subject Name	T-S	Credits	
ME	3105	Fluid Mechanics	3-0	3.00
ME	3101	Mechanics of Machinery	3-0	3.00
ME	3103	Engineering Mechanics	3-0	3.00
ME	3109	Measurement and Instrumentation	3-0	3.00
Math	3107	Mathematics-IV	3-0	3.00
<b>Sub Total=</b>			<b>15.00</b>	<b>15.00</b>
ME	3106	Fluid Mechanics Sessional	0-1.5	0.75
ME	3102	Mechanics of Machinery Sessional	0-1.5	0.75
ME	3110	Instrumentation and Measurement Sessional	0-3	1.50
ME	3100	Communication Seminar	0-3	1.50
<b>Sub Total=</b>			<b>9.00</b>	<b>4.50</b>
<b>Total=</b>			<b>24.00</b>	<b>19.50</b>

Year-3 / Semester-2				
Subject Code	Subject Name	T-S	Credits	
ME	3201	Machine Design	3-0	3.00
IPE	3205	Production Planning and Control	3-0	3.00
ME	3203	Control Engineering	3-0	3.00
IPE	3231	Industrial Management	3-0	3.00
ME	3205	Heat and Mass Transfer	3-0	3.00
<b>Sub Total=</b>			<b>15.00</b>	<b>15.00</b>
ME	3202	Machine Design Sessional	0-3	1.50
ME	3204	Control Engineering Project	0-3	1.50
ME	3206	Heat and Mass Transfer Sessional	0-3	1.50
<b>Sub Total=</b>			<b>9.00</b>	<b>4.50</b>
<b>Total=</b>			<b>24.00</b>	<b>19.50</b>

Year-4 / Semester-1				
Subject Code	Subject Name	T-S	Credits	
ME	4101	Internal Combustion Engine	3-0	3.00
ME	4103	Fluid Machinery	3-0	3.00
ME	4105	Refrigeration and Building Mechanical Systems	3-0	3.00
ME	xxxx	Optional-I	3-0	3.00
TEX	4107	Textile Technology	3-0	3.00
<b>Sub Total=</b>			<b>15.00</b>	<b>15.00</b>
ME	4102	Heat Engine Sessional	0-1.5	0.75
ME	4104	Fluid Machinery Sessional	0-1.5	0.75
ME	4000	Project and Thesis	0-6	3.00
<b>Sub Total=</b>			<b>6.00</b>	<b>4.50</b>
<b>Total=</b>			<b>24.00</b>	<b>19.50</b>

Year-4 / Semester-2				
Subject Code	Subject Name	T-S	Credits	
ME	4201	Power Plant Engineering	3-0	3.00
ME	4203	Automobile Engineering	3-0	3.00
ME	4205	Mechatronics	3-0	3.00
IPE	3105	Modern Machining Processes	3-0	3.00
ME	xxxx	Optional-II	3-0	3.00
<b>Sub Total=</b>			<b>15.00</b>	<b>15.00</b>
ME	4202	Applied Thermodynamics Sessional	0-1.5	0.75
ME	4000	Project and Thesis	0-6	3.00
<b>Sub Total=</b>			<b>7.50</b>	<b>3.75</b>
<b>Total=</b>			<b>22.50</b>	<b>18.75</b>
<b>Total Credit Hours=</b>				<b>156.75</b>

### Optional Courses

Subject Code	Subject Name	T-S	Credits
ME 4011	Renewable Energy	3-0	3.00
ME 4013	Combustion and Pollution	3-0	3.00
ME 4015	Energy and Environment	3-0	3.00
ME 4017	Fluids Engineering	3-0	3.00
ME 4019	Aerodynamics	3-0	3.00
ME 4021	Applied Engineering Mathematics	3-0	3.00
ME 4023	Similitude in Engineering Mechanics	3-0	3.00
ME 4025	Fluidics <i>Fluid Power &amp; Control</i>	3-0	3.00
ME 4027	Design of Fluid Machines	3-0	3.00
ME 4029	Biomedical Fluid Mechanics	3-0	3.00
ME 4031	Theory of Structures	3-0	3.00
ME 4033	Noise and Vibration	3-0	3.00
ME 4035	Robotics	3-0	3.00
ME 4037	Composite Materials	3-0	3.00
ME 4039	Petroleum Engineering	3-0	3.00
ME 4041	Applied Statistics	3-0	3.00
ME 4043	Advanced Thermodynamics	3-0	3.00
ME 4045	Nuclear Engineering	3-0	3.00
ME 4047	Bio-Engineering	3-0	3.00
ME 4049	Plastics Process Technology	3-0	3.00

## Chapter-6

### Course Contents for Undergraduate Program of Mechanical Engineering

**ME 1103: Introduction to Mechanical and Industrial Engineering 3-0**  
Study of sources of energy: conventional and renewable, environmental pollution; study of steam generation units with their accessories and mountings; Introduction to: steam turbine with their accessories, internal combustion engines and gas turbines with their accessories, automobiles; introduction to pumps, blowers and compressors, refrigeration and air conditioning systems.

Evolution of industrialization; Involvement of Industrial and Production Engineering in the entire life cycle of a product; Design of product; Basic processes for product manufacturing; Machineries for manufacturing; Computer in manufacturing; Managing manufacturing system; Improvement of systems—optimization, quality management, ergonomics, safety, organizational behavior etc.

**IPE 1110: Machine Shop Practice-I 0-3**

Foundry Technology: The practice-cum-experiments to impart an understanding on the various steps in metal casting including pattern design, sand preparation, molding and melting:

- Study on various types of patterns and pattern materials
- Layout of a pattern
- Study on sand preparation
- Study on variation of mould properties with different molding machines
- Study on the effect of molding parameters on the properties of moulds
- Study of melting furnace and melting of ferrous and non ferrous alloys including degasification.

Welding: Practical classes designed with the objective of imparting hands on training as well as understanding of welding technology. Suggested exercises are:



- Understanding of welding machine characteristics and controls, electrode specifications, selection of electrode size and current, laying of beads.
- Study of joint configuration and specification, required edge preparations; practice on preparing both side square groove butt weld; grinding of weld crown to make bead flush with plate surface; visual inspection of defects and reporting.
- Study of various types of oxy-acetylene flames; practice on flame adjustment, gas welding/brazing.
- Study and practice on different types of welding methods.

#### Math 1107: Mathematics I

3-0

Differential Calculus: Rolle's Theorem, Cauchy's mean value theorem (Lagrange's mean value theorem as a special case), Taylor's and Maclaurin's 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 - Lagrange's method of multipliers.

Integral Calculus: Fundamental theorem of integral calculus, mean value theorems, evaluation of definite integrals - reduction formulae.

Solid Geometry: System of co-ordinates, distance between two points; section formula; Projection, direction cosine; Equations of planes and lines.

#### Phy 1105: Physics

3-0

Waves and Oscillations: Simple harmonic motion, Differential equation of simple harmonic oscillator, total energy and average energy, combination of simple harmonic oscillations, spring mass system, torsional pendulum; two body oscillation, reduced mass, damped oscillation, forced oscillation, resonance, vibrations of membranes and columns, progressive wave, power and intensity of wave, stationary wave, energy calculation of

progressive and stationary wave, group and phase velocities, sound waves- Doppler Effect, Sabine's formula, architectord acoustics.

Optics: Defects of images: Spherical aberration, astigmatism, coma, distortion, curvature, chromatic aberration, theories of light, Huygen's principle; Interference of light: Young's double slit experiment, displacement of fringes and its uses, Fresnel biprism, interference in thin film, Newton's rings, interferometers; Diffraction: Diffraction by single slit, diffraction from a circular aperture, resolving power of optical instruments, diffraction at double slit and N-slits, diffraction grating; Polarization: production and analysis of polarized light, Brewster's law, Malus law, polarization by double refraction, Nicol prism, optical activity, polarimeters, optics of crystal optical effect in crystal, laser, nonlinear optics.

Modern Physics: Galilean relatively and Einstein's special theory of relativity; Lorentz transformation equations, Length contraction, time dilation and mass-energy relation, photoelectric effect, Compton effect, De'Broglie matter waves.

Nuclear Physics: Constituent of atomic nucleus, Nuclear binding energy, different types of radioactivity, radioactive decay law; Nuclear reactions, nuclear fission, nuclear fusion.

#### Phy 1106: Physics Sessional

0-3

Sessional works compatible to Phy 1105.

#### Chem 1107: Chemistry

3-0

Atomic Structure, quantum numbers, Pauli's exclusion principle, electronic configuration, periodic table, properties and uses of noble gases, different types of chemical bonds and their properties, molecular structures of compounds, selective organic reactions. Different types of solutions and their compositions. Phase rule, phase diagram of monocomponent system. Properties of dilute solutions. Thermochemistry, chemical kinetics, chemical equilibrium. Ionization of water and pH concept. Electrical properties of solution.

#### Chem 1108: Chemistry Sessional

0-3

Sessional works compatible to Chem 1107.

**Hum 1107: Critical Thinking and Communication** 3-0

Objective: The aim of this foundational course is to help the second language learners acquire fluency in both spoken and written English to communicate messages with clarity, precision and confidence in the workplace. The course will have three components: Language, Speaking and Writing. The skills required in these areas will be imparted through Lectures and Sessionals. While lectures will introduce learners to the basic concepts in communication, sessionals will provide hands-on experience. It is hoped that after commanding the skills required in spoken and written English, learners will be able to communicate better.

Lecture topics:

- Introduction to communication
- Language and grammar skills
- Speaking skills
- Writing skills

**Hum 1108: English Language Sessional** 0-3

Building Vocabulary, Building sentences, Grammar, Pronunciation drills, Phonetics, vowels, Diphthongs, consonants, Stress, Rhythm and intonation, Conversational skills, Meta Language, The writing process, Writing with a thesis, Writing topic sentences, Writing a paragraph, Linking paragraph.

**IPE 1210: Machine Shop Practice-II** 0-3

Machining:

- Facing, drilling, boring, turning-straight, taper, eccentric, grooving, thread cutting, forming etc. in center lathes
- Surfacing, making regular polygons and cutting gear teeth in milling machines
- Gear teeth generation in gear shaping machine and hobbing machine
- Part programming and machining in CNC machining center
- Setting and operation of EDM, ECM, etc.
- Finishing by grinding
- Measurement of dimensions, forms and surface finish of machined products.

Bulk Deformation Processes and Sheet Metalworking:

- Bulk deformation processes in metal working
  - Rolling
  - Forging
  - Extrusion
- Sheet metal working

**EEE 1287: Basic Electrical Engineering** 3-0

Sources of energy: General structure of electrical power systems, Power transmission and distribution via overhead lines and underground cables, Steam, Hydraulic, Gas and Nuclear power generation.

DC Networks: Kirchoff's laws, node voltage and mesh current methods, Delta-star and star-delta conversion, Superposition principle, Thevenin's and Norton's theorems.

Single phase AC Circuits: Single phase EMF generation, average and effective values of sinusoids, solution of R,L,C series circuits, the  $j$  operator, complex representation of impedances, phasor diagram, power factor, power in complex notation, solution of parallel and series, parallel circuits.

Three phase AC Circuits: Three phase EMF generation, delta and Y connections, line and phase quantities, solution of three phase circuits, balanced supply voltage and balanced load, phasor diagram, measurement of power in three phase circuits, Three phase four wire circuits.

Magnetic Circuits: Ampere's circuital law, B-H curve, solution of magnetic circuits, hysteresis and eddy current losses, relays, an application of magnetic force, basic principles of stepper motor.

Transformers: Construction, EMF equation, ratings, phasor diagram on no load and full load, equivalent circuit, regulation and efficiency calculations, open and short circuit tests, auto-transformers.

Induction Motor: The revolving magnetic field, principle of orientation, ratings, equivalent circuit, Torque-speed characteristics, starters for cage and wound rotor type induction motors.

DC Machines: Construction, EMF and Torque equations. Characteristics of DC generators and motors, speed control of DC motors and DC motor starters.

Electrical Measuring Instruments: DC PMMC instruments, shunt and multipliers, multimeters, moving iron ammeters and voltmeters, dynamometer, wattmeter, AC watt-hour meter, extension of instrument ranges.

**EEE 1288: Electrical Engineering Sessional** 0-3  
Sessional works compatible to EEE 1287.

**CSE 1287: Computer Programming** 3-0  
Introduction to the Digital Computer ; Introduction to Programming Variables, Assignment; Expressions; Input/Output; Conditionals and Branching; Iteration; Functions; Recursion; Arrays; Introduction to Pointers; Structures; Introduction to Data-Procedure Encapsulation; Dynamic allocation; Linked structures; Introduction to Data Structure, Stacks and Queues; Search Trees; Time and space requirements. (A programming language like C/C++ may be used as a basis language. The same language must be used for the laboratory).

**CSE 1288: Computer Programming Sessional** 0-3  
Sessional works compatible to CSE 1287.

**Math 1207: Mathematics II** 3-0  
**Vector Analysis:** Linear dependent and independent vector, product of vectors; Differentiation and integration of vectors together with elementary application; Line, surface and volume integral; gradient of a scalar function, divergence and curl of a vector function; Physical significance of gradient, divergence and curl; Integral forms of gradient, divergence and curl; Divergence theorem, Stokes theorem, Green theorem and Gauss's theorem.

**Matrices:** Algebra of Matrices; transpose, adjoint and inverse of a matrix; Rank and elementary transportation of matrix; Quadratic forms, matrix polynomial; Normal and canonical forms.

**Ordinary Differential Equations:** First order differential equations - exact, linear and Bernoulli's form, second order differential equations with

constant coefficients, method of variation of parameters, general linear differential equations with constant coefficients, Euler's equations, system of differential equations.

**Hum 1207: Sociology and Accounting** 3-0  
Sociology of architecture, Society, groups and sub-groups, group formation and dynamics, culture, elements of culture, cultural systems and sub-systems, lag, Institutions, social, political and economic; formal Organizational & bureaucracy, Stratification, Status and Role, Social Policy and Planning.

Basic concepts of accounting; Accounts transaction, accounting procedure; Financial statement and their analysis.

Cost terms and classification; Costing methods - overhead costing, job-order costing, process costing; Cost-volume-profit analysis; Variable costing; Standard costing; Relevant cost and profitability analysis for decision making.

**Hum 1209: Society, Ethics and Technology (SET)** 3-0  
Historical Perspectives of Technology, Social Perspectives of Technology, Ethical Perspectives of Technology, Economics, Globalization and Human Rights, Information Systems Technology, Biomedical Technology, Population and The Environment

**IPE 2101: Manufacturing Processes** 3-0  
Classification of manufacturing processes, casting processes for ferrous and non-ferrous metals; sand, die, centrifugal, slush, plaster mold, loam mold, precision investment casting etc. casting defects, design of moulds, riser, gate sprue and core, cost analysis.

Joining methods: Soldering, brazing, welding, conventional welding processes: Gas, arc, TIG, MIG, Submerged, Resistance, Thermit, LASER, Electron beam etc.

Different machining processes: Various operations, cutting tools and their analyses in turning, milling, drilling, shaping, grinding, broaching etc.; Product design considerations for sound and economic machining.

Processes for plastic products: Injection molding, compression molding, blow molding, transfer molding, compounding, extrusion, vacuum forming, thermo-forming etc.

**IPE 2102: Manufacturing Processes Sessional** 0-3  
Sessional works compatible to IPE 2102.

**ME 2101: Basic Thermodynamics** 3-0  
Fundamental concepts-heat, work and energy; Thermodynamic System-state, process and cycle; Kinetic theory of gasses; Properties of gases and vapors; Non-flow and flow processes; Laws of thermodynamics and their corollaries. Second law of thermodynamics: availability, irreversibility and entropy. Ideal gases and their power cycles: vapor power cycles and gas power cycles; refrigeration cycles and reciprocating compressors. Equations of state; Mixtures of gases and vapors; Real gases; Psychrometrics; Fuels and combustion.

**ME 2102: Basic Thermodynamics Sessional** 0-1.5  
Sessional works compatible to ME 2101.

**ME 2110: Mechanical Drawing I** 0-3  
Introduction; Instruments and their uses; First and third angle projections; Orthographic drawings; Isometric views; Missing lines and views; Sectional views and conventional practices; Auxiliary views.

**EEE 2187: Electrical Machines** 3-0  
Transformer: Constructional features, equivalent circuit and phasor diagram -regulation and efficiency, parallel operation. Three phase transformer connections; Harmonic in transformers; Testing; Inrush current; Phase conversion; Autotransformer.

D.C Machines: Construction, armature windings, armature voltage and torque equations, classification. D.C generators' performance characteristics; D.C motors- torque/speed characteristics, speed control and braking. Testing and efficiency.

Induction machines: Constructional features and rotating magnetic field. Circuit model and phasor diagram. Steady state characteristics. Testing.

starting and speed control. Time harmonics and space harmonics. Single phase induction motors - classification and equivalent circuit. Universal motors.

Synchronous machines: Constructional features; synchronous generators and motors; equivalent circuit and phasor diagram; power and torque characteristics and capability curves. Parallel operation. Salient pole synchronous machine - phasor diagram and determination of synchronous reactances; starting and speed control of synchronous motors.

**EEE 2188: Electrical Machines Sessional** 0-1.5  
Sessional works compatible to EEE 2188.

**Math 2107: Mathematics III** 3-0  
Laplace Transform: Definition of Laplace Transform, Linearity property, condition for existence of Laplace Transform; First & Second Shifting properties, Laplace Transform of derivatives and integrals; Unit step functions, Dirac delta-function. Differentiation and Integration of transforms, Convolution Theorem, Inversion. Periodic functions. Evaluation of integrals by L.T., Solution of boundary value problems.

Fourier Transform: Fourier Integral formula, Fourier Transform, Fourier sine and cosine transforms. Linearity, Scaling, frequency shifting and time shifting properties. Self reciprocity of Fourier Transform. Convolution theorem. Application to boundary value problems. Brief Introduction of Z-Transform and Wavelet Transform.

Partial Differential Equations: Linear and non-linear first order equations; Standard forms; Linear equation of higher order; Second order equations with variable coefficient.

**Hum 2107: Engineering Economy** 3-0  
Money management: Engineering economic decisions; Time value of money; Market and effective interest rates; Equivalence calculation under inflation.

Evaluating business and engineering assets: Present worth, annual equivalence and rate-of-return analysis; Resolution of multiple rates of return.

Development of project cash flow: Accounting for depreciation and income taxes; Project cash flow analysis; Handling project uncertainty, Replacement decisions; Benefit-cost analysis.

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**ME 2201: Mechanics of Materials** **3-0**

Stress analysis: statically indeterminate axially loaded member, axially loaded member, thermal and centrifugal stresses; Stresses in thin and thick walled cylinders and spheres.

Beams: shear force and bending moment diagrams; Various types of stresses in beams; Flexure formula; Deflection of beams: integration and area moment methods; Introduction to reinforced concrete beams and slabs.

Torsion formula; Angle of twist; Modulus of rupture; Helical springs; Combined stresses: principal stress, Mohr's Circle; Columns: Euler's formula, intermediate column formulas, the Secant formula; Flexure formula of curved beams.

Introduction to experimental stress analysis techniques; Strain energy; Failure theories.

**ME 2202: Mechanics of Materials Sessional** **0-1.5**

Sessional works compatible to ME 2201.

**ME 2203: Engineering Materials** **3-0**

Introduction; Engineering materials, materials cycle, application and selection criteria of materials. Atomic structure & bonding: Elementary particles, electronic distribution and atomic size/structure, bonding-primary and secondary, effect of bonding on material properties. Structure of solids: Crystallinity in metals, ceramics, semiconductors and polymers; crystal system/lattice/structure, crystallographic indexing of planes & directions, atomic aggregates and their structure, significance of microstructure; crystalline defects: dimensions, origin and their effect on properties; amorphous structure.

Phase diagrams: Origin, construction, interpretation and application of binary phase diagrams with reference to a few important metallic and

ceramic systems. Properties of materials: physical, mechanical, chemical, electrical, semi/super conducting, magnetic, optical, thermal properties of solids; units and testing.

Engineering materials: Structure, properties, processing, fabrication and application of-metals and alloys, ceramics, rubber, plastics, semiconductors, and composites.

**ME 2204: Engineering Materials Sessional** **0-1.5**

Sessional works compatible to ME 2203.

**ME 2210: Mechanical Drawing-II** **0-3**

Review of orthographic projections; Fasteners, gears, keys and springs; Sectional views and conventional practices; Auxiliary views; Specifications for manufacture; Working drawings; Plan and elevation of building; Computer Aided Drawing; Computer Aided Design.

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**EEE 2285: Introduction to Analog and Digital Electronics** **3-0**

Equivalent circuits using transconductance parameter for low and high frequency operation of BJTs and FETs, Ebers-Moll model view ; design and analysis of single / multistage amplifiers, wideband / narrowband amplifiers ; differential amplifiers ; current mirror- different configurations, feedback amplifiers, oscillators and waveform generators ; power amplifiers- class AB/classB push-pull/class C ; op-amp design: different stages of op-amp-a case study ; active filter design, switched capacitor circuits ; ADC , DAC

Switching algebra, minimizing functions using maps, different logic families, TTL, ECL, NMOS , CMOS , pass transistor logic, combinational logic circuits:- adders / subtractor , demultiplexers, encoders , decoders , ROMs , PLAs etc. sequential logic circuits:- flip flops and latches , shifters, counters, finite state machine, state transition diagrams and state transition tables. Memory elements: - ROM, PROM, RAM-SRAM, DRAM. Case studies: a simple computer, RTL micro-instruction, instruction decoders timing and controller circuits, data path unit.

**EEE 2286: Analog and Digital Electronics Sessional** **0-3**

Sessional works compatible to EEE 2285.

**Math 2207: Numerical Analysis and Statistics** 3-0  
Errors in computations; Roots of equation-bracketing method, open method, roots of polynomial; Linear algebraic equations-Gauss elimination, decomposition and matrix inversion; Curve fitting-interpolation and Fourier approximation; Numerical differentiation and integration; Ordinary differential equation-Runge Kutta method, stiffness and multistep method, boundary value and eigen value problems; Partial differential equations-finite difference for elliptic and parabolic equations, finite element method.

Probability: Classical, relative frequency and axiomatic definitions of probability, addition rule and conditional probability, multiplication rule, total probability, Bayes' Theorem, and independence. Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation. Special Distributions: Discrete uniform, Binomial, Geometric, Poisson, Exponential, Gamma, Normal distributions. Sampling Distributions: The Central Limit Theorem, Confidence interval, Chi-Square, t and F distributions; hypothesis testing; regression analysis.

**Hum 2207: Industrial Law and Safety Management** 3-0  
Principles of law of contract; Company law: Law regarding formation, incorporation, management and winding up of companies; Labor law: Law in relation to wage hours, health, safety and other work conditions; The trade union legislation arbitration; The policy of the state in relation to labor; The Factory Act; Law of compensation.

Safety Management: Evolution of modern safety concepts; Industrial hazard, safety and risk management; Worker health and safety; Proactive techniques for safety management; Safety standard and regulation for engineering works.

**ME 3105: Fluid Mechanics** 3-0  
Fluid statics: basic hydrostatic equation, pressure variation in static incompressible and compressible fluids; Forces on plane and curved surfaces; Buoyant force; Stability of floating and submerged bodies.

Continuity, momentum and energy equations; Introduction to in viscid incompressible flow to include two dimensional basic flows.

Dimensional analysis and similitude; Fundamental relations of compressible flow; Speed of sound wave; Stagnation states for the flow of an ideal gas; Flow through converging-diverging nozzles;

Real fluid flow; Frictional losses in pipes and fittings.

Introduction to boundary layer theory; Estimation of boundary layer and momentum thickness, Skin friction and drag of a flat plate.  
Introduction to open channel flow; Best hydraulic channel cross-sections.

**Me 3106: Fluid Mechanics Sessional** 0-1.5  
Sessional works compatible to ME 3105.

**ME 3101: Mechanics of Machinery** 3-0  
Mechanisms; displacement, velocity and acceleration; Turning moment: inertia and kinetic energy of reciprocating and rotating parts; Static and dynamic balancing: reciprocating and rotating parts; Balancing machines.

Undamped free vibrations with one and two degrees of freedom; Longitudinal, transverse and torsional vibrations; Damped free and forced vibrations with single degrees of freedom; Whirling of shafts and rotors; Vibration of geared systems; Vibration absorption, isolation and disolation; Vibration measuring instruments.

Study of cams and cam followers; Power transmission by belts, ropes and chains; Clutches and brakes; Dynamometers. Study of governors; Gyroscopes: principles and applications.

**ME 3102: Mechanics of Machinery Sessional** 0-1.5  
Sessional works compatible to ME 3101.

**ME 3103: Engineering Mechanics** 3-0  
Basic concepts of mechanics; Statics of particles and rigid bodies; Centroids of lines, areas and volumes; Forces in struss, frames, and cables; Friction; Moments of inertia of areas and masses.  
Kinetics of particles: Newton's second law of motion; Principles of work, energy, impulse and momentum; System of particles; Kinematics of rigid

bodies; Kinetics of plane motion of rigid bodies; forces and acceleration; Principles of work and energy.

**ME 3109: Instrumentation and Measurement** 3-0  
Basic principles of measurements; Characterization and behavior of typical measuring systems; Different types of sensing elements; Measuring, transmission and recording methods; Measurements of displacement, pressure, temperature, heat flux, flow, motion and vibrations, force, torque and strain; Data acquisition and processing

**ME 3110: Instrumentation and Measurement Sessional** 0-3  
Sessional works compatible to ME 3109.

**ME 3100: Communication Seminar** 0-3  
Topics will be related to industrial sectors.

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**Math 3107: Mathematics IV** 3-0  
Complex number system; General functions of a complex variable; Limits and continuity of a function of complex variables and related theorems, Complex differentiation and Cauchy-Riemann equation; Line integral of a complex function; Cauchy's integral formula, Liouville's theorem; Taylor's and Laurent's theorem; Singular points, Residue; Cauchy's residue theorem; Contour integration; Conformal mapping.

Real and Complex forms of Fourier series; Finite transformation; Fourier integral; Fourier transformation and their uses in solving boundary value problems.

Solution of differential equations in series; Bessel's function, Legendre's polynomials and their properties.

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**ME 3201: Machine Design** 3-0  
Introduction to design; Stress analyses; Pressure vessels; Stresses in curved members; Shock and impact; Column design; Types of fits; Design for static strength; Fracture mechanics in design; Design for

fatigue strength; Design of fasteners and connections; Keys and couplings, welded and brazed joints.

Mechanical springs; Rolling contact bearings; Lubrication and journal bearings; Spur, helical, worm and bevel gears; Shafts; Brakes and clutches; Rope, belt and chain drives; Design with composite materials.

**ME 3202: Machine Design Sessional** 0-3  
Sessional works compatible to ME 3201.

**IPE 3205: Production Planning and Control** 3-0  
Elements of production control; Types of production systems. Product development and design-product analysis; break even point and P/V ratio; Relation between original planning and supplementary planning. Forecasting; Coordination between sales, manufacturing and purchase departments; Techniques of forecasting. Manufacturing economics, cost reduction and cost control. Inventory; Purchase models and production models. Scheduling: Basic concept and different techniques-Gantt Charts, index method; Line of balancing etc. plant location; Plant layout: Principles and common problems; Evaluation of layout; Plant budgetary control; Time and motion study; Machine capacity; Design of Production system.

**ME 3203: Control Engineering** 3-0  
Introduction to control systems and their representation by different equations and Laplace transforms; Block diagrams and transfer functions; Analog computer solution of system equations; System response, control action and system types; Frequency response; System analysis; System compensation; Analogues of control systems; Hydraulic and pneumatic control systems; Elements of electro-mechanical controls; Introduction to digital computer control.

**ME 3204: Control Engineering Project** 0-3  
Sessional works compatible to ME 3203.

**IPE 3231: Industrial Management** 3-0  
Organization and management evolution, management functions, organization structure, development of organization theory, study of various types of organization and management information system, concepts and scope of application.

Cost management elements of cost of products, cost centers and allocation of overhead costs. Management accounting: marginal costing, standard costing, cost planning and control, budget and budgetary control, development and planning process, annual development plan, national budget.

Financial management: objectives, strategy, financing, performance analysis of enterprises, investment appraisal, criteria of investment.

Personnel management: importance, scope, needs hierarchy, motivation, defense mechanism, productivity and satisfaction, leadership, group. Job evaluation and merit rating personnel development-hiring, training, wage systems.

Marketing management: marketing concept, marketing organization, industrial and consumer selling, channel decisions, advertising decisions, new product strategy.

**ME 3205: Heat and Mass Transfer 3-0**

Basic modes of heat transfer; General conduction equation for one dimensional and three dimensional situation; Steady state conduction in different geometrics and composite structures for one dimensional situation; Analysis of heat conduction of system with heat sources and heat transfer from finned surfaces.

Transient heat conduction in solids with negligible internal resistance and with internal and surface resistance; Use of Heisler charts; Analytical and numerical solutions of conduction heat transfer problems.

Mechanism of convective heat transfer; General methods for estimation of convective heat transfer coefficient; Heat and momentum transfer associated with laminar and turbulent flow of fluids in forced convection; Fully developed flows and boundary layer developments in tubes/ducts over flat plates: empirical equations; Free convection from exterior surfaces of common geometrics.

Heat transfer by the mechanism of radiation; Laws of radiation heat transfer; Blackbody radiation and radiative properties of surfaces; Angle factor; Net radiation interchange between two infinite parallel planes, concentric spheres and long cylinders.

Heat transfer mechanism with change of phase: Boiling: mechanism and heat transfer correlations; Condensation: types, applications; Heat pipe.

Heat exchanger: basic types, LMTD, exchanger effectiveness-NTU relations, fouling and scaling of heat exchanger.

Mass Transfer: mechanism of mass transfer by diffusion convection and change of phase, simultaneous heat and mass transfer phenomena; Analogy between heat and mass transfer; Empirical equations.

**ME 3206: Heat and Mass Transfer Sessional 0-3**  
Sessional works compatible to ME 3205.

**ME 4101: Internal Combustion Engines 3-0**

Introduction: basic engine types, their operation; Engine construction; Engine subsystems; Fuel metering systems for SI and CI engines; Fuels; IC engine fuels, their properties and tests; Combustion: SI engine, CI engine; Idealized cycles and processes; Equilibrium charts; Air capacity of engines: naturally aspirated and turbocharged; Performance and design: Engine performance, design considerations, application of principle of similitude in engine design. Engine testing; Exhaust gas analysis and air pollution; Emission control devices: Catalytic converter, Diesel particulate filters, Exhaust gas recirculation.

**ME 4102: Heat Engines Sessional 0-1.5**  
Sessional works compatible to ME 4101.

**ME 4103: Fluid Machinery 3-0**

Types of fluid machinery; Rotodynamic and positive displacement machines; Velocity diagrams and Euler pump/turbine equation; Impulse and reaction turbines; Centrifugal and axial flow pumps; Deep well turbine pumps; Dimensional analysis applied to fluid machinery: specific speed, unit power, unit speed, unit discharge; Performance and characteristics of turbines and pumps; Design of pumps; Cavitation; Reciprocating pump, gear and screw pumps; Fans, blowers and compressors; Hydraulic transmission: fluid coupling and torque converter; System analysis and selection of fluid machine.



**ME 4104: Fluid Machinery Sessional**

0-1.5

Sessional works compatible to ME 4103.

**ME 4105: Refrigeration and Building Mechanical Systems** 3-0

Concept of refrigeration and its applications; Different refrigeration methods; Analysis of vapour compression refrigeration, absorption refrigeration and air-cycle refrigeration systems; Refrigerants; Refrigeration equipment: compressors, condensers, evaporators, expansion devices, other control and safety devices; Multi-evaporator, multi-compressor systems; Low temperature refrigeration.

Concept of air conditioning and its uses; Cooling load calculation; Psychrometric analysis; Air conditioning systems; Air distribution systems; Duct design methods; Air conditioning equipment; Application criteria; Control systems.

Fire Hazards; Fire fighting equipment; Vertical transportation, its system design; Escalators and moving ramps.

**ME 4000: Project and Thesis** 0-6

In this course, students are required to undertake a major project in engineering analysis, design development of research. The objective is to provide an opportunity to develop initiative, self reliance, creative ability and engineering judgment. The results must be submitted in a comprehensive report with appropriate drawings, charts, bibliography, etc. along with products if any. Use of locally available materials in manufacturing and feasibility study of local industrial units will be emphasized.

**Tex 4107: Textile Technology** 3-0

Introduction to textiles, its Industry and market; Various types of fibres: their properties and uses; Fibre to yarn: spinning processes and machinery for various fibres, quality parameters for yarns; Yarn to fabrics: weaving processes and machines, knitting, compound fabric constructions, felted and nonwoven fabric formation, decorative fabric constructions; Back processes for grey fabrics and their functional effects. Dyeing process for major types of fabrics: Printing and flocking; Fabrics

quality parameters; Product packaging; Environment for different processes.

**ME 4201: Power Plant Engineering** 3-0

Sources of energy, production of power, comparison of different types of power plants, survey of power plants in Bangladesh.

The variable load problem, economic analysis of power plants, theory of rates. Diesel-electric power plants: engine types and their performances, advantages, present trend. Gas turbine power plants: cycle analysis; intercooling, regeneration and reheating, governing. Thermal power plants: fuels, combustion equipment; boilers. Steam turbines: reheat, regenerative, superposed, binary and combined cycles. Condensers, evaporators and cooling towers, gas loop and water loop, steam piping and insulations. Hydro-electric power plants: site selection, components of the plant. Governing of water turbine. Nuclear power plant: types of reactors, layout of nuclear power plant; waste disposal.

**ME 4202: Applied Thermodynamics Sessional** 0-1.5

Sessional works compatible to ME 4201.

**ME 4203: Automobile Engineering** 3-0

Introduction to road vehicles; Components of automobile; Automotive engines: types and construction; Specialities of automotive engines; Alternative fuels and alternative types of engines.

Vehicle performance: linear and angular inertia, braking effects, gyroscopic effects and reactions, tractive effort and vehicle vibration; Resistance to vehicle motion: gradient resistance, aerodynamic resistance, rolling and frictional resistance; Development strategies for minimum resistance.

Automotive transmission systems and power train: clutch, gear, differential and final drives. Automotive safety: brakes; Reduction of injuries; Automotive body: materials and vehicle shape; Springs and suspension; Steering system. Electrical systems: cranking motor, alternator and lighting; Electronic control systems and indicators.

Environmental considerations: vehicle emissions and control strategies; Noise pollution and control; Vehicle fuel economy. Testing of vehicles; Motor vehicle regulations.

**ME 4205: Mechatronics** 3-0

Introduction: Organization structure; System concept; mechanical, electrical, electronic and software components; process; software based tools: Virtual instrumentation; CAD; CAM; Computer integrated systems; Computer interfacing; Manipulator; Actuator types; Sensors and vision systems; Smart robots; Artificial intelligence; Factory, Office and Home automation; Future trend.

**ME 3105: Modern Machining Processes** 3-0

Modern machining processes: ultrasonic machining, abrasive jet machining, abrasive flow machining, orbital grinding, water jet cutting, electrochemical machining, electrical discharge machining, electron beam machining, laser beam machining, plasma arc machining, chemical machining; working principles of the related machines.

**ME 4000: Project and Thesis** 0-6

In this course, students are required to undertake a major project in engineering analysis, design development of research. The objective is to provide an opportunity to develop initiative, self reliance, creative ability and engineering judgment. The results must be submitted in a comprehensive report with appropriate drawings, charts, bibliography, etc. along with products if any. Use of locally available materials in manufacturing and feasibility study of local industrial units will be emphasized.

**ME 4011: Renewable Energy** 3-0

Reserves of non-renewable fuels; Prospects of renewable energy, and its sources and pattern of usage; characteristics of renewable sources: intermittent, low power density etc.; use of renewables in small scale systems;

Current technology: wind wave, tidal, passive and active solar, biological and examples of devices; Energy management, interaction of non-technical requirements (social, economic, political, environment) in engineering design and innovation; case-study.

**ME 4013: Combustion and Pollution** 3-0

Introduction to combustion; Heat of reaction, adiabatic flame temperature, heating values, chemical composition of products of combustion; Chemistry and kinetics of reactions; Reaction rate and flame propagation; Structure of laminar premixed flames; Explosions and fuel oxidation; Detonation; Combustion in internal and external combustion engines.

Production of pollutants in combustion systems; Emissions of green house gases, carbon monoxide, oxides of nitrogen and sulphur, and other pollutants.

Pollution control: post-engine exhaust treatment for emission control - thermal reactors, exhaust gas recirculation, catalysis; Pollution control by modification of combustion parameters; Other pollution control strategies.

**ME 4015: Energy and Environment** 3-0

Energy sources and utilization; Principles of energy conversion and storage.

Building thermal energy-principles and optimization; Energy economy tools and techniques; Environmental impacts of energy conversion; Environmental economics and management; Case studies.

**ME 4017: Fluids Engineering** 3-0

Conservation of mass, momentum and energy; Derivation of Navier Stokes equations; Steady and unsteady flows; Flow in 2-D and axisymmetric ducts; Laminar jets; Stability of laminar flow; Orr-Sommerfield equation; Flow in branching pipe systems; Unsteady flow in pipes; Water hammer; Economics of pipe systems; Hydraulic machines: press, intensifier, ram, jigger, lift, jack.

**ME 4019: Aerodynamics** 3-0

Inviscid incompressible flow to include potential function, stream function, circulation and basic flows; Kutta Joukowski theorem; Aerofoil theory and wing theory.

Drag, aircraft propulsion and propeller; Static performance problem; Special performance problem; Introduction to stability and control.

Longitudinal stability and control; Lateral and directional stability and control.

**ME 4021: Applied Engineering Mathematics** 3-0  
Non-linear differential equations: asymptotic method, perturbation method, Rayleigh-Ritz method, collocation method; Finite difference method; Finite element method; Boundary element method; Calculus of variations; Chaos theory.

**ME 4023: Similitude in Engineering Mechanics** 3-0  
Reduction of physical problems: similarity rules revealed by dimensional analysis; Supplementary information; Self-similar solutions by dimensional analysis and other groups of transformations; Applications to fluid mechanics and other fields; Local solution and their uses; Self-similar solutions with concealed exponent.

**ME 4025: Fluidics** 3-0  
Hydraulic and pneumatic components and systems; Servocontrol valves; Fluid transmission lines; Actuators; Fluids; Power supplies and fluid motors; Compressibility and leakage; System modelling, stability and compensation.

**ME 4027: Design of Fluid Machines** 3-0  
General theory of fluid machines; Similarity considerations to fluid machines; Pumps, fans, blowers and compressors: design considerations; Cascade fluid mechanics including effects of viscosity, compressibility and three dimensional flow; Performance characteristics and limitations; Cavitation and surging.

**ME 4029: Biomedical Fluid Mechanics** 3-0  
Engineering approach to the analysis of circulatory and respiratory systems and to other problems in physiology involving fluid dynamics; Review of relevant anatomy and physiology emphasising qualitative considerations; Presentations and discussions; Simulation of physiological phenomena.

**ME 4031: Theory of Structures** 3-0  
Preliminaries; Elements stiffness matrices; Pin-joint structures; 2-D rigid-joint structures; Elastic plane element structures; Mixed elements

structures; Elastic stability of 2-D rigid-joint structures; Frequency of rigid-joint structures; Finite element method.

**ME 4033: Noise and Vibration** 3-0  
Sound waves; Sound sources; Sound transmission through walls and structures; Acoustics of large and small rooms; Mechanism of sound absorption; Design of silencers.

Vibration isolation, machine foundation design; Vibration absorption; Random vibration; Beam and plate vibrations.

**ME 4035: Robotics** 3-0  
Introduction to robotics; Definitions; Plane, rotational and spatial motion with applications to manipulators; Geometric configurations: structural elements, linkages, arms and grippers; Kinematics of manipulators; Motion characteristics, trajectories, dynamics and control of manipulators; Actuators and sensors for manipulators; Application of industrial robots and programming; Teleoperators, mobile robots and automated guided vehicles. Special purpose robots.

**ME 4037: Composite Materials** 3-0  
Fibrous composites; Reinforcement types; Ply stiffness; Ply strength; Failure criteria; Layered laminate; Laminate stiffness; Laminate strength; Residual stress; Thin-walled composite sections; Interlaminar stresses; Hole in laminates; Buckling of laminates

**ME 4039: Petroleum Engineering** 3-0  
An overview of hydrocarbon reserves in Bangladesh; Classification of rocks and hydrocarbon deposits and their genesis; Geophysical exploration of oil and gas; Physical properties and characteristics of reservoir rocks; Origin, accumulation, composition and behaviour of hydrocarbon reserves; Analysis and prediction of reservoir performance.

Drilling rigs and their types; Rig moving equipment; Rig components and their auxiliaries; Drilling operations; Vertical and direction drilling; Well logging and interpretation; Cracking and steaming; Well completion and cementation.

**ME 4041: Applied Statistics** 3-0  
Simple regression and correlations, multiple regression. Tests of significance. Analysis of variance. Experimental design. Factor analysis. Statistical packages.

**ME 4043: Nuclear Engineering** 3-0  
World energy resources; Importance of fission energy; Atomic structure; Nuclear energy and nuclear forces; Nuclear fission and fusion processes; Nuclear fission reactors; Reactor controls; Reactor coolants; Process waste disposal; Nuclear power reactor systems.

**ME 4045: Bio-Engineering** 3-0  
Introduction to human musculoskeletal system; Biomechanics of human movement; applications of engineering mechanics to the movements of muscles, bones and skeletal joints; Material and structural characteristics of bones, ligaments, muscle/tendons and joints - alternative materials.

Introduction to biomechanical fluid mechanics; Engineering approach to the function of circulatory and respiratory systems involving fluid dynamics.

Introduction to biomedical instrumentation; Ultrasound, x-ray, laser, microwave and ultra-violet rays - physics and technology of generation - their use in diagnostic, therapeutic, and processing applications in medicine and industry.

**ME 4047: Advanced Thermodynamics** 3-0  
Introduction to classical and statistical viewpoints in thermodynamics; Concepts of equilibrium, stability, reversibility, irreversibility and availability; Concepts of entropy; Principle of increase of entropy; Calculation of entropy changes; Statistical interpretation; Entropy of mixing; Absolute entropy; Entropy flow and entropy production; Properties of pure substances; Ideal gases; Ideal gas mixtures of constant composition; Ideal gas mixtures of variable compositions; Thermodynamic potentials: Helmholtz free energy functions, Gibbs free energy function; Application of free energy functions; Transformations and thermodynamic potentials; Maxwell relations; Phase transitions; The Clausius-Clapeyron equation; Statistical mechanics: fundamental principles, energy states and levels; Thermodynamic probability; Bose-Einstein statistics, Fermi-Dirac statistics; Thermodynamic properties of a

system; Special Topics: elastic systems, fuel cells, magnetic systems, thermo-electricity.

**ME 4049: Plastics Process Technology** 3-0

Introduction; Properties; Testing of properties; Identification of common plastics; Flow behaviour; Processing parameters; degradation; Fillers; Additives; Mixing and compounding; Mills; internal and continuous; Processing of plastic materials: extrusion, injection moulding, thermo-forming, blow moulding, film blowing, compression moulding, and transfer moulding; Reinforcement of plastics; Calendering and laminating; Instrumentation and control.