DIBRUGARH UNIVERSITY INSTITUTE OF ENGINEERING AND TECHNOLOGY
MODIFIED COURSE STRUCTURE & DETAIL SYLLABAI
FOR B. TECH PROGRAMME
IN
MECHANICAL ENGINEERING
(FOR BATCHES 2016 ONWARDS)

3rd SEMESTER

THEORY PAPERS	Code	Credit Structure			Contact Hours	Total Credit
		L	T	P		
Linear Algebra & Complex Analysis	MA 201	3	1	0	5	4
Thermodynamics	ME 201	3	1	0	5	4
Mechanics of Fluids	ME 202	3	1	0	5	4
Metallurgy and Materials Engineering	ME 203	3	0	0	3	3
Electrical Technology	EE 201	3	1	0	5	4
Machine Drawing	ME 204	2	0	2	6	4
PRACTICAL PAPERS						
Thermodynamics Lab.	ME 210	0	0	1	2	1
Electrical Technology Lab	EE 211	0	0	1	2	1
Mechanics of Fluids Lab	ME 212	0	0	1	2	1
Computational lab	CS-211	0	0	1	2	1
	Total	17	4	6	37	27

4th SEMESTER

THEORY PAPERS	Code	Credit Structure			Contact Hours	Total credit
		L	T	P		
Probability Distributions, Transforms and Numerical Methods	MA202	3	1	0	5	4
Heat and Mass Transfer	ME-205	3	1	0	5	4
Kinematics of Machinery	ME 206	3	1	0	5	4
Manufacturing Technology	ME 207	3	0	0	3	3
Mechanics of Solid	ME 208	3	1	0	5	4
Fundamental of accountancy and Management	HU-201	3	1	0	5	4
PRACTICALPAPERS						
Material testing lab	ME 212	0	0	1	2	1
Dynamics of Machinery Lab	ME 213	0	0	1	2	1
	Total	18	5	2	32	25

5th SEMESTER

THEORY PAPERS	Code	Credit Structure			Contact Hours	Total credit
		L	T	P		
Advanced Mechanics of Solids	ME-301	3	1	0	5	4
Dynamics of Machinery	ME 302	3	1	0	5	4
Design of Machine Elements- I	ME 303	3	1	0	5	4
Applied Thermodynamics-I	ME 304	3	1	0	5	4
Metrology and Measurements	ME 305	3	1	0	5	4
Open Elective-I	ME-OE-301	3	1	0	5	4
PRACTICAL PAPERS						
Metrology and Measurements Lab.	ME 313	0	0	1	2	1
Heat transfer Lab.	ME 314	0	0	1	2	1
	Total	18	6	2	34	26

6th SEMESTER

THEORY PAPERS	Code	Credit Structure			Contact Hours	Total Credit
		L	T	P		
Fluid Machinery	ME-307	3	1	0	5	4
Applied Thermodynamics-II	ME 310	3	1	0	5	4
ME Elective-I	ME-ELV-301	3	1	0	5	4
Design of Machine Elements- II	ME 311	3	1	0	5	4
Control System	EC 310	3	0	0	3	3
Open Elective-II	ME-OE-302	3	1	0	5	4
PRACTICAL PAPERS						
Fluid Machinery Lab	ME 315	0	0	1	2	1
Thermal Engineering Lab	ME 316	0	0	1	2	1
Advanced Engineering Workshop	ME 317	0	0	2	4	2
	Total	18	5	4	36	27

7th SEMESTER

THEORY PAPERS	Code	Credit Structure			Contact Hours	Total Credit
		L	T	P		
ME Elective-II	ME-ELV-401	3	1	0	5	4
ECONOMICS AND FUNDAMENTALS OF MANAGEMENT	HU-401	3	0	0	3	3
ME Elective-III	ME-ELV-402	3	1	0	5	4
Open Elective-III	ME-OE-401	3	1	0	5	4
TRAINING/PROJECT						
Project-I	ME-411	-	-	-	20	10
	Total	12	3	0	38	25

8th SEMESTER

THEORY PAPERS	Code	Credit Structure			Contact Hours	Total Credit
		L	T	P		
Industrial Engineering	ME 401	3	0	0	3	3
ME Elective-IV	ME-ELV-403	3	1	0	5	4
ME Elective-V	ME ELV-404	3	1	0	5	4
Open Elective-IV	ME-OE-402	3	1	0	5	4
PROJECT						
Project-II	ME-412	-	-	-	20	10
Composite Viva-voce	ME-413	-	-	-	-	2
	Total	12	3	0	38	27

CUMMILATIVE CREDIT=157

List of Probable Elective / Open Elective Subjects:

ME Elective-I

1. Internal Combustion Engines
2. Aerospace Engineering
3. Numerical Methods & Computer programming

ME Elective-II

1 Advanced Fluid Mechanics

2 Convective Heat and Mass Transfer

3 Computer Aided Design (CAD)

ME Elective-III

1. Computational Fluid Dynamics
2. Operation Research
3. Computer Aided Manufacturing (CAM)

ME Elective-IV

1. Advanced Manufacturing Technology
2. Power Plant Engineering
3. Mechanical Vibration

ME Elective-V

1. Refrigeration and air conditioning
2. Advance Heat and Mass Transfer
3. Modern Engineering Materials

Open Elective-I

1 Robotics
2 Non-conventional Energy

Open Elective-II

1. Applied linear algebra
2. Mathematical methods
3. Optimization Methods in Engineering

Open Elective-III

1. Mechatronics
2. Automobile Engineering

Open Elective-IV

1. Quality engineering
2. Advanced Energy Management

DETAIL SYLLABUS
SEMESTER - 3

Course No	Course Name	L-T-P-Credits
MA-201	Linear Algebra & Complex Analysis	3-1-0-4

Unit-I : Limit, continuity and derivative of complex functions. Analytic Functions, Cauchy–Riemann Equation (Proof of sufficient condition of analyticity & C R Equations in polar form not required) - Laplace's Equation Harmonic functions, Harmonic Conjugate.

Unit-II :Geometry of Analytic functions Conformal Mapping, Circles and straight lines, extended complex plane, fixed points Special linear fractional Transformations, Cross Ratio, Cross Ratio property-Mapping of disks and half planes

Unit-III :Definition Complex Line Integrals, First Evaluation Method, Second Evaluation Method Cauchy's Integral Theorem (without proof), Independence of path (without proof), Cauchy's Integral Theorem for Multiply Connected Domains (without proof) Cauchy's Integral Formula- Derivatives of Analytic Functions (without proof). Application of derivative of Analytical Functions Taylor and Maclaurin series (without proof), Power series as Taylor series, Practical methods (without proof) Laurent's series (without proof).

Unit-IV: Singularities, Zeros, Poles, Essential singularity, Zeros of analytic functions Residue Integration Method, Formulas for Residues, Several singularities inside the contour Residue Theorem. Evaluation of Real Integrals.

Unit-V :Linear systems of Equations, Coefficient Matrix, Augmented Matrix Gauss Elimination and back substitution, Elementary row operations, Row equivalent systems, Gauss elimination-Three possible cases, Row Echelon form and Information from it. Linear independence-rank of a matrix Vector Space-Dimension-basis-vector space Solution of linear systems, Fundamental theorem of non-homogeneous linear systems (Without proof) - Homogeneous linear systems (Theory only)

Unit-VI: Determination of Eigen values and Eigen vectors-Eigen space Symmetric, Skew Symmetric and Orthogonal matrices –simple properties (without proof). Basis of Eigen vectors- Similar matrices Diagonalization of a matrix- Quadratic forms- Principal axis theorem (without proof)

Text Books:

1. Erwin Kreyszig: Advanced Engineering Mathematics, 10th ed. Wiley, 2010

References:

1. Murray R Spiegel, Seymour Lipschutz, John J. Schiller&Dennis Spellman - Complex Variables, 2ed (Schaum's Outline Series), Mc Graw Hill,2009
2. S. Ponnusamy- Foundations Of Complex Analysis, 2ed,Narosa Book Distributors,2011
3. Seymour Lipschutz&Marc Lipson - Linear algebra, 5ed (Schaum's Outline Series), Mc Graw Hill,2012
4. Michael Artin- Algebra, 2ed,Pearson,2015.
5. Dennis g Zill&Patric D Shanahan-A first Course in Complex Analysis with Applications, 2ed, Jones &Bartlet Publishers,2008

6. B. S. Grewal. Higher Engineering Mathematics, 44ed, Khanna Publishers, New Delhi, 2017
7. Lipschutz, Linear Algebra,3e (Schaums Series) McGraw Hill Education India, 2005
8. Complex variables introduction and applications,2ed,Mark.J.Owitz, Cambridge Publication, 2003

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Course No	Course Name	L-T-P-Credits
ME-201	Thermodynamics	3-1-0-4

Unit-I

Basic concepts, zeroth law of thermodynamics and thermometry, energy, first law of thermodynamics

Unit-II

Second law of thermodynamics.

Unit-III

Entropy, irreversibility and availability, third law of thermodynamics

Unit-IV

Properties of pure substances, equations of state, properties of gas mixtures, general thermodynamic relationships,

Unit-IV

Thermodynamic cycles - Otto, Diesel, dual.

Text Books

1. P.K.Nag, Engineering Thermodynamics,5th Edition, McGraw Hill, 2013.
2. Y. A. Cengel and M. A.Boles,Thermodynamics an Engineering Approach, 8th Edition, McGraw Hill, 2015

References Books:

1. G.VanWylen, R.Sonntag and C.Borgnakke, Fundamentals of Classical Thermodynamics, 8th Edition, John Wiley & Sons, 2012
2. Holman J.P, Thermodynamics, McGraw Hill, 4th Revised edition ,1987
3. M.Achuthan, Engineering Thermodynamics, PHI, 2nd Edition, 2009.
4. R.S.Khurmi, Steam table with Mollier chart, S.Chand,8th edition 2008

Course No	Course Name	L-T-P-Credits
ME-202	MECHANICS OF FLUIDS	3-1-0-4

Unit-I

Fluid Properties

Introduction: Fluids and continuum, Physical properties of fluids, density, specific weight, vapour pressure, Newton's law of viscosity. Ideal and real fluids, Newtonian and non-Newtonian fluids.

Unit-II

Fluid Statics

Pressure-density-height relationship, manometers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to uniform accelerations, measurement of pressure.

Unit-III

Kinematics of fluid flow

Eulerian and Lagrangian approaches, velocity and acceleration in fluid, classification of fluid flow, 1-D, 2-D and 3-D flow, steady, unsteady, uniform, non-uniform, laminar, turbulent, rotational, irrotational flows, stream lines, path lines, streak lines, stream tubes, circulation and vorticity, stream function and potential function, Laplace equation, equipotential lines flow nets, uses and limitations

Unit-IV

Dynamics of fluid flow

Fluid Dynamics: Energies in flowing fluid, head, pressure, dynamic, static and total head, Control volume analysis of mass, momentum and energy, Equations of fluid dynamics: Differential equations of mass, energy and momentum (Euler's equation), Naiver-Stokes equations (without proof) in rectangular and cylindrical co-ordinates, Bernoulli's equation and its applications:

Venturi and Orifice meters, Notches and Weirs (description only for notches and weirs). Hydraulic coefficients, Velocity measurements: Pitot tube and Pitot-static tube.

Unit-V

Flow through pipes

Viscous flow: Reynolds experiment to classify laminar and turbulent flows, significance of Reynolds number, critical Reynolds number, shear stress and velocity distribution in a pipe, law of fluid friction, head loss due to friction, Hagen Poiseuille equation. Turbulent flow: Darcy- Weisbach equation, Chezy's equation Moody's chart, Major and minor energy losses, hydraulic gradient and total energy line, flow through long pipes, pipes in series, pipes in parallel, equivalent

Pipe, siphon, transmission of power through pipes, efficiency of transmission, Water hammer, Cavitation.

Unit-VI

Concept of Boundary Layer

Growth of boundary layer over a flat plate and definition of boundary layer thickness, displacement thickness, momentum thickness and energy thickness, laminar and turbulent boundary layers, laminar sub layer, velocity profile, Von- Karman momentum integral equations for the boundary layers, calculation of drag, separation of boundary

and methods of control.

Unit-VII

Dimensional Analysis and Hydraulic similitude

Dimensional analysis, Buckingham's theorem, important dimensional numbers and their Significance, geometric, Kinematic and dynamic similarity, model studies. Froude, Reynold, Weber, Cauchy and Mach laws- Applications and limitations of model testing, simple problems only

Text Books-

1. Fox R. W. and A. T. McDonald, Introduction to Fluid dynamics Wiley India Private Limited (2017)
2. Cengel, Fluid Mechanics, McGraw Hill Education; Third edition (2017)

References Books:

1. Munson, Young, Okhisi, Huebsch, Fluid Mechanics-7th edition,2015, Wiley and Sons.
2. White F.M., Fluid Mechanics, 6th edition, Tata McGraw Hill, 2008
3. Streeter V. L., E. B. Wylie and K. W. Bedford, Fluid Mechanics, Tata McGraw Hill, Delhi, 9th Edition 2010.
4. Bansal R. K., A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications,9th Edition 2017
5. PatiSukumar, A Textbook on Fluid Mechanics and Hydraulic Machines, McGraw Hill. 1st edition 2012

Course No	Course Name	L-T-P-Credits
ME-203	Metallurgy and Materials Engineering	3-0-0-3

UNIT I

Crystallography:- Crystal, space lattice, unit cell- BCC, FCC, HCP structures - short and long range order – effects of crystalline and amorphous structure on mechanical properties.
Coordination number and radius ratio; theoretical density;
Simple problems - Polymorphism and allotropy.Miller Indices: - crystal plane and direction - Attributes of miller indices for slip system, brittleness ofBCC, HCP and ductility of FCC - Modes of plastic deformation: - Slip and twinning. Schmid's law, equation, critical resolved shear stress, correlation of slip system with plastic deformation in metals and applications.
Mechanism of crystallization: Homogeneous and heterogeneous nuclei formation, under cooling, dendritic growth, grain boundary irregularity. Effects of grain size, grain size distribution, grain shape, grain orientation on dislocation/strength and creepClassification of crystal imperfections: - types of dislocation– effect of point defects on mechanical properties - forest of dislocation, role of surface defects on crack initiation. Burgers vector –dislocation source, significance of Frank Read source in metals deformation - Correlation of dislocation density with strength and Nano concept, applications. Significance high and low angle grain boundaries on dislocation – driving force for grain growth and applications during heat treatment.Fundamentals and crystal structure determination by X –ray diffraction, simple problems –SEM and TEM. Diffusion in solids, Fick's laws, mechanisms, applications of diffusion in mechanical engineering, simple problems.

UNIT II

Phase diagrams: - Limitations of pure metals and need of alloying - classification of alloys, solid solutions, HumeRothery`s rule - equilibrium diagram of common types of binary systems: five types.

Coring - lever rule and Gibb`s phase rule - Reactions: - monotectic, eutectic, eutectoid, peritectic, peritectoid. Detailed discussion on Iron-Carbon equilibrium diagram with microstructure and properties changes in austenite,, ferrite, cementite, special features of martensite transformation, bainite, spheroidite etc.

Heat treatment: - Definition and necessity – TTT for a eutectoid iron–carbon alloy, CCT diagram, applications -annealing, normalizing, hardening, spheroidizing.

Tempering:-austermpering, martempering and ausforming- Comparative study on ductility andstrength with structure of pearlite, bainite, spherodite, martensite, tempered martensite and ausforming.

Types of strengthening mechanisms: - work hardening, equation - precipitation strengthening and over ageing dispersion hardening. Cold working: Detailed discussion on strain hardening; recovery; re-crystallization,.

UNIT I11

Alloy steels:- Effects of alloying elements on steel: dislocation movement, polymorphic transformation temperature, alpha and beta stabilizers, formation and stability of carbides, grain growth, displacement of the eutectoid point, retardation of the transformation rates, improvement in corrosion resistance, mechanical properties

Nickel steels, Chromium steels etc. - Enhancement of steel properties by adding alloying elements: - Molybdenum, Nickel, Chromium, Vanadium, Tungsten, Cobalt, Silicon, Copper and Lead.

High speed steels:- Mo and W types, effect of different alloying elements in HSS 1

Cast irons: Classifications; grey, white, malleable and spheroidal graphite cast iron etc., composition, microstructure, properties and applications.

Principal Nonferrous Alloys: - Aluminium, Copper, Magnesium, Nickel, study of composition, properties, applications, reference shall be made to the phase diagrams whenever necessary.

UNIT 1V

Fatigue: - Stress cycles – Primary and secondary stress raisers - Characteristics of fatigue failure, fatigue tests, S-N curve.

Factors affecting fatigue strength: stress concentration, size effect, surface roughness, change in surface properties, surface residual stress.

Ways to improve fatigue life – effect of temperature on fatigue, thermal fatigue and its applications in metal cutting

Fracture: – Brittle and ductile fracture – Griffith theory of brittle fracture – Stress concentration, stress raiser – Effect of plastic deformation on crack propagation.

Structural features of fatigue: - crack initiation, growth, propagation - Fracture toughness (definition only) – Ductile to brittle transition temperature (DBTT) in steels and structural changes during DBTT, applications.

Creep: - Creep curves – creep tests - Structural change:- deformation by slip, sub-grain formation, grain boundary sliding

Mechanism of creep deformation - threshold for creep, prevention against creep - Super plasticity: need and applications.

UNIT V

Composites:- Need of development of composites -geometrical and spatial Characteristics of particles –classification - fibre phase: - characteristics, classifications -matrix phase:- functions – only need and characteristics of PMC, MMC, and CMC – applications of composites: aircraftapplications, aerospace equipment and instrument structure, industrial applications of composites, marine applications, composites in the sporting goods industry, composite biomaterials..

Modern engineering materials: - only fundamentals, need, properties and applications fomentermetallic,, super alloys, Titanium – introduction to nuclear materials, smart materials and bio materials.

Ceramics

Text Books

1. Raghavan V, Material Science and Engineering, Prentice Hall,2004
2. Jose S and Mathew E V, Metallurgy and Materials Science, Pentagon, 2011

Reference

1 Anderson J.C. *et.al*., Material Science for Engineers,Chapman and Hall,1990
2 Clark and Varney, Physical metallurgy for Engineers, Van Nostrand,1964
3. Reed Hill E. Robert, Physical metallurgy principles, 4th Edn. Cengage Learning,2009
4. Avner H Sidney, Introduction to Physical Metallurgy, Tata McGraw Hill,2009
5. Callister William. D., Material Science and Engineering, John Wiley,2014
6. Dieter George E, Mechanical Metallurgy,Tata McGraw Hill,1976
7. Higgins R.A. - Engineering Metallurgy part - I – ELBS,1998
8. Myers Marc and Krishna Kumar Chawla, Mechanical behavior of materials, Cambridge University press,2008
9. Van Vlack -Elements of Material Science - Addison Wesley,1989
10. http://nptel.ac.in/courses/113106032/1
11. http://www.myopencourses.com/subject/principles-of-physical-metallurgy-2
12. http://ocw.mit.edu/courses/materials-science-and-engineering/3-091sc-introduction-tosolid-state-chemistry-fall-2010/syllabus/
13. http://www.msm.cam.ac.uk/teaching/partIA.php

Course No	Course Name	L-T-P-Credits
EE 201	Electrical Technology	3-1-0-4

Unit-I

Electrical machines: Principles of electromechanical energy conversion, DC machines, AC machines: synchronous machines, synchronous condensers, three phase and single phase induction motors, applications of special types of motors (linear stepper, reluctance).

Unit-II

Transformers: Single phase and three phase transformers, parallel operations, autotransformers. Power transmission and distribution: High-voltage AC (HV AC) and high-voltage DC (HV DC) transmissions, industrial and domestic loads, power factor improvement, safety and protection-fuses, circuit breakers, earthling, lighting rods, earth leakage detectors.

Unit-III

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

Texts/References:

1. Cotton,H., Advanced Electrical Technology, CBS Publishers and Distributors, New Delhi.7th MKS edition 2011
2. Nagrath I.J. and Kothari, D.P., Electrical Machines, TMH, New Delhi. 4th edition 2010
3. Hambley, A.R., Electrical Engineering: Principles and Applications,Prentice Hall.3rd edition 2004
4. Yamayee,Z.A and Bala, JL, Electromechanical Energy Devices an Power Systems, John Wiley & Sons Inc. 1st 1993
5. Mohan, N., Power Electronics: Converters, Applications & Design, John Wiley and Sons, 2010.

Course No	Course Name	L-T-P-Credits
ME204	Machine Drawing	2-0-2-4

Unit-I
Review of Orthographic projection and sectioning of solids and isometric projection.

Unit-II
Profiles of various threads; Representation of various kinds of threads, Different types of nuts and bolts. IS/ISO codes; Limits, tolerances and Fits, Surface finish; Symbols for weldments, process flow,

Unit-III
Different types of Laps and Butt joints; Riveted joints of plates at right angles.

Unit IV
Different types of keys; cotter joints; knuckle joints; Flanged joint and hydraulic joint

Unit V
Muff coupling; flange coupling; universal coupling,Stop pulley and v-belt pulley

Unit VI
Assembly and Part Drawings of simple assemblies and subassemblies of machine parts viz., couplings, clutches, bearings, gear assemblies, I.C. Engine components, valves, machine tools, etc.;

Texts/References:

1. N.D. Bhatt, *Machine Drawing*, Charotar Book Stall, Anand.49thedition ,2014

2. N. Sidheswar, P. Kanniah and V.V.S. Sastry, *Machine Drawing*, Tata McGraw Hill. 1st edition, 2001

SEMESTER – 4

Course No	Course Name	L-T-P-Credits
MA202	Probability Distributions, Transforms and Numerical Method	3-1-0-4

Unit-I

Discrete random variables and Discrete Probability Distribution.

Discrete Random Variables, Probability distribution function, Cumulative distribution function. Mean and Variance of Discrete Probability Distribution. Binomial Distribution-Mean and variance.Poisson Approximation to the Binomial Distribution.Poisson distribution-Mean and variance.

Unit-II

Continuous Random variables and Continuous Probability Distribution.

Continuous Random Variable, Probability density function, Cumulative density function, Mean and variance.Normal Distribution, Mean and variance (without proof).Uniform Distribution.Mean and variance.Exponential Distribution, Mean and variance.

Unit-III

Fourier transforms. Laplace Transforms.

Fourier Integrals.Fourier integral theorem (without proof). Fourier Transform and inverse transform. Fourier Sine & Cosine Transform, inverse transform. Laplace Transforms, linearity, first shifting Theorem. Transform of derivative and Integral, Inverse Laplace transform, Solution of ordinary differential equation using Laplace transform. Unit step function, second shifting theorem.Convolution Theorem (without proof).Differentiation and Integration of transforms.

Unit-IV

Numerical methods-solution of Algebraic and transcendental Equations, Interpolation.

Solution Of equations by Iteration, Newton- Raphson Method.Interpolation of Unequal intervals-Lagrange's Interpolation formula.Interpolation of Equal intervals-Newton's forward difference formula, Newton's backward difference formula.Numerical solution of system of Equations.

Unit-V

Solution to linear System- Gauss Elimination, Gauss Seidal Iteration Method.Numeric Integration-Trapezoidal Rule, Simpson's 1/3 Rule. Numerical solution of first order ODE-Euler method, Runge-Kutta Method (fourth order)

Text Books:

1. Miller and Freund's "Probability and statistics for Engineers"-Pearson-Eighth Edition. 2015

2. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th edition, Wiley, 2015.

References:

1. V. Sundarapandian, "Probability, Statistics and Queuing theory", PHI Learning, 1st Edition, 2009.

2. C. Ray Wylie and Louis C. Barrett, "Advanced Engineering Mathematics"-Sixth Edition. 1995

3. Jay L. Devore, "Probability and Statistics for Engineering and Science"-Eight Edition.2010

4. Steven C. Chapra and Raymond P. Canale, "Numerical Methods for Engineers"-Sixth Edition-Mc Graw Hill. 2010

Course No	Course Name	L-T-P-Credits
ME 205	Heat & Mass Transfer	3-1-0-4

Unit I

Modes of heat transfer; Conduction: 1-d, 2-d, and 3-d steady conduction, 1-d unsteady conduction – analytical /numerical/ graphical solution methods, fins;

Unit II

Convection: fundamentals, order of magnitude analysis of momentum and energy equations, hydrodynamic and thermal boundary layers, dimensional analysis, free and forced convection, external and internal flows, heat transfer with phase change;

Unit III

Radiation: Stefan Boltzmann law, Planck's law, emissivity and absorptivity, radiant exchange between black surfaces;

Unit IV

Heat exchangers: LMTD and -NTU methods, heat transfer enhancement techniques, special heat transfer processes like transpiration and film cooling, ablative cooling;

Unit V

Mass transfer: molecular diffusion, Fick's law, equimolar counter diffusion, molecular diffusion in a stationary gas, analogy between heat and mass transfer, evaluation of mass transfer coefficients by dimensional analysis. Mass transfer in boundary layer, flow over a flat plate.

Texts/References:

1. F.P. Incropera and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley and Sons.6thedition ,2005

2. J.P. Holman, Heat Transfer, McGraw Hill. 10th edition, 2011

3. M.N. Ozisik, Heat Transfer – A basic approach, McGraw Hill.1st edition 1985

4. A. Bejan, Convection Heat Transfer, Interscience. 4th edition,2013

Course No	Course Name	L-T-P-Credits
ME 206	Kinematics of Machinery	3-1-0-4

Unit-I

Kinematics: Link, Pair, chain, mechanism, inversions, degrees of freedom, Classification of kinematic pairs, four link mechanism, simple velocity and acceleration diagram.

Unit-II

Gear train: introduction, simple and compound gear train, reverted gear train, planetary of epicyclic, gear train, automobile gear train.

Unit-III

Governor: Watt, porter, proell, spring controlled governors, inertia governors, Stability, effects of friction, Isochronism, Hunting, Effrot and power.

Unit-IV

Flywheel: Fluctuations of energy, co-efficient of fluctuation of energy and speed, function of flywheel.

Unit-V

Brake and clutch: working principles, related simple problems.

Unit-VI

Belt and rope drive: Relation for torque, maximum power transmission, length of open and cross belt, slip, crowning of pulley.

Texts/References:

1. J. E. Shighley and J.J. Uicker, Theory of Machines and Mechanisms, McGraw Hill.4th revised edition, 2010

2. J. S. Rao and R. V. Dukkipati, Mechanism and Machine Theory, New Age International,Second edition,1992.

3. S. S. Rattan, Theory of Machines, Tata McGraw Hill.4th ,2017

4. T. Bevan. Theory of Machines, CBS Publishers and Distributors. 3rd edition, 2005

Course No	Course Name	L-T-P-Credits
ME 207	Manufacturing Technology	3-0-0-3

Unit-I

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

Unit-II

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

Unit-III

Metal joining processes: brazing, soldering and welding;Solid state welding methods: resistance welding, arc welding; submerged arc welding, inert gas welding: Welding defects, inspection.

Unit-IV

Metal forming Processes: Various metal forming techniques and their analysis, viz Forging, rolling, Extrusion and wire drawing, Sheet metal working, Spinning, Swaging; super plastic deformation. Powder metallurgy and its applications.

Texts/References:

1. James S Campbell, Principles of Manufacturing Materials and Processes, Tata McGraw Hill. 4th Edition 2011

2. F.C. Flemmings, Solidification processing, Tata McGraw Hill. 6th Edition 2015

3. M J Rao, Manufacturing Technology: Foundry, Forming and Welding, Tata McGraw Hill, 4th Edition, 2013.

4. R W Heine, C R Loper, and P C Rosenthal, Principles of Metal Casting,Tata McGraw Hill,McGraw Hill Education; 2 edition ,2017.

5. A Ghosh and A K Mallik, Manufacturing Science,Wiley Eastern,2nd Edition, 2010.

Course No	Course Name	L-T-P-Credits
ME208	Mechanics of Solids	3-1-0-4

Contents:

Unit I

Resistance and Deformation: Concept of Resistance and deformation - Determinate and Indeterminate problems in Tension and Compression - Thermal Stresses - pure shear –

Young's modulus of elasticity, Poisson's ratio, Modulus of rigidity and Bulk modulus - Relation between elastic constants - Stress-strain diagrams for brittle and ductile materials - working stress –

Unit II

Strain energy in tension and compression - Impact loading. Thin and Thick Cylinders: Thin and Thick Cylinders – spherical shells subjected to internal fluid pressure – Wire wound thin cylinders – Compound cylinders – Shrink fit. Principal Stresses and Strains: Analysis of Biaxial state of stress with and without shear

Unit III

Shear Force And Bending Moment: Types of supports - Types of beams – Types of loads – articulated beams - Shear Force and Bending Moment diagrams.

Unit IV

Theory of Simple Bending: Assumptions - Bending stresses in beams - Efficiency of various cross sections - Composite beams. Shear Stress Distribution: Flexural shear stress distribution in different cross sections of beams.

Unit V

Deflection of Beams: Slope and deflection of beams - Double Integration method – Macaulay's method – strain energy method. Springs: Axial load and torque on helical springs – stresses and deformations – compound springs - leaf springs.

Unit VI

Torsion of Circular cross sections: Theory of pure torsion - transmission of Power in Solid and Hollow circular shafts – Combined bending and torsion. - Theories of failures for isotropic materials-

Texts:

1. Timoshenko and Gere, Mechanics of Materials, CBS Publishers, 2011.
2. E.P.Popov, Engineering Mechanics of Solids, PHI, 2009.
3. S. B. Junarkar, Mechanics of Structures, Charotar Publishers, 2010
4. F. P. Beer, E. R. Johnston (Jr.) and J.T. DeWolf, Mechanics of Materials, Tata McGraw Hill, 2005

Course No	Course Name	L-T-P-Credits
HU-201	Fundamental ofAccountancyand Management	3-1-0-4

Unit-I

Fundamentals of Managerial Accounting.Meaning and Significance. Need to learn Accounting. Financial, Cost and Management Accounting.Recognizing Financial Transactions - Money Measurement Concept.Single entry vs. Double Entry.Uses of Accounting Information - Various Stakeholders.Forms of Organization.

Unit-II

Financial Statements: Financial Statements. Balance Sheet and P & L Account.Time reference - Periodicity.Understanding Assets & Liabilities - Entity Concept.Concept of Capital and Borrowings .Basic Balance Sheet Structure.Contents of Annual Reports.Income Statement - P & L Account.Income vs Expenditure - Matching Concept.Revenue Recognition - Realization

& Accrual Concept.Basic Format of Income Statement.Operating Profit, PBIT, PBT, PAT. Outstanding Expense, Provision, Contingent liability.

Unit-III

Recording Financial Transactions: Books of Accounts - Journal, Ledger & other books.

System of Accounting - Cash vs. Mercantile System.Impact on Balance Sheet.Cases for Recording Simple transactions. Preparation of Simple Final accounts. Corporate Accounting - Issue of Shares, Issue and redemption of Debentures.

Unit-IV:

Accounting Standards, GAAP, IFRS Principles of Accounting. Accounting Standards,

IAS, IFRS. Convergence of GAAPs.Depreciation and Inventory Doctrine of Conservatism.Depreciation and other provisions.Goodwill and its Amortization. Valuation and Accounting for Inventory. Window Dressing.

Unit-V

Cash Flow: Cash Flow Statement. Fund Flow Statement. Cases on preparation and Interpretation of Cash Flow Statement.

Unit-VI

Interpretation and analysis of accounts: Ratio Analysis. Vertical and Horizontal analysis.Interpretation and analysis of Accounts.

Unit-VII

Introduction to Cost & Managerial Accounting Definition of Cost, Period Cost, Expenses,

Variable and fixed costs, other classifications of cost.

Unit-VII

Cost Accumulation Direct and indirect costs, predetermined overhead rate, under/over application of overheads.

Unit-IX

Product and Process Costing Job costing, process costing, normal loss, abnormal loss, operation costing.

Unit-X

Activity Based Costing Activity Based Costing (ABC), Traditional costing methods-limitations, benefits of ABC.

Unit-XI

Cost Volume Profit analysis CVP, Fixed costs, variable costs, semi variable costs, operating leverage, contribution margin, breakeven point.

Unit-XII

Relevant Costs in Decision making Shut down/continue, make/buy, processing of joint products, introducing a new product, effect of sunk costs.

Unit-XIII

Budgeting: Budgeting, Concept and advantages, Types, Flexible Budgeting.Standard Costing and Variance analysis: Standard Costs and Variances: Material,labour, overhead and Sales variances.

References:

1. J. H. Rossell, W.W. Frasure and D.H. Taylor, Managerial Accounting, 3rd ed., Merrill, Columbus. 2002

2. PrasannaChandra : Managers Guide to Finance and Accounting, Tata McGraw Hill. 2005

3. Ramchandran and Kakani, Financial Accounting for Management, Tata Mcgraw Hill. 4th edition , 2007

SEMESTER - 5

Course No	Course Name	L-T-P-Credits
ME-301	Advanced Mechanics of Solids	3-1-0-4

Unit-I

Contents: Analysis of stresses: 3D state of stress at a point; principal stresses; invariants; 3D Mohr's circle; octahedral stresses; hydrostatic and pure shear stresses. Differential equations of equilibrium in rectangular and polar coordinates.Boundaryconditions.Saint-Venant's principle, Principle of superposition. Analysis of strains: 3D strain components in rectangular and polar coordinates; state of strain at a point; principal strains; strain deviators and invariants. Compatibility conditions in rectangular and polar coordinates. Constitutive relations.

Unit-II

Boundary value problems: Stress formulation and displacement formulation; Beltrami-Michell equations and Navier's equations. Methods of solution and uniqueness of solution. Plane problems: Plane stress and plane strain problems. Airy stress function. 2D problems in rectangular and polar coordinates and axisymmetric problems: Cantilever beam with end load; uniformly loaded beam; thick and thin walled cylinders; rotating discs and cylinders; plate with a circular hole. Curved beams.

Unit-III

Torsion of non-circular bars: SaintVenant's semi-inverse method; Prandtl's stress function method. Unsymmetrical bending, shear center and shear flow. Energy methods: Principle of virtual work; minimum potential energy; statically indeterminate systems. Elastic stability: Analysis of beam columns. Yield and Fracture criteria: Different failure theories; stress space and strain space; yield surfaces.

Texts:

1. S. P. Timoshenko and J. N. Goodier, Theory of Elasticity, McGraw Hill International, 2010.
2. L. S. Srinath, Advanced Mechanics of Solids, Tata McGraw-Hill, 2008
3. H. Shames and J. M. Pitarresi, Introduction To Solid Mechanics, Prentice Hall of India, 2003.

Course No	Course Name	L-T-P-Credits
ME-302	Dynamics of Machinery	3-1-0-4

Unit-I

Mechanism, their inversions, mobility (Kutzhbach criteria) and range of movements(Grashof's law); Miscellaneous mechanisms: straight line generating mechanism, intermittent motion mechanism;

Unit-II

Displacement, velocity and acceleration analysis of planar mechanisms by graphical and analytical method.

Unit-III

Dimensional synthesis for motion; function and path generation; Cam profile synthesis and determination of equivalent mechanisms;
Static and dynamic force analysis;

Unit-IV

Balancing of rotating and reciprocating masses; Balancing of Engines; firing order. Balancing of machines, Field Balancing.
Gyroscope and gyroscopic effects;
Cam dynamics: analysis of cam and follower

Texts/References:

1. J. E. Shighley and J.J. Uicker, Theory of Machines and Mechanisms, McGraw Hill.4th revised edition, 2010.

2. J. S. Rao and R. V. Dukkipati, Mechanism and Machine Theory, New Age International, 2nd edition,1992.

3. S. S. Rattan, Theory of Machines, Tata McGraw Hill.4th ,2017.

4. T. Bevan. Theory of Machines, CBS Publishers and Distributors.3rd edition, 2005.

Course No	Course Name	L-T-P-Credits
ME-303	Design of Machine Elements I	3-1-0-4

UNIT I

Introduction to Design, Steps in Design process, Design factors-Tolerances and Fits. Standardization;
Selection of Materials, Stresses in machine parts-Tension, compression, shear, bending and Torsional Stresses

UNIT II

Principles of mechanical design; Modes of failures.Combined steady and variable stress-Gerber, Goodman, Soderbergmethod.Factor of safety, strength, rigidity, fracture, wear, and material considerations; Stress concentrations; Design for fatigue.

UNIT III

Design of riveted, bolted, and welded joints

UNIT IV

Design of Power screws.

UNIT V

Design of Shaft subjected to bending, torsion, axial and combine loading, keys, cotter and Knuckle joint.

UNIT VI

Design of springs: A brief introduction to various types of springs and its design consideration.

UNIT VII
Design of Rigid and flexible couplings

UNIT VIII
Design of Belt and chain drives; flat and V-belts.

Texts/references:
1. J. E. Shigley, Mechanical Engineering Design,10tht edition, 2014,McGraw Hill.
2. M. F. Spotts, Design of Machine Elements, 8th ed, 2006, Prentice Hall.

Course No	Course Name	L-T-P-Credits
ME-304	Applied Thermodynamics-I	3-1-0-4

Unit-I

Vapour Power Cycles: Carnot cycle, Rankine cycle, reheat cycle, regenerative cycle, steam cycles for nuclear power plant, back-pressure and extraction turbines and cogeneration, low-temperature power cycles, ideal working fluid and binary/multi-fluid cycles;

Unit-II

Steam Generator: subcritical and supercritical boilers, fluidized bed boilers, fire-tube and water-tube boilers, mountings and accessories, Condenser: Cooling Tower:

Unit-III

Steam Turbine: impulse and reaction stage, degree of reaction, velocity triangle, velocity and pressure compounding, efficiencies, reheat factor, governing, nozzles;

Unit-IV

Reciprocating Air Compressors: work transfer, volumetric efficiency, isothermal efficiency of multistage compression with intercooling.

Unit-V

Heat Pump and Refrigeration Cycles: reversed Carnot cycle and performance criteria, vapour compression and vapour absorption refrigerators, gas cycles, refrigerants. Air-conditioning;

Texts/References:

1. G F C Rogers and Y R Mayhew, Engineering Thermodynamics Work and Heat Transfer, Pearson. 7th ed, 2017.

2. P. K. Nag, Basic and Applied Thermodynamics, Tata McGraw Hill,2nd Edition, 2009.

3. M J Moran and H N Shapiro, Fundamentals of Engineering Thermodynamics, John Wiley,2014.

4. P K Nag, Powerplant Engineering, Tata McGraw Hill,2017.

Course No	Course Name	L-T-P-Credits
ME-305	Metrology and Measurements	3-1-0-4

UNIT I

BASICS OF METROLOGY

Introduction to Metrology – Need – Elements – Work piece, Instruments – Persons – Environment – their effect on Precision and Accuracy – Errors – Errors in Measurements – Types – Control – Types of standards.

UNIT II

LINEAR AND ANGULAR MEASUREMENTS

Linear Measuring Instruments – Evolution – Types – Classification – Limit gauges – gauge design – terminology – procedure – concepts of interchange ability and selective assembly – Angular measuring instruments – Types – Bevel protractor clinometers angle gauges, spirit levels sine bar – Angle alignment telescope – Autocollimator – Applications.

UNIT III

ADVANCES IN METROLOGY

Basic concept of lasers Advantages of lasers – laser Interferometers – types – DC and AC Lasers interferometer – Applications – Straightness – Alignment. Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Basic concepts of Machine Vision System – Element – Applications.

UNIT IV

FORM MEASUREMENT

Principles and Methods of straightness – Flatness measurement – Thread measurement, gear measurement, surface finish measurement, Roundness measurement – Applications.

UNIT V

MEASUREMENT OF POWER, FLOW AND TEMPERATURE

Force, torque, power -mechanical, Pneumatic, Hydraulic and Electrical type. Flow measurement: Venturimeter, Orifice meter, rotameter, pitot tube – Temperature: bimetallic strip, thermocouples, electrical resistance thermometer – Reliability and Calibration – Readability and Reliability.

TEXT BOOKS:

1. Jain R.K. “Engineering Metrology”, Khanna Publishers, 2005.

2. Gupta. I.C., “Engineering Metrology”, Dhanpatrai Publications, 2005.

REFERENCES:

1. Charles Reginald Shotbolt, “Metrology for Engineers”, 5th edition, Cengage Learning EMEA,1990.

2. Backwith, Marangoni, Lienhard, “Mechanical Measurements”, Pearson Education , 2006.

Open Elective-I

1) Robotics
2) Non-conventional Energy

Course No	Course Name	L-T-P-Credits
ME-OE-301	Robotics	3-1-0-4

UNIT I

INTRODUCTION

Definition, Need Application, Types of robots – Classifications – Configuration, work volume, control loops, controls and intelligence, specifications of robot, degrees of freedoms, end effectors – types, selection applications.

UNIT II

ROBOT KINEMATICS

Introduction – Matrix representation Homogeneous transformation, forward and inverse – Kinematic equations, Denvit – Hartenbers representations – Inverse Kinematic relations. Fundamental problems with D-H representation, differential motion and velocity of frames – Jacobian, Differential Charges between frames:

UNIT III

ROBOT DYNAMICS AND TRAJECTORY PLANNING

Lagrangeon mechanics, dynamic equations for sing, double and multiple DOF robots – static force analysis of robots, Trajectory planning – joint space, Cartesian space description and trajectory planning – third order, fifth order - Polynomial trajectory planning

UNIT IV

ROBOT PROGRAMMING & AI TECHNIQUES

Types of Programming – Teach Pendant programming – Basic concepts in A1 techniques – Concept of knowledge representations – Expert system and its components.

UNIT V

ROBOT SENSORS AND ACTUATORS

Design of Robots – characteristics of actuating systems, comparison, microprocessors control of electric motors, magnetostrictive actuators, shape memory type metals, sensors, position, velocity, force, temperature, pressure sensors – Contact and non contact sensors, infrared sensors, RCC, vision sensors.

Texts/References:

1. Gordon Mair, ‘Industrial Robotics’, Prentice Hall (U.K.) 1988
2. Wesley E Snyder R, ‘Industrial Robots, Computer Interfacing and Control’, Prentice Hall International Edition, 1988.
3. Groover.M.P. Industrial Robotics, McGraw – Hill International edition, 1996.
4. Saeed.B.Niku, ‘Introduction to Robotics, Analysis, system, Applications’, Pearson educations, 2002

Course No	Course Name	L-T-P-Credits
ME-OE-301	NON CONVENTIONAL ENERGY	3-1-0-4

Unit-I

Solar Energy -Sun as Source of Energy, Availability of Solar Energy, Nature of Solar Energy, Solar Energy & Environment. Various methods of using solar energy –Photo thermal, Photovoltaic, Photosynthesis, Present & Future Scope of Solar energy. .

Unit-II

Bio-mass -Biomass: Generation and utilization, Properties of biomass, Agriculture Crop & Forestry .residues used as fuels. Biochemical and Thermo-chemical Conversion, Combustion, Gasification, Biomass gasifiers and types etc. Applications of Gasifiers to thermal power and Engines, Biomass as a decentralized power generation source for villages ,Concept of Bio-energy:Photosynthesis process, Bio-fuels, Biomass resources

Bio based chemicals and materials, Thermo-chemical Conversion: Pyrolysis, Combustion, Gasification, Liquification.

Unit-III

Bio-Chemical Conversion: Aerobic and Anaerobic conversion, Fermentation etc.

Bio-fuels: Importance, Production and applications. Types of Bio-fuels, Production processes and technologies, Bio fuel.

Wind Energy -Wind Energy: Basics & Power Analysis, Wind resource assessment, Power Conversion Technologies and applications, Wind Power estimation techniques, Principles of Aerodynamics of wind turbine blade, various aspects of wind turbine design.

Texts/References:

1. Biomass Renegerable Energy – D.O.hall and R.P. Overeed

(John Wiley and Sons, New york, 1987)

2. Biomass for energy in the developing countries –D.O.Hall, G.W.barnard and

P.A.Moss (Pergamon Press Ltd. 1982)

3. Thermo chemical processing of Biomass, Bridgurater A V.

4. Biomass as Fuel – L.P.White (Academic press1981)

5. Biomass Gasification Principles and Technology, Energy technology review No. 67, -

T.B. Read (Noyes Data Corp. 1981)

6. Wind energy Conversion Systems – Freris L.L. (Prentice Hall1990)

SEMESTER – 6

Course No	Course Name	L-T-P-Credits
ME-307	Fluid machinery	3-1-0-4

Unit-I

Impact of jets: Introduction to hydrodynamic thrust of jet on a fixed and moving surface (flat and curve), – Series of vanes - work done and efficiency

Unit-II

Hydraulic Turbines :Impulse and Reaction Turbines – Degree of reaction, Pelton Wheel – Constructional features - Velocity triangles– Euler's equation – Speed ratio, jet ratio and work done , losses and efficiencies, design of Pelton wheel – Inward and outward flow reaction turbines- Francis Turbine – Constructional features – Velocity triangles, work done and efficiencies.

Unit-III

Axial flow turbine (Kaplan) Constructional features – Velocity triangles- work done and efficiencies – Characteristic curves of turbines – theory of draft tubes – surge tanks – Cavitation in turbines –Governing of turbines – Specific speed of turbine , Type Number– Characteristic curves, scale Laws – Unit speed – Unit discharge and unit power.

Unit-IV

Rotary motion of liquids – free, forced and spiral vortex flows Rotodynamic pumps-centrifugal pump impeller types,-velocity triangles-manometric head- work, efficiency and losses, H-Q

Characteristic, typical flow system characteristics, operating point of a pump. Cavitation in centrifugal pumps- NPSH required and available- Type number-Pumps in series and parallel operations. Performance characteristics- Specific speed-Shape numbers – Impeller shapes based

on shape numbers.

Unit-V

Positive displacement pumps- reciprocating pump – Single acting and double acting- slip, negative slip and work required and efficiency indicator diagram- acceleration head - effect of acceleration and friction on indicator diagram – speed calculation- Air vessels and their purposes, saving in work done to air vessels multi cylinder pumps.

Multistage pumps-selection of pumps-pumping devices-hydraulic ram, Accumulator, Intensifier, Jet pumps, gear pumps, vane pump and lobe pump.

Unit-VI

Compressors: classification of compressors, reciprocating compressor-single stage compressor, equation for work with and without clearance volume, efficiencies, multistage compressor, Intercooler, free air delivered (FAD)

Unit-VII

Centrifugal compressor-working, velocity diagram, work done, power required, width of blades of impeller and diffuser, isentropic efficiency, slip factor and pressure coefficient, surging and chocking. Axial flow compressors:- working, velocity diagram, degree of reaction, performance. Roots blower, vane compressor, screw compressor.

Text Books:

1. Som, Introduction to Fluid Mechanics and Fluid Machines, McGraw Hill Education India 2011
2. Bansal R. K., A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications, 2005.
Reference Books:
1. Cengel Y. A. and J. M. Cimbala, Fluid Mechanics, Tata McGraw Hill, 2013
2. Yahya S. M, Fans, Blower and Compressor, Tata McGraw Hill, 2005.
3. Shepherd D. G, Principles of Turbo Machinery, Macmillan, 1969.
4. Stepanoff A. J, Centrifugal and Axial Flow Pumps, John Wiley & Sons, 1991.
5. Rajput R. K, Fluid Mechanics and Hydraulic Machines, S. Chand & Co., 2006.
6. Subramanya, Fluid mechanics and hydraulic machines, 1e McGraw Hill Education India, 2010.

Course No	Course Name	L-T-P-Credits
ME-310	Applied Thermodynamics-II	3-1-0-4

Unit-I

I. C. Engines: Classification - SI, CI, two-stroke, four-stroke etc., operating characteristics – mean effective pressure, torque and power, efficiencies, specific fuel consumption etc., air standard cycles – Otto, Diesel and dual, real air-fuel engine cycles.

Unit-II

Thermochemistry of fuels – S.I. and C.I. engine fuels, self-ignition, octane number, cetane number, alternate fuels etc., combustion – combustion in S.I. and C.I. engines.

Air and fuel injection – injector and carburetor, MPFI etc.

Unit-III

Gas Power Cycles: Simple gas turbine cycle – single and twin shaft arrangements, intercooling, reheating, regeneration, closed cycles, optimal performance of various cycles, combined gas and steam cycles; Introduction to Axial-Flow Gas Turbine; Introduction to Centrifugal and Axial-Flow Compressors;

Unit-IV

Jet Propulsion: turbojet, turboprop, turbofan, ramjet, thrust and propulsive efficiency; Rocket Propulsion;

Unit-V

Direct Energy Conversion: thermionic and thermoelectric converters, photovoltaic generators, MHD generators, fuel cells.

Texts/references:

1. G F C Rogers and Y R Mayhew, Engineering Thermodynamics Work and Heat Transfer, Pearson,4ed, 2002.

2. H I H Saravanamuttoo, G F C Rogers and H. Cohen,Andrew Nix Prof Paul Straznicky, Gas Turbine Theory, Pearson,7 ed,2017.

3. T D Eastop and McConkey, Applied Thermodynamics for Engineering Technologists, Pearson, 5 ed,2002.

4. W WPulkrabek, Engineering Fundamentals of the Internal Combustion Engine , PHI, 2ed,2011.

Course No	Course Name	L-T-P-Credits
ME-311	Design of Machine Elements II	3-1-0-4

Unit-I

Design of Gears: A brief introduction of different types of gears and its design consideration.

Unit-II

Design of brakes and clutch

Lubrication and Wear consideration in Design;

Unit-III

Design and selection of Bearings: Hydrodynamic lubrication theory, Hydrostatic and Hydrodynamic bearings (e.g., journal), Rolling Element Bearings;

Unit-IV

Design consideration of cams.

Gasket for static load, in vessel opening.

Unit-V

Systems Approach to Design: Decision Making, Sensitivity analysis of design parameters, Value Analysis and Value Addition to designed components and systems; Overview of Optimization in Design;

Texts/References:

1. J. E. Shigley, Mechanical Engineering Design, IS Metric ed., McGraw Hill. 4th Edition 2008

2. V. Ramamurti, Computer Aided Mechanical Design and Analysis, Tata McGraw Hill.3rd Edition2007

3. John R Dixon, Design Engineering: Inventiveness, Analysis and Decision Making, TMH, New Delhi.6th Edition 2015

Course No	Course Name	L-T-P-Credits
EC 310	Control system	3-0-0-3

Unit-I

Feedback systems, mathematical modelling of physical systems;

Laplace transforms, block diagrams, signal flow graphs, state-space models;

Time domain analysis: performance specifications, steady state error, transient response of first and second order systems;

Unit-II

Stability analysis: Routh-Hurwitz stability criterion, relative stability;

Proportional, integral, PI, PD, and PID controllers;

Lead, lag, and lag-lead compensators;

Unit-III

Root-locus method: analysis, design;

Unit-IV

Frequency response method: Bode diagrams, Nyquist stability criterion, performance specifications, design;

Unit-V

State-space methods: analysis, design;

Unit-VI

Physical realizations of controllers: hydraulic, pneumatic, and electronic controllers.

Texts/References:

1. K Ogata, Modern Control Engineering, Pearson Education Asia,4th Edition 2015

2. M Gopal, Modern Control System Theory, New Age International,5th Edition2011

3. P. Belanger, Control Engineering: A modern approach, Saunders College Publishing.6th Edition 2010

Department Electives I: ME ELV-I

1 Internal Combustion Engines
2 Aerospace Engineering
3 Numerical Methods & Computer programming

Course No	Course Name	L-T-P-Credits
ME-ELV-301	Internal Combustion Engines	3-1-0-4

Unit I

Introduction-Review of fundamentals of IC engines-classification, design and operating parameters-performance characteristics.

Unit II

Combustion: - Combustion in Spark Ignition engines- flame propagation-stages of combustion-normal combustion- theoretical and actual p-theta diagrams- effect of spark timing on combustion-Highest Useful Compression Ratio-Factors affecting combustion process-ignition lag-Detonation-ignition quality of fuel- Octane rating. Combustion in Compression Ignition Engines-Stages of CI engine combustion process-air motion within the CI engine-swirl, squish, tumble and turbulence- effect of injection timing on CI engine combustion process-delay period- Knocking- ignition quality of CI engine fuel-Cetane rating. Advanced Combustion processes:- Limitations of conventional combustion processes of SI and CI engines-Concept of Homogeneous Charge Compression Ignition, Premixed Charge compression Ignition, Reactive Charge Compression Ignition; Combustion chambers:- Desirable characteristics of combustion chambers for SI and CI engines-effect of surface to volume ratio-L, I, F and T-head and fast burn combustion chambers for SI engines-direct and indirect injection combustion chambers for CI Engines.

Unit III

Advanced Fuel Injection systems for SI and CI engines:-Mixture preparation for SI engines-Limitations of carburetion system-fuel injection system for SI engine-mechanical and electronic fuel injection systems – L-jetronic and D-jetronic, multi point fuel injection systems for SI engine. Objectives of good fuel injection syste for CI engines-Limitations of mechanical injection systems for CI engines-Common rail direct injection system for CI engine-working, advantages and limitations.

Unit IV

Modern trends in the development of IC Engines:-Charge stratification-Stratified charge engine-Texaco combustion process, Ford PROCCO and Honda CVCC. Concept of low heat rejection engines-Thermal barrier coatings-Roary combustion engine-Wankel engine.

Unit V

Engine emissions and control:-Engine emissions-evaporative and exhaust emissions-mechanism of formation of emissions including CO,HCs, NOx and PM in SI and CI engines-Methods of control of engine emissions-in cylinder control and after treatment techniques-Use of catalysts, catalytic converters and particulate traps. Emission norms-legislation- EURO and Bharath Stage norms.

Unit VI

Alternate fuels: - Need for alternate fuels-desirable characteristics of good alternate fuel-Petroleum derived alternate fuels and renewable fuels-biofuels- ethanol, biogas, and vegetable oils-Biodiesel. Advantages and limitations of alternate fuel run engines.

Texts/References:

1. V. Ganesan, Internal Combustion Engines, Tata Mc Graw Hill Co, 4th Edition 2010

2. M.L.Mathur and R.P.Sharma,A first course in IC Engines, Dhanpat Rai & Sons ,3rd Edition 2008

Course No	Course Name	L-T-P-Credits
ME-ELV-301	Aerospace Engineering	3-1-0-4

Unit I

Aerodynamic forces and moments; continuity, momentum and energy equations; Inviscidincompressible flow – incompressible flow in a low speed wind tunnel,

Unit II

Source and doubletflows, no lifting flow over a circular cylinder, Kutta-Joukowski theorem; Incompressibleflow over airfoils and finite wings – Kutta condition, Kelvin's circulation theorem, Biot-Savart law, Helmholtz vortex theorem, Prandtle's classical lifting line theory; Thin aerofoil theory

Unit III

Three dimensional source and doublet; Inviscid compressible flow – normal andoblique shocks, expansion waves, supersonic wind tunnels; Elements of hypersonic flow,Newtonian theory; Equations of viscous flow;

Unit IV

Laminar and turbulent boundary layers; Panelmethods in aerodynamics

Textbooks/References:

[1] Anderson, J.D. Jr, Fundamentals of Aerodynamics, McGraw Hill4th Edition(2005).
[2] Bertin, J.J., Aerodynamics for Engineers, Pearson Education3rd Edition (2002).
[3] Clancy, L. J., Aerodynamics, Himalayan Books(1996).
[4] Houghton, E.L., and Carruthers, N.B. Aerodynamics for Engg. Students,
Arnold Publications 1st Edition(1988).
[5] Kuethe, A. M., and Chow, C-Y, Foundations of Aerodynamics, Wiley, 2nd Edition(1998).

Course No	Course Name	L-T-P-Credits
ME-ELV-301	Numerical Methods & computer Programing	3-1-0-4

Unit I

SOLUTION OF EQUATIONS AND EIGEN VALUE PROBLEMS:

Iterative method, Newton-Raphson method for single variable and for simultaneous equations with two variables.Solutions of a linear system by Gaussian, Gauss-Jordan, Jacobi and Gauss-Seidel methods.Inverse of a matrix by Gauss-Jordan method.Eigen value of a matrix by Power and Jacobi Methods.

Unit II

INTERPOLATION:

Newton's divided difference formulae, Lagrange's and Hermite's polynomials, Newton forward and backward difference formulae, Stirling's and Bessel's Central difference formulae.

Unit III

NUMERICAL DIFFERENTIATION AND INTEGRATION:

Numerical differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's (both 1/3 rd and 3/8 th) rules. Two and Three point Gaussian quadrature formula. Double integrals using Trapezoidal and Simpson's rule.

Unit IV

INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS:

Single Step Methods - Taylor Series, Euler and Modified Euler, Runge-Kutta method of order four for first and second order differential equations. Multistep Methods - Milne and Adam's-Bashforth predictor and corrector methods.

Unit V

BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS:

Finite difference solution for the second order ordinary differential equations, Finite difference solution for one dimensional heat equation (both implicit and explicit).One dimensional wave equation and two dimensional Laplace and Poisson equations.

Texts/References:

1. T. VeeraRajan and T. Ramachandran, Numerical Method, Tata MCgraw hill (2008).
2. C. Chapra, Numerical Methods for Engineers, Tata MCgraw hill, 2nd revised edition edition (1988).
3. E. Balaguruswamy, Numerical Methods, Tata MCgraw hill4th Edition(2017).
4. Sastry, S.S., Introductory Methods of Numerical Analysis, Printice Hall of India, Fifth edition (2012).

Open Elective-II

1 Applied linear algebra
2 Mathematical methods
3 Optimization Methods in Engineering

Course No	Course Name	L-T-P-Credits
ME-OE-302	Mathematical Methods	3-1-0-4

Unit I

Linear Programming: Formulation and geometric ideas, Graphical method, convex set, simplex method, revised simplex methods, dual simplex method, two-phase method.

Duality and sensitivity, interior-point methods for LP problems, transportation, assignment, and integer programming problems.

Unit II

Nonlinear optimization: Basic theory, method of Lagrange multipliers, Karush-Kuhn-Tucker theory, numerical methods for nonlinear optimization, convex optimization, quadratic optimization; Dynamic programming; Optimization models.

Unit III

Numerical optimization techniques: Line search methods, Gradient methods, Newton's method, Conjugate Direction methods, Quasi-Newton methods, Projected Gradient methods, penalty methods.

Unit IV

Calculus of variation: The method of variations in problems with fixed boundaries, Variation of a functional, Euler's equation, functionals involving derivatives of higher order, optimal control as a problem of variational calculus.

Text books:

1. D. G. Luenberger and Y. Ye, "Linear and Nonlinear Programming", 3rd Edition. Springer India, 2008.

2. B. V. Brunt, "The calculus of Variation", Springer-Verlag, 4th Edition 2004.

References:

1. E. K. P. Chong and S. H. Zak, "An Introduction to Optimization", 2nd Edition, Wiley India, 2001.
2. M. S. Bazarra, H. D. Sherali and C. M. Shetty, Nonlinear Programming Theory and Algorithms, 3rd Edition, Wiley India, 2006.

Course No	Course Name	L-T-P-Credits
ME-OE-302	Applied Linear Algebra	3-1-0-4

Unit I

Vector Spaces: Definition, Subspaces, linearly independent and dependent, spanning sets, Basis, dimension, fundamental subspaces associated with a matrix, revisit the system of linear equations, Intersection and Sum of Subspaces, Direct Sums, Embedding of sub- spaces.

Unit II

Linear Transformations: Definition, Matrix representations, Change of Basis, Similarity transformations, Invertible transformations.

Unit III

Inner Products: Definition, induced norm, inequalities, Orthogonality, Gram-Schmidt orthogonalization process, Orthogonal projections, rank-one projections, Unitary transformations, isometry.

Unit IV

Eigen Decomposition: Eigen vectors and Eigen Values, Eigen spaces, Characteristic polynomial and minimal polynomial, Gershgorin circles, Diagonalizability conditions, Invariant subspaces, Spectral theorem, Rayleigh quotient.

Unit V

Canonical form: Triangular form, Primary decomposition, Jordan canonical form.

Unit VI

The algebraic eigenvalue problem: Jacobi's method, Given's method, Householder's method, Power method, inverse Power method, QR method, Lanczos' method.

Text Books:

1. S. Lipschutz, M. Luipson, "Linear Algebra", Schaum's Outlines, 3rd Edition, Tata McGraw Hill.
2. M. Artin, "Algebra", 2nd Edition, Pearson Modern Classics for Advanced Mathematics Series.

References:

1. D. C. Lay, "Linear algebra and its applications", Pearson, 3rd edition
2. S. H. Friedberg, A. J. Insel, L. E. Spence, " Linear Algebra", 4th Edition, PHI, 2003
3. G. Strang, "Linear Algebra and its applications", 3rd Edition

Course No	Course Name	L-T-P-Credits
ME-OE-301	Optimization Methods in Engineering	3-1-0-4

Unit I

Introduction to OR modeling approach and various real life situations

Unit II

Linear programming problems and applications, Various components of LP problem formulation, Solving Linear Programming problem using simultaneous equations and Graphical Method, Simplex Method and extensions,

Unit III

Sensitivity analysis +Duality theory, Revised Simplex Transportation and assignment problems

Unit IV

Network Analysis+shortest Paths, Maximal Flow including PERT+CPM. Integer programming concepts, formulation, Solution and applications.

Unit V

Dynamic Programming—Modeling, Optimization, Replacement.

Game Theory—Introduction, Decisions under risk, Decisions under uncertainty

Queuing Theory—Introduction, basic definitions& notations, axiomatic derivation of the arrival &departure;Distributions for Poission Queue, Poission Queuing model, M/M/I queues in series , application.

Texts/References:

1.Hamdy A. Taha, "Operations Research",., Macmillan Publishing Company4th Edition 2014

4. Hadley G.,"Linear Programming", Narosa Publishers, 5th Edition 2010

SEMESTER – 7

ME Elective-II

4 Advanced Fluid Mechanics
5 Convective Heat and Mass Transfer
6 Computer Aided Design (CAD)

Course No	Course Name	L-T-P-Credits
ME-ELV-401	Advanced Fluid Mechanics	3-1-0-4

Unit-I

Fluid kinematics; Integral and differential forms of governing equations; Mass, momentum, and energy conservation equations;

Unit-II

Navier-Stokes equations and its applications; Potential flow; Laminar boundary-layer; Free-shear flows: jet, wake, and mixing layer;

Unit-III

Turbulent flow; Compressible flow: Isentropic flow; flow with area change; flow with heat transfer; flow with friction.

Text Books

1. J. D. Anderson (Jr.), Modern Compressible Flow, McGraw-Hill International Edition, 1990.

2. C. T. Crowe, D. F. Elger, B. C. Williams and J. A. Roberson, Engineering Fluid Mechanics, McGraw Hill, Eigth Edition, 2006

References Books:

1. B.R.Munson, D.F.Young and T.H.Okiishi., Fundamental of Fluid Mechanics, John-Wiley and Sons., 1994.

2. P.M.Gerhar, R.J.Gross and J.I.Hochstein., Fundamentals of Fluid Mechanics, Addison-Wesley Publishing Co., 1993.

3. F.M.White, Fluid Mechanics, McGraw-Hill international editions. 1994.

4. F.M.White, Viscous Fluid Flow, McGraw-Hill international editions. 1991.

Course No	Course Name	L-T-P-Credits
ME-ELV-401	Convective Heat and Mass Transfer	3-1-0-4

Unit-I

Basics of Heat Transfer and Fluid Flow: Modes of heat transfer (conduction vs. convection),Laws of heat transfer: Fourier's law of heat conduction vs. Newton's law of cooling, Continuum approach, Knudsen number, control volume, Types of flow, Non dimensional numbers and physical significance,

Unit-II

Introduction to convective heat transfer: advection vs. convection, types of convection; Boundary Layer Theory: Velocity and thermal BL theory of horizontal and vertical flat plat and mechanism of flow, Boussinesq approximation; Governing Equations: Differential form of continuity, momentum and energy equation, Non dimensionalisation of governing equations, Scale analysis, Governing equation inside BL, Assumptions, Similarity solution; External flow: flat plate in parallel flow, flow over cylinder and sphere, and Internal Flows: hydrodynamic considerations, Fully developed flow, mean velocity, maximum velocity, velocity profiles, mean temperature, average velocity and pressure drop in circular pipe.

Text Books

1. W. M. Kays and E. M. Crawford, Convective Heat and Mass Transfer, Mc-Graw Hill, 3rd Edition, 1993.
2. T. L. Bergeman, A. S. Lavine, F. P. Incropera and D. P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley and Sons, 7th Edition, 2011.
3. Y. Çengel, and A. J. Ghajar, Heat and Mass Transfer: Fundamentals and Applications, Tata Mc-Graw Hill Publication, 4th Edition, 2014.

References Books:

1. Louis C Burmeister, Convective Heat Transfer, John Wiley and Sons, 2nd Edition, 1993.
2. Adrian Bejan, Convective Heat Transfer, John Wiley and Sons, 4th Edition, 2013.

Course No	Course Name	L-T-P-Credits
ME-ELV-401	**Computer Aided Design**	3-1-0-4

Unit-I

Introduction to Engineering Design – Various phases of systematic design – sequential engineering and concurrent engineering – Computer hardware & Peripherals – software packages for design and drafting.

Computer Graphics Fundamentals And Geometric Model -Computer graphics – applications – principals of interactive computer graphics – 2D 3D transformations – projections – curves –

Unit-II

Geometric Modeling – types – Wire frame surface and solid modeling – Boundary Representation, constructive solid geometry –

Graphics standards – assembly modeling – use of software packages

Product Design Concepts -Understanding customer needs – Product function modeling – Function trees and function structures – Product tear down methods – Bench marking – Product portfolio – concept generation and selection.

Unit-III

Product Modeling – types of product models; product development process tools – TRIZ – Altshuller's inventive principles – Modeling of product metrics – Design for reliability – design for manufacturability – machining, casting, and metal forming – design for assembly and disassembly - Design for environment – FMEA – QFD – Poka Yoke - DOE – Taguchi method of DOE – Quality loss functions – Design for product life cycle.

Texts/References:

1. Biren Prasad, "Concurrent Engineering Fundamentals Vol.11", Prentice Hall, 1997.
2. James G.Bralla, "Handbook of Product Design for Manufacturing", McGraw Hill, 1994
3. Ibrahim Zeid, "CAD/CAM theory and Practice", Tata McGraw Hill, 1991.
4. David F.Rogers.J, Alan Adams, "Mathematical Elements for Computer Graphics", McGraw Hill, 1990
5. Kevin Otto, Kristin Wood, "Product Design", Pearson Education, 2000

Course No	Course Name	L-T-P-Credits
HU-401	**ECONOMICS AND FUNDAMENTALS OF MANAGEMENT**	3-0-0-3

Economics:

Unit-I

Introduction, Demand and Supply Analysis, Production and Cost, Price Output Determination, Capital Market and Investment Decisions, Outline of Welfare Economics, Resource Accounting and Sustainability,

Unit-II

Income Determination and Fluctuations, Trade, Aid and Development. Economic Systems & Indian Economic Policies.

Management:

Unit-I

Meaning, Objectives and Scope of Management;

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

Unit-II

Styles of Management.

Basics of Financial Magnagement; Marketing Management; Human Resource Management; and Production Management

Texts/references:

1. L. M. Prasad : Principles and Practice of Management, Sultan Chand and Sons, New Delhi. 9th edition 2015
2. V. S. Ramaswamy and S. Namakumari : Marketing Management, Macmillan India, Pvt. Ltd., New Delhi. 7th edition 2007
3. S. S. Khanka : Human Resource Management, S. Chand & Company Pvt. Ltd., New Delhi. 3rd edition 2002
4. P. Rama Murty : Production and Operations Management, New Age International Publishers, New Delhi. 6th edition 2009

ME Elective-III

1 Computational Fluid Dynamics
2 Operation Research
3 Computer Aided Manufacturing (CAM)

Course No	Course Name	L-T-P-C
ME-ELV-402	Computational Fluid Dynamics	3-1-0-4

Unit-I

Finite Difference Method- Classification of PDEs - Initial and Boundary conditions - Initial and Boundary value problems - Finite difference method- Central, Forward, Backward difference for a uniform grid – Central difference expressions for a non-uniform grid - Numerical error - Accuracy of solution – Grid independence test.

Incompressible Fluid Flow- Introduction - Governing equations - Difficulties in solving Navier- Stokes equation - Stream function - Vorticity method - In viscid flow (steady) - Determination of pressure for viscous flow.

Unit-II

Conduction Heat Transfer- Applications of Heat conduction - Steady and Unsteady conductions - One dimensional steady state problems - Two dimensional steady state problems. Three dimensional steady state problems - Transient one dimensional problem.

Unit-III

Convection Heat Transfer- Introduction - Steady one dimensional Convection-Diffusion - Unsteady one. Dimensional Convection – Diffusion – Unsteady two dimensional Convection – Diffusion.

Applications of Computational Fluid Dynamics- Computer graphics in CFD - Future of CFD - Enhancing the design process - understanding - Applications - Automobile, Engine, Industrial, Civil, Environmental.

Texts/References:

1. K. Muralidhar, and T. Sundararajan, "Computational Fluid flow and Heat Transfer", NarosaPublishingHouse, (2009).
2. John D. Anderson, "Computational Fluid Dynamics: The Basics with Applications", McGraw Hill Education (Indian Edition)(2012).
3. H. Versteeg, W. Malalasekra, "An Introduction to Computational Fluid Dynamics: The finite volume method", Pearson Education, Second Edition (2007).
4. G. Biswas, S. Mukherjee,"Computational Fluid Dynamics", NarosaPublishingHouse, First Edition (2014).

Course No	Course Name	L-T-P-Credits
ME-ELV-402	Operation research	3-1-0-4

Unit-I

Introduction to OR modeling approach and various real life situations.Linear programming problems and applications, various components of LP problem formulation, Solving Linear Programming problem using Graphical Method and Simplex Method.

Unit-II

Duality theory, Transportation and assignment problems

Unit-III

Network Analysis .PERT and CPM

Unit-IV

Game Theory—Introduction, Decisions under risk, Decisions under uncertainty

Queuing Theory—Introduction, basic definitions & notations, Poisson Queue.

Text:

1.Hamdy A. Taha, "Operations Research", Fifth Edition., Macmillan Publishing Company

2.V.K.Kapoor, Operations Research

3. KantiSwaroop, Operations Research

4. Hadley G.,"Linear Programming", Narosa Publishers

5. Hillier & Lieberman—Introduction to Operations Research,TMH

6.Hiller F. and LeibermannG.J.,"OperationResearch",Holder Day Inc,

Course No	Course Name	L-T-P-Credits
ME-ELV-402	COMPUTER AIDDED MANUFACTURING	3-1-0-4

Unit-I

COMPUTE-AIDED PROGRAMMING- General information, APT programming, Examples Apt programming.NC programming on CAD/CAM systems, the design and implementation of post processors .Introduction to CAD/CAM software, Automatic Tool Path generation.

Unit-II

TOOLING FOR CNC MACHINES-Interchangeable tooling system, preset and qualified toois, coolant fed tooling system, modular fixturing, quick change tooling system, automatic head changers. DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages arid disadvantages of DNC, adaptive control with optimization, Adaptive control with constrains, Adaptive control of machining processes like turning, grinding.

Unit-III

POST PROCESSORS FOR CNC-Introduction to Post Processors: The necessity of a Post Processor, the general structure of a Post Processor, the functions of a Post Processor, DAPP — based- Post Processor: Communication channels and major variables in the DAPP — based Post Processor

Unit-IV

MICRO CONTROLLERS-Introduction, Hardware components, I/O pins, ports, external memory:, counters, timers and serial data I/O interrupts. Selection of Micro Controllers Embedded Controllers, Applications and Programming of Micro Controllers. Programming Logic Controllers (PLC' s): Introduction, Hardware components of PLC, System, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC's in CNC Machines.

Unit-V

COMPUTER AIDED PROCESS PLANNING: Hybrid CAAP System, Computer Aided Inspection and quality control, Coordinate Measuring Machine, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods, Artificial Intelligence and expert system: Artificial Neural Networks, Artificial Intelligence in CAD, Experts systems and its structures.

Texts/References:

1. Computer Control of Manufacturing Systems / YoramKoren / Mc Graw Hill. 1983.
Sarcar, PHI, 2008.
2. CAD / CAM / CIM, Radhakrishnan and Subramanian, New Age . 4th Edition 2011

Open Elective-III

1. Mechatronics
2. Automobile Engineering

Course No	Course Name	L-T-P-Credits
ME-OE-401	MECHATRONICS	3-1-0-4

Unit-I.

Electrical Systems

Mathematical modeling of Electro Mechanical Systems, RLC Circuits, active and passive electrical circuits, PMDC Motor, Stepper motor, three phase squirrel cage induction motor, three phase permanent magnet synchronous motor, servo motor.

Unit-II

Mechanical Systems

Introduction to various systems of units, mathematical modeling of mechanical systems, Newton's laws, moment of inertia, forced response and natural response, rotational systems, spring mass system, free vibration, spring mass damper system, mechanical systems with dry friction, work energy and power, passive elements and active elements an energy method for deriving equations of motion, energy and power transformers.

Unit-III

Fluid and Thermal systems

Mathematical modeling of liquid level system: Resistance and capacitance of liquid level systems with interaction. Mathematical modeling of pneumatic systems: Resistance and capacitance of pneumatic systems, mathematical modeling of a pneumatic systems, liberalization of non-linear systems. Mathematical modeling of hydraulic systems: Hydraulic circuits, hydraulic servo-meter and mathematical model of hydraulic servo motor dashpots. Mathematical modeling of thermal systems: Thermal resistance and 7 thermal capacitance mathematical modeling of thermal systems.

Unit-IV

Design of Mechanical Elements

The phases of design, Design considerations, codes and standards, optimum design process, design variables, cost functions, design constraints, optimum design. Springs, rolling contact bearing, journal bearing, Spur and helical gear, bevel and worm gears, shafts, axes and spindles, Flexible Mechanical Elements, Belts, timing belts, chain and sprocket, flexible shafts, brakes, clutches, cams, four bar mechanism.

Unit-V

Design of Hydraulic System

Hydraulic circuit design, Actuator design, selection of pumps, selection of valves, design of control circuit.

Course No	Course Name	L-T-P-Credits
ME-OE-401	Automobile Engineering	3-1-0-4

Unit I

Introduction:

Overview of the course, Examination and Evaluation patterns, History of Automobiles, Classification of Automobiles; types of cycles, working principle of an IC engine, advanced classification of Engines- Multi cylinder engines, Engine balance, firing order.

Unit II

Fuel System and Ignition System and Electrical system:spark Ignition engines- Fuel tank, fuel filter, fuel pump, air cleaner/filter, carburettor, direct injection of petrol engines. Compression Ignition engines, Fuel Injection System- air & solid injection system, Pressure charging of engines, super charging and turbo charging, Components of Ignition systems, battery ignition system, magneto ignition system, electronic ignition and ignition timing. Main electrical circuits, generating & stating circuit, lighting system, indicating devices, warning lights, speedometer.

Unit III

Lubricating system and cooling systems:

Functions & properties of lubricants, methods of lubrication-splash type, pressure type, dry sump, and wet sump & mist lubrication. Oil filters, oil pumps, oil coolers. Characteristics of an effective cooling system, types of cooling system, radiator, thermostat, air cooling & water cooling.

Unit IV

Chassis:

Systems in an automobile, body, chassis frame, parts of the automobile body, terminology, automobile frames, functions, constructions, sub frames, materials and defects in frames.

Unit V

Transmission, axles, clutches, propeller shafts and differential:

Types of gear boxes, automatic transmission, electronic transmission control, functions and types of front and rear axles, types and functions of the clutches, design considerations of Hotchkiss drive torque tube drive, function and parts of differential and traction control.

Unit VI

Steering, Braking and Suspension Systems:

Functions of steering mechanism, steering gear box types, wheel geometry; wheel quality, assembly, types of wheels, wheel rims. Construction of tyres and tyre specifications.functions and types of brakes, operation and principle of brakes, constructional and operational classification and parking brake. Types of springs shock observers, objectives and types of suspension system, rear axles suspension, electronic control and proactive suspension system

Unit VII

Automotive air conditioning:ventilation, heating, air condition, refrigerant, compressor and evaporator.

Texts/References:

1. Crouse, W.H., and Anglin, D.L., Automotive Mechanics, Tata McGraw Hill, 2nd edition, 2006

2. Heitner, J., Automotive Mechanics, Affiliated South West Press, New Delhi, 4th edition, 2008

SEMESTER – 8

Course No	Course Name	L-T-P-Credits
ME 401	Industrial Engineering	3-0-0-3

Unit-I

Plant location and layout: - Importance of plant location, factors affecting plant location, plant layout

Unit-II

Production and Productivity: definition, measurement.Types of production systems, factors affecting low productivity, methods to improve productivity.

Unit-III

Work study and its role in improving productivity of an organization. Work measurement, Method study. Objectives of work measurement, Objectives of method study.

Unit-IV

Introduction to production planning and control.

Unit-V

Inventory control: - Importance of inventory, types of inventory, objectives of inventory control, functions of inventory control. Economic order quantity.

Unit-VI

Break-even analysis, Sales forecasting.

Texts/References:

1. S L Narasimhan, D W McLeavey, P J Billington, Production, Planning and Inventory Control, Prentice Hall, 2nd edition 2013.

2. O P Khanna, "Industrial Engineering and Management",,Dhanpat Rai, 2ndEdition2004.
3. MartandTelsang, "Industrial Engineering and Management",2ndEdition, S. Chand &Comapany, 2008.
4.Dr. C Nadha Muni Reddy and Dr. K Vijaya Kumar Reddy"Reliability Engineering & Quality Engineering",Galgotia Publications,1st Edition, 2008.
5. J K Sharma, Operations Research, Macmillan, 5th edition 2013

ME Elective-IV

1. Advanced Manufacturing Technology
2. Power Plant Engineering
3. Mechanical Vibration

Course No	Course Name	L-T-P-Credits
ME-ELV-403	Advanced Manufacturing Technology	3-1-0-4

Unit-I

Theory of metal cutting: Mechanics of chip formation, single point cutting tool, forces in machining, Types of chip, cutting tools – nomenclature, orthogonal metal cutting, thermal aspects, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability. Machine Tools: Generation and machining principles

Unit-II

Turning machines: Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss type, automatic screw type – multi spindle

Unit-III

Shaper, milling and gear cutting machines: Shaper - Types of operations. Drilling, reaming, boring, And Tapping. Milling operations- types of milling cutter.Gear cutting – forming and generation principle and construction of gear milling, hobbing and gear shaping processes – finishing of gears.

Unit-IV

Abrasive process and broaching: Abrasive processes: grinding wheel – specifications and selection, types of grinding process– cylindrical grinding, surface grinding, centerless grinding and internal grinding- Typical applications – concepts of surface integrity, broaching machines: broach construction – push, pull, surface and continuous broaching machines

Unit-V

CNC machining: Numerical Control (NC) machine tools – CNC types, constructional details, special features, machiningcentre, part programming fundamentals CNC – manual part programming – micromachining – wafer machining

Unit-VI

Tooling: Jigs and Fixtures, Principles of location and clamping. Finishing: Micro finishing (Honing, Lapping, Superfinishing)

Unit-VII

Unconventional Methods: Electro-chemical, Electro-discharge, Ultrasonic, LASER, Electron Beam, Water Jet, Rapid Prototyping and Rapid Tooling

Texts/References:

1. Amitabha Ghosh and Ashok Kumar Mallick, Manufacturing Science Affiliated East West Press Ltd, 1st edition 1986
2. S .Kalpakjian and Steven R Schimid, Manufacturing Engineering and Technology, Pearson, 1st edition 2001

Course No	Course Name	L-T-P-Credits
ME-ELV-403	Power Plant Engineering	3-1-0-4

Unit-I

Economics of the power plant: Load curve, load duration curve, various factors, and effect of fluctuating load on operation and design of the plant, methods of meeting fluctuating load. Selection of the generating equipment, load sharing, cost of electrical energy. Tariff methods.Performance and operating characteristics of Power Plants.Hydro power plant: Rainfall, runoff and its measurement, hydrograph, flow duration curve, mass curve, and reservoir storage capacity. Classification of the plants- Run-off river plant, storage river plant, pumped storage plant.

Unit-II

Fluidized bed combustion- regimes of combustion, circulating and pressurized fluidized bed combustion system, Fluidized bed boilers, its important features, and classification.Control of Nitrogen oxides.

Unit-III

Nuclear power plant: Introduction of nuclear engineering- radioactive decay, half-life, fission, fusion, nuclear materials. Thermal fission reactors and power plant - PWR, BWR, Liquid metal fast breeder reactors. Reactor control.

Unit-IV

Diesel and Gas turbine power plant: General layout, application of diesel power plant, advantages and disadvantages, component, performance of gas turbine power plant, gas turbine material.

Unit-V

Combined cycle power generation: Coupled cycle- thermodynamics, combined cycle plant-thermodynamics of GT-ST plant operation; Advantages. Base Load plants. Peak load plants.Co-ordination of different types of power plants.

Unit-VI

Environmental impact of power plant: Social and economical issues of the power plants, Greenhouse effect, Acid precipitation- acid rain and acid snow, dry deposition and acid fog, Thermal pollution, air pollution, Radiation from nuclear power plant effluents.Coal storage, Inplant handling of coal, Ash handling systems. Dust collectors. Flue gas, desulfurization methods.

Texts/References:

1. Power Plant Engineering - P. K. Nag - Tata McGraw Hill,kindle ed,2017.
2. Power Plant Technology - M. M. EL - Wakil - McGraw Hill,India ed,2017.
3. Power Plant Engineering - P. C. Sharma,S.K. Kataria& Sons, 2013.

Course No	Course Name	L-T-P-Credits
ME-ELV-403	Mechanical Vibration	3-1-0-4

Unit-I

INTRODUCTION: relevance of and need for vibration analysis-Mathematical modelling of vibrating systems - Discretes and continous systems - review of single-degree of freedom systems-free and forced vibrations, Various damping models.

Unit-II

TWO DEGREE-OF-FREEDOM SYSTEMS: General solution to free vibration problem-damped free vibration - Forced vibration of undamped system -dynamic vibration absorbers - Technical applications.

Unit-III

MULTI DEGREE-OF-FREEDOM SYSTEMS: Free and forced vibrations of multi-degree of freedom systems in longitudinal torsional and lateral modes- Matrix methods of solution-normal modes - Orthogonality principle-Energy methods, Introduction to vibrations of plates.

Unit-IV

CONTINUOUS SYSTEMS:Torsional vibrations - Longitudinal vibration of rods - transverse vibrations of beams - Governing equations of motion-Natural frequencies and normal modes - Energy methods, Introduction to vibration of plates.

Unit-V

VIBRATION MEASUREMENT: Vibration monitoring-data acquisition-Vibration Parameter Selection-Vibration sensors-Accelerometers- Performance characteristics-Sensor location-Signal preamplification-Types of preamplifiers-Instrumentation- Tape recorders-Real time analysis-Digital Fourier transforms-FFT Analysis- Signature analysis and preventive maintenance: Vibration meters-vibration signatures-standards-vibration testing equipment-in-site balancing of rotors.

Texts/References:

2. P.Srinivasan, Mechanical Vibration Analysis, Tata-McGraw Hill, New Delhi. 1982 5th edition

2. L.Meirovitch, Elements of vibration Analysis, McGraw Hill, New York 2nd edition 2002

ME Elective-V

1 Refrigeration and air conditioning
2 Advance Heat and Mass Transfer
3 Modern Engineering Materials

Course No	Course Name	L-T-P-Credits
ME-ELV-404	Refrigeration and Air Conditioning	3-1-0-4

Unit I
Introduction:
Unit-II

Introduction to Refrigeration –Basic Definition, ASHRAE Nomenclature
Unit III
Vapour Compression Refrigeration System(VCRS):
Vapour Compression Refrigeration system – Carnot Vapour compression refrigeration cycle, Working and analysis, Limitations, Standard Vapour Compression Refrigeration system, Working and analysis, Effects of sub cooling and super heating, Multi-Pressure or Compound Vapour Compression Refrigeration Systems –Flash Gas removal, Flash inter cooling and water inter cooling.
Unit-IV

Air Refrigeration:
Air Refrigeration Cycles-reversed Carnot cycle, Bell-Coleman cycle analysis, Air Refrigeration systems-merits and demerits, analysis.
Unit V
Refrigerants:
Classification, Selection of Refrigerants and Nomenclature of refrigerants, Desirable Properties of an ideal refrigerant,A discussion on Ozone layer Depletion and Global Warming Refrigeration systems Equipment: Refrigeration System Equipment – Compressors, Condensers, Expansion Devices and Evaporators, A brief look at other components of the system.
Unit VI
Vapour Absorption systems:
Vapour Absorption Refrigeration Systems, Absorbent – Refrigerant combinations, Water-Ammonia Systems, Water-Lithium Bromide System, Contrast between the two systems, Modified Version of Aqua-Ammonia System with Rectifier and Analyser Assembly Other systems: Brief Discussion on (i) Steam-Jet refrigeration system and (ii) Thermoelectric refrigeration system
Unit VII
Psychometry& Load Analysis:
Introduction to Air-Conditioning, Basic Definition, Classification, ASHRAE Nomenclature pertaining to Air-Conditioning, Applications of Air-Conditioning, Psychrometry – Air-water vapour mixtures, Psychrometric Properties, Psychrometric or Air-Conditioning processes, Psychrometric Chart; Mathematical Analysis of Air-Conditioning Loads, Related Aspects, Numerical Problems, Different Air-Conditioning Systems-Central – Station Air-Conditioning System, Unitary Air-Conditioning System, Window Air-Conditioner and Packaged Air-Conditioner, Components related to Air-Conditioning Systems.

Texts/References:

1. Roy J. Dossat, Principles of Refrigeration, Wiley Limited 5th edition 2001

2. Arora C.P., Refrigeration and Air-conditioning, Tata Mc Graw –Hill, New Delhi 3rd edition,2008

Course No	Course Name	L-T-P-Credits
ME-ELV-404	Advanced Heat and mass transfer	3-1-0-4

Unit I

Governing fluid flow equations:

Conservation equations and boundary conditions**;** Forced Convection: Boundary Layer Theory, Velocity and Thermal Boundary Layers, Prandtl number, Governing Equations – Continuity, Navier-Stokes and Energy equations, Boundary layer assumptions, Integral and Analytical solutions to above equations,

Unit II

Turbulent flow:

Various empirical solutions, Numerical Problems, Forced convection flow over cylinders and spheres, internal flows –laminar and turbulent flow solutions, Numerical Problems. Free convection: Laminar and Turbulent flows, Vertical Plates, Vertical Tubes and Horizontal Tubes, Empirical solutions, Numerical Problems.

Unit III

Thermal Radiation:

Fundamental principles - Gray, White, Opaque, Transparent and Black bodies, Spectral emissive power, Wien's, Rayleigh-Jeans' and Planck's laws, Hemispherical Emissive Power, Stefan-Boltzmann law for the total emissive power of a black body, Emissivity and Kirchhoff's Laws, View factor, View factor algebra, Net radiation exchange in a two-body enclosure, Typical examples for these enclosures, Radiation Shield, Numerical problems on all the above topics.

Unit IV

Heat Exchangers:

Definition, Classification, LMTD method, Effectiveness - NTU method, Analytical Methods, Numerical Problems, Chart Solution Procedures for solving Heat Exchanger problems: Correction Factor Charts and Effectiveness-NTU Charts, Numerical Problems.

Unit V

Mass Transfer:

Fick's law as referred to ideal gases, Steady-state equimolar counter diffusion of ideal gases, Mass diffusivity analogy between heat and mass transfer; evaluation of mass transfer coefficients by dimensional analysis.

Texts/References

1 Louis C Burmeister, Convective Heat Transfer, John Wiley and Sons, 1st edition 1993.
2 Adrian Bejan, Convective Heat Transfer, John Wiley and Sons,2nd edition 1995
3 Holman, J. P., Heat Transfer, , Tata McGraw Hill, New York, 9th Edition 2008

Course No	Course Name	L-T-P-Credits
ME-ELV-404	MODERN ENGINEERING MATERIALS	3-1-0-4

Unit-I

The Structures of Materials-Metals, Ceramics, Polymers and Composites;

Properties: Chemical, Physical, Mechanical and Dimensional Properties.

Unit-II

Ferrous Alloys-Heat Treatments, Selective and Surface-Hardening, Specifications, Low Alloy and High Alloy Steels, Tool Steels, Stainless Steels, Cast irons.

Unit-III

Non-ferrous Alloy-Copper and its alloys, Aluminum and its alloys, Nickel, Zinc, Titanium, Magnesium and Refractory Metals; Shape Memory Phenomenon and Alloys-Ceramicsand Carbon Products;
Engineering Plastics, Polymeric Coatings and Adhesives.

Texts/References:

1. Engineering Design; A Materials and processing approach by Dieter, G.E., McGraw Hill,1st edition 1991
2. Materials selection in Mechanical Design by Ashby, M.F., Pergamon press, 1st edition 1992
3. Introduction To Engineering Materials & Manufacturing Processes by NIIT, Prentice-Hall of India. 1st edition 2004

Open Elective-IV

1 Quality engineering
2 Advanced Energy Management

Course No	Course Name	L-T-P-Credits
ME-OE-402	QUALITY ENGINEERING	3-1-0-4

UNIT – I

QUALITY & STATISTICAL PROCESS CONTROL

Quality – Definition – Quality Assurance – Variation in process – Factors – process capability – control charts – variables X, R and X, - Attributes P, C and U-Chart tolerance design. Establishing and interpreting control charts – charts for variables – Quality rating – Short run SPC.

UNIT – II

ACCEPTANCE SAMPLING

Lot by lot sampling – types – probability of acceptance in single, double, multiple, sampling plans – OC curves – Producer's risk and consumer's risk. AQL, LTPD, AOQL, Concepts – standard sampling plans for AQL and LTPD – use of standard sampling plans.

UNIT – III

CONCEPT OF RELIABILITY

Definition – reliability vs quality, reliability function – MTBF, MTTR, availability, bathtub curve – time dependent failure models – distributions – normal, weibull, lognormal –
Reliability of system and models – serial, parallel and combined configuration – Markoveanalysis, load sharing systems, standby systems, covarient models, static models, dynamic models.

Texts/References:

1 Amata Mitra "Fundamentals of Quality Control and improvement" Pearson Education,2nd edition 2002.
2. Bester field D.H., "Quality Control" Prentice Hall, 2nd edition 1993.
3. Patrick D To' connor, Practical Reliability Engineering, John-Wiley and Sons Inc, 3rdedition 2002

Course No	Course Name	L-T-P-Credits
ME-OE-402	Advanced Energy Management	3-1-0-4

Unit I

SOLAR ENERGY:

Solar radiation at the earth's surface – solar radiation measurements – estimation of average solar radiation - solar thermal flat plate collectors - concentrating collectors – solar thermal applications - heating, cooling, desalination, drying, cooking, etc. – solar thermal electric power plant - principle of photovoltaic conversion of solar energy, types of solar cells - Photovoltaic applications: battery charger, domestic lighting, street lighting, water pumping etc. - solar PV power plant – Net metering concept

Unit II

WIND ENERGY:

Nature of the wind – power in the wind – factors influencing wind – wind data and energy estimation - wind speed monitoring - wind resource assessment - Betz limit - site selection - wind energy conversion devices - classification, characteristics, applications – offshore wind energy - Hybrid systems - safety and environmental aspects – wind energy potential and installation in India - Repowering concept.

Unit III

BIO-ENERGY:

Biomass resources and their classification - Biomass conversion processes - Thermochemical conversion - direct combustion – biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion - types of biogas Plants - applications - alcohol production from biomass – bio diesel production – Urban waste to energy conversion - Biomass energy program in India.

Unit IV

OTHER TYPES OF ENERGY:

Ocean energy resources - principle of ocean thermal energy conversion (OTEC) - ocean thermal power plants - ocean wave energy conversion - tidal energy conversion – small hydro - geothermal energy - geothermal power plants – hydrogen production and storage - Fuel cell – principle of working - various types - construction and applications.

Unit V

Energy Audit and Management Definition, Energy audit:

Types of energy audit, Energy management (audit) approach understanding energy costs, Bench marking, Energy performance, Matching energy use to requirement, Maximizing system efficiencies, Optimizing the input energy requirements, Fuel and energy substitution.

Texts/References:

1. Biomass for energy in the developing countries –D.O.Hall, G.W.barnard and

P.A.Moss (Pergamon Press Ltd. 1982)

2. Thermo chemical processing of Biomass, Bridgurater A V.

3. Biomass as Fuel – L.P.White (Academic press1981)

4. Biomass Gasification Principles and Technology, Energy technology review No. 67, -

T.B. Read (Noyes Data Corp. 1981)