Course Structure & Curriculum
For
B. Tech. Programme

In
MECHANICAL ENGINEERING

Department of Mechanical Engineering
Motilal Nehru National Institute of Technology Allahabad

Curriculum for
Bachelor of Technology in
Mechanical Engineering

3rd Semester (Mechanical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1301	Engineering Thermodynamics	3	1		4
AM-1302	Kinematics of Machines	3	1		4
AM-1303	Material Science and Engineering	3			3
AM-1304	Strength of Materials	3	1		4
EE-1305	Basic Electrical and Electronics	3			3
MA-1301	Numerical Methods and Statistical Techniques	3	1		4
ME-1351	Computational Lab			3	2
AM-1352	Material Science Lab			3	2
AM-1353	Strength of Materials Lab			3	2
EE-1354	Basic Electrical and Electronics Lab			3	2
	Total	18	4	12	30

4th Semester (Mechanical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1401	Automatic Control	3	1		4
ME-1402	Industrial Engineering	3			3
ME-1403	Measurement and Metrology	3			3
AM-1401	Fluid Mechanics	3	1		4
ME-1405	Heat and Mass Transfer	3	1		4
AM-1402	Dynamics of Machines	3	1		4
ME-1451/ ME-1452	Measurement and Metrology/ Automatic Control Lab			3	2
ME-1453	Thermal Engineering Lab – I			3	2
AM-1451	Fluid Mechanics and Hydraulics Lab			3	2
	Total	18	4	9	28

5th Semester (Mechanical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1501	Computer Aided Design	3	1		4
ME-1502	Machine Design-I	3	1		4
ME-1503	Manufacturing Science and Technology-I	3	1		4
ME-1504	Steam Power Engineering	3	1		4
HS-1501	Principles of Management	3			3
ME-1551	Computer Aided Design Lab			3	2
ME-1552	Machine Design Lab –I			3	2
ME-1553	Manufacturing Technology Lab-I			3	2
ME-1554	Thermal Engineering Lab – II			3	2
	Total	15	4	12	27

6th Semester (Mechanical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1601	Computer Aided Manufacturing	3	1		4
ME-1602	Machine Design-II	3	1		4
ME-1603	Manufacturing Science and Technology-II	3	1		4
ME-1604	Automobile Engineering	3	-		3
ME-1605	Internal Combustion Engine	3	1		4
HS-1601	Communication Skill (Workshop)			3	0
ME-1651	Computer Aided Manufacturing Lab			3	2
ME-1652	Machine Design Lab –II			3	2
ME-1653	Manufacturing Technology Lab – II			3	2
ME-1654	Thermal Engineering Lab – III			3	2
	Total	15	4	15	27

7th Semester (Mechanical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1701	Refrigeration and Air Conditioning	3	1		4
HS-1701	Economics	3			3
ME-1731 to 1740	Professional Elective I	3	1		4
ME-1741 to 1750	Professional Elective II	3	1		4
OE-1781 to 1790	Open Elective I	3			3
ME-1791	Major Project (Stage 1)			12	6
ME-1751	Thermal Engineering Lab – IV			3	2
	Total	15	3	15	26

8th Semester (Mechanical Engineering)

Course Code	Course name	L	T	P	Credit
ME-1801	Product Design and Development	3	1		4
ME-1831 to 1840	Professional Elective III	3	1		4
ME-1841 to 1850	Professional Elective IV	3	1		4
OE-1881 to 1890	Open Elective II	3			3
ME-1891	Major Project (Stage 2)			12	6
	Total	12	3	12	21

1st digit; 1: UG, 2nd digit; 2, 3, etc.: Semester

Code	Description
01-30	Theory Courses
31-40	Professional Elective –I
41-50	Professional Elective –II
51-70	Practical Courses
81-90	Open Elective
91-99	Project

ENGINEERING THERMODYNAMICS (ME-1301)

UNIT 1: Introduction to thermodynamics System, surroundings, boundaries, classification of systems. Unit and dimensions, conversion factors.Properties of systems, equilibrium, processes, heat and work interaction.The work interaction.Thermodynamic definition of work, characteristics of the work interaction.Evaluation of work.Adiabatic systems and processes. 9(L)

UNIT 2: Diathermic boundary, Zeroth law. Isothermal states.Empirical temperature.Principles of thermometry.Scales of temperature.Gas thermometer.The ideal gas.Ideal gas temperature scale. 4(L)

UNIT 3: The first law. Basic form.Energy of a system.The heat interaction. Sign convention. First law for open systems.Steady-flow energy equation and its applications. 4(L)

UNIT 4: Equations of state. Properties of gases.Properties of steam.Introduction to steam tables.Other equations of state.Van-der-waals gas.Critical state.Reduced equation of state. 4(L)

UNIT 5: The second law. Kelvin-Planck and Clausius statements.Equivalence of statements.Carnot theorem.Thermodynamic temperature.Kelvin scale.Carnot engine, refrigerator and heat pump. 6(L)

UNIT 6: Clausius inequality. Definition of entropy.Combined first and second law, Evaluation of entropy. Principle of increase of entropy. 4(L)

UNIT 7: Irreversibility and exergy. Lost work. 3(L)

UNIT 8: Introduction to cycles. Classifications of cycles.Gas power cycles- Otto, Diesel, Brayton. Vapour power cycle- Rankine cycle, vapour- compression refrigeration cycle. 5(L)

Text/Reference Books:

- Engineering thermodynamics by P K Nag, Tata McGraw Hill
- Thermodynamics : An engineering approach by Cengel& Boles, McGraw Hill

KINEMATICS OF MACHINES (AM-1302)

UNIT 1: Introduction-Kinematics and Dynamics, Kinematic Links, Kinematic Pairs, Types of constrained Motion, Classification of Kinematic Pair, Kinematic Chain, Types of Joints in A Chain, Mechanism, Number of Degree of Freedom for Planar Mechanism, Grubler's Criteria for Plane Mechanisms, Inversion of Mechanism, Types of Kinematic Chains. 8(L)

UNIT 2: Velocity and Acceleration in Mechanism-Velocity of A Link of A Machine, Relative Velocity Method, Instantaneous Center Method, Kennedy's Theorem for Three Centers, Acceleration Diagram, Corriolis Component of Acceleration, Klein's Construction. 8(L)

UNIT 3: Friction (Belt, Rope and clutches)-Types of Friction, Laws of Friction, Pivot and Coller Friction, Uniform Wear and Uniform Pressure, Frictional Clutches, Single Disc or Plate Clutch, Multi Plate Disc Clutch, Introduction to Cone Clutch and Centrifugal Clutches. Selection of A Belt Drive, Types of Belt Drive, Types of Belts, Toothed Belt, Materials used for Belts, Types of Flat Belt Drives, Velocity Ratio of Belt Drive, Slip of Belt, Creep in Belt, Condition for Maximum Power Transmission, V-Belt Dive. Fiber Ropes, Wire Ropes, Rope Drive and Introduction to Chain Drive. 8(L)

UNIT 4: Cams-Classification of Cams and Followers, Nomenclature, Types of Follower Motion, Generation of Cam Profile with Uniform Velocity, SHM, Uniform Acceleration and Retardation, Cycloidal Motion of The Follower, Cam Applications and Manufacturing. 8(L)

UNIT 5: Gear and Gear Trains-Types of Gears: Spur Helical, Bevel, Spiral and Worm, Gears – Terminology, Fundamental Law of Gearing, Gear Profiles, Law of Gearing and Undercutting. Gear Trains: Simple, Compound, Reverted and Epicyclic Gear Trains, Gear Box, Differential. 8(L)

Text/Reference Books:

- The Theory of Machines by Thomas Bevan, CBS Publishers & Distributors.
- Theory of Machines and Mechanisms by John J. Uicker, Jr. Gordon R. Pennock& Joseph E. Shigley, Oxford University Press, New York.
- Theory of Mechanisms and Machines by Dr. JagdishLal, Metropoliton Book Co. Pvt. Ltd.
- Theory of Machines by S.S. Ratan, Tata McGraw-Hill

MATERIAL SCIENCE AND ENGINEERING (AM-1303)

UNIT 1: Introduction-Historical perspective of Materials Science, Structure and properties relationship of Engineering Materials, Classification of materials, Advanced Materials. 3(L)

UNIT 2: Structure of Solids and Characterization of Materials-Introduction to crystal structures and systems, Metallic structures, Ceramic crystal structures, Carbon nano-structures, Crystallographic directions and planes, Miller indices, Density computations, Crystallography, Diffraction methods, Electron microscopy, Metallography, Thermal characterization techniques. 6(L)

UNIT 3: Imperfections in Solids-Point defects, Dislocations, Interfacial Defects, Bulk defects. 4**(**L)

UNIT 4: Diffusion-Diffusion mechanisms, steady and non-steady state diffusion, Factors that influence diffusion, Law's of diffusion, Applications of Diffusion. 4(L)

UNIT 5: Mechanical Behaviour of Materials-Elastic and plastic properties, Creep, Fatigue, Fracture, Heat treatment of steels. 6(L)

UNIT 6: Phase Diagrams and Phase Transformations-Unary, Binary, Equilibrium phase diagrams, Eutectic, Eutectoid, Peritectic and peritectoidreactions**,** Transformation rate effects and TTT diagrams. Microstructure and property changes in iron-carbon system, Iron-Carbon (Fe-C or Fe-Fe_3C) Diagram. 6(L)

UNIT 7: Ceramic Materials-Ceramic types, Properties, Processing Application, Advanced ceramics. 2(L)

UNIT 8: Composites-Introduction, Applications, Particle reinforced composites, Fiber reinforced composites, Structural composites. 2(L)

UNIT 9: Thermal, Electrical, Magnetic, Optical Properties-Heat capacity, Thermal expansion, Thermal conductivity, Thermal stresses, Electrical conduction, Semi conductivity, Super conductivity, Electrical conduction in ionic ceramics and in polymers, Dielectric behaviour, Ferroelectricity, Piezoelectricity, Diamagnetism and paramagnetism, Ferromagnetism, Antiferromagnetism and ferrimagnetism, Influence of temperature on magnetic behaviour, Domains and hysteresis, Optical properties of metals, Optical properties of non-metals, Application of optical phenomena. 5(L)

UNIT 10: Economic, Environmental and Social Issues of Material Usage-Economic considerations, Environmental and societal considerations, Recycling issues, Life cycle analysis and its use in design. 2(L)

Text/Reference Books

- Callister W. D. Jr., Materials Science and Engineering An Introduction.
- Van Vlack, Material Science.
- Raghavan V, Material Science.
- K. M. Gupta, Material Science and Engineering.

STRENGTH OF MATERIALS (AM-1304)

UNIT 1: Analysis of Stress & Strain-Uniaxial stress and strain: Stress, Strain, Hooke's Law, Stress-strain curves, Elastic Constants, Strain Energy, Statically Indeterminate problems, Thermal Effects, Impact Loading; Biaxial stress and strain: Stress at a Point, Variation of Stress, Stress Transformation, Analysis of Strain, Strain-displacement relations, Strain transformation, Strain Measurements, Constitutive equations, Principal stresses and strain. 10(L)

UNIT 2: Bending & Shear Stresses-Introduction, Pure Bending, Normal stresses in beams, Combined Bending and Axial Stress, Composite Beams, Shear Stress, Shear Centre, Strain energy in bending 6(L)

UNIT 3: Torsion-Introduction, Torsion of Circular Shaft, Power Transmitted by a Shaft, Compound Shaft, Tapered Shaft, Strain Energy in Torsion, Combined Bending and Twisting, Torsion of Thin Walled Tubes, Open and Closed Coiled Springs 6(L)

UNIT 4: Thin & Thick Cylinders & Spheres-Introduction, Thin Walled Shells, Thick Shells, Compound Cylindrical Shell 6(L)

UNIT 5: Deflections Of Beams-Introduction, Equation of Elastic Curve, Methods for Determining Deflections - Double Integration, Macaulay's Method, Moment-Area Method, Conjugate-beam method, Castigliano's Theorem 5(L)

UNIT 6: Columns and Theories of Failure-Introduction, Euler's Theory for Long Columns, Rankine-Gordon Formula, Empirical Formulae, Eccentrically Loaded Columns 7(L)

Text/Reference Books:

- Elements of Strength of Materials, S.P. Timoshenko and D.H. Young, East-West Press Pvt. Ltd. Publications.
- Mechanics of Materials, Pytel and Kiusalaas, Cengage Learning Publications.
- Mechanics of Materials, Gere and Timosheinko, CBS Publications.
- Mechanics of Materials, E. P. Popov, Prentics Hall Publications.
- Strength of Materials, G. H. Ryder, Macmillan India Limited.
- Strength of Materials- Pytel and Singer, Harpercollins College division publications.
- Strength of Materials, Crandal, Dahal and Lardener, Tata Mcgraw Hill Publications.
- Mechanics of Materials- Riley, Struges and Morris, John Wiley & Sons.

BASIC ELECTRICAL AND ELECTRONICS (EE-1305)

Electrical Engineering

UNIT 1: Introduction to Electrical Energy-Generation**:** Types of power Plant, Functional Block diagram of generating stations (Hydel & Thermal Stations); Transmission, Distribution and Utilization, Domestic Wiring: Materials, accessories & ratings of the wiring materials, types of wiring, earthing and electricity rules. 3(L)

UNIT 2: Electric Circuits-Basic Circuit Elements, Ohm's law, KCL & KVL, Node & Loop Analysis, Superposition, Thevenin's Theorem & Norton's Theorem, Maximum Power Transfer Theorem. 4(L)

UNIT 3: Steady-state analysis of AC circuits-Sinusoidal and phasor representation of Voltage & current, single phase ac circuit behaviour of R, L and C. Combination of R, L and C in series and parallel, Resonance. three-phase circuits. 4(L)

UNIT 4: Transformer& Rotating Machines-Principle of operation and construction of single-phase transformer, efficiency and voltage regulation. Principle of electromagnetic energy conversion, Starting and speed control of DC and AC motors. 4(L)

Electronics Engineering

UNIT 1: Semiconductor Devices-Junction Diode**,** Bipolar -junction Transistor, JFET and MOSFET, Linear IC and its applications. 5(L)

UNIT 2: Digital circuits-Number systems, conversion of bases, Boolean Algebra, logic gates, Concept of universal gate, Flip-Flops and counter**.** 5(L)

Measurement and Mechatronics Instrumentation

UNIT 1: Measuring Instruments-Types of instruments, working principles of Ammeter, Voltmeter, Wattmeter & Energy meter, Digital instruments, Oscilloscopes. 3(L)

UNIT 2: Transducers and Sensors-For measurement of displacement, velocity, acceleration, force, torque, liquid level flow, temperature etc. 2(L)

UNIT 3: Signal Conditioning Operational Amplifiers and Circuits, Instrumentation amplifiers, Voltage to Current converters and Current boosters, Logarithmic amplifiers filters. 3(L)

UNIT 4: Timing Circuits-VCO, Waveform Generator, 555 timer circuits. 1(L)

UNIT 5: Converters-Analog to Digital and Digital to Analog Conversion, Sample and Hold circuits, Analog, multiplexers, de-multiplexers. 1(L)

UNIT 6: Power Control-SCRs, Triacs and other solid state devices various power converters and power control. 2(L)

UNIT 7: Actuators and Motors-Actuators, Brushed DC servo motors, Brushless PM motors and controllers, The AC induction motor as a servo drive, stepper motor. 2(L)

UNIT 8: Controllers for automation-Introduction to microprocessors, Automation of systems using microcontrollers. 1(L)

Text/Reference Books:

- V. Del Toro: Principle of Electrical Engineering, PHI
- W. H. Hayt & Kemmerley, Engineering Circuit Analysis, Mc Graw Hill.
- Millman & Halkias, Integrated Electronics, TMH
- Boylstad & Nashishky, Electronic Devices & circuits, PHI
- Mavino & Leach, Digital Principles and applications.

- W. D. Cooper Electronic Instrumentation & Measurement Techniques, PHI
- D. V. S. Murthy, Transducer and Instrumentation,
- Richard M. Crowder, Electric Drives and their Controls
- Douglas V. Hall, Microprocessors and interfacing programming and Hardware
- Scot Mackenzie ,The 8051 Microcontrollers

NUMERICALMETHODS AND STATISTICAL TECHNIQUES (MA-1301)

UNIT 1: Introduction-Errors in Numerical Computation, Mathematical Preliminaries, Errors and their analysis. 3(L)

UNIT 2: Algebraic and Transcendental Equation-Bisection method, Method of false position, Iteration Method, Newton-Raphson method, Secant method, Rate of convergence, Methods for Complex Roots: Muller's method, Lin-Bairstow's method, Quotient difference method, Gauss-Seidel iterative method for solving system of equations. 8(L)

UNIT 3: Interpolation-Introduction, Errors in Polynomial Interpolation, Interpolation by Evenly spaced points:Finite Differences, Detection of Errors, Newton's Formulae for Interpolation, Gauss, Stirling, Bessel's and Everett's Formulae, Interpolation by Unevenly spaced points: Lagrange Interpolation Formula, Divided Difference, Newton's General Interpolation Formula. 7(L)

UNIT 4: Curve Fitting, Cubic Splines and Approximation-Introduction, Least–squares curve fitting procedures, Weighted Least–squares curve fitting, Curve fitting by sum of exponentials, Data fitting with cubic splines, Approximations of Functions. 5(L)

UNIT 5: Numerical Differentiation and Integration-Introduction, Numerical differentiation, Numerical integration, Trapezoidal Rule. Simpson 1/3 rule, Simpson 3/8 rule, Boole's and Weddle's Rule, Euler–Maclaurin Formula, Gaussian Formula, Numerical Evaluation of Singular Integrals. 4(L)

UNIT 6: Statistical Techniques-Discrete and continues distribution function; Poisson and Normal Distribution. Moment Generating function, linear statistical models', theory of least squares and analysis of variance, least squares estimates and their precision. Test of significance and interval estimates based on least squares theory in one-way. Two-way and three-way classified data. Regression analysis, linear regression, curvilinear regression and orthogonal polynomials, Discriminate analysis. 12(L)

Text/Reference Books:

- Gerald and Wheatley, Applied numerical analysis, Addison Wesley.
- Flowers, Numerical Methods in C++, Oxford University Press.
- E. Balaguruswamy, Numerical Methods. TMH.
- S. S. Sastry, Introductory Methods of Numerical Analysis, Prentice Hall of India
- Jain, Iyengar, Jain, Numerical Methods for Scientific & Engineering Computation, New Age International

COMPUTATIONAL (LAB) (ME-1351)

Experiment 1: Make a program to evaluate a given polynomial $f(x)$ for a given value of x using Horner's Rule.

Experiment 2: Make a program to find the derivative of a given polynomial $f(x)$ for a given value of x.

Experiment 3: Make a program to find the roots of a given polynomial $f(x)$ using following methods:

a) Bisection method.
b) Method of False Position.
c) Iteration method.
d) Newton-Raphson method.
e) Secant method.
f) Muller's method.
g) Lin-Bairstow's method.
h) Quotient-Difference method.

Experiment 4: Make a program to solve the given set of equations using Gauss-Seidel Iterative method.

Experiment 5: Make a program to determine the following difference tables for given data points:

a) Forward Difference table.
b) Backward Difference table.
c) Central Difference table.
d) Divided Difference table.

Experiment 6: Make a program to find the interpolation polynomial / interpolation value of $f(x)$ at a specified value for evenly spaced data points using the following methods:

a) Newton's Forward and Backward Difference methods.
b) Gauss, Stirling, Bessel's and Everett's methods.

Experiment 7: Make a program to find the interpolation polynomial / interpolation value of $f(x)$ at a specified value for unevenly spaced data points using the following methods:

a) Lagrange Interpolation method
b) Newton's General Interpolation method.

Experiment 8: Make a program to fit a given polynomial to the given set of data points and to evaluate it at a specified value of x.

Experiment 9: Make a program to find the n^{th} (n = 1, 2 and 3) derivative of $f(x)$ at a specified value of x for the given set of data points.

Experiment 10: Make a program to find the numerical integration of $f(x)$ at a specified value of x for the given set of data points using the following rules:

a) Trapezoidal rule.
b) Simpson 1/3 & Simpson 3/8 rules.
c) Boole's and Weddle's rules.
d) Gaussian formula

MATERIAL SCIENCE (LAB) (AM-1352)

Experiment 1: Study of various dislocation models, drawing burgers circuit and finding Burgers vector.

Experiment 2: Study of various unit cells and crystals for,

a) Their geometry and symmetry,

b) Total number of atoms and their arrangement,
c) Effective number of atoms per unit cell,
d) Co-ordination number,
e) Atomic packing efficiency,
f) Determining density,
g) Concept of Miller indices and Inter-planer spacing.

Experiment 3: To study the effect of a surface treatment (Etching) on the strength of glass.

Experiment 4: Heat treatment processes (Annealing, Normalizing, Quenching) and comparison of hardness before & after heat treatment.

Experiment 5: To predict creep characteristic of materials by plotting strain vs. time curves for different loadings.

Experiment 6: Comparative study of microstructures of different given specimens (mild steel, grey C.I., brass, and copper).

Experiment 7: Specimen preparation for micro structural examination by cutting, grinding, polishing and etching of aluminium specimen.

Experiment 8: Fabrication of composite by hand-lay up technique.

Experiment 9: Mechanical testing ofcomposite made by hand-lay up technique in experiment no. 8.

Experiment 10: To study the fatigue behaviour of a given sample.

STRENGTH OF MATERIALS (LAB) (AM-1353)

Experiment 1: Tension Test

Experiment 2: Compression Test

Experiment 3: Torsion Test

Experiment 4: Beam Bending

Experiment 5: Impact Tests

Experiment 6: Closed and Open coiled springs

Experiment 7: Shear Test

Experiment 8: Buckling of Struts

Experiment 9: Hardness Test (Brinell and Rockwell)

Experiment 10: Tensometer (Tension Test)

BASIC ELECTRICAL AND ELECTRONICS (LAB) (EE-1354)

Experiment 1: Verification of Network Theorems.

Experiment 2: Study of the phenomenon of resonance in RLC series circuit.

Experiment 3: Measurement of Power in three phase circuits by two-wattmeter method.

Experiment 4: Determination of parameters and losses in a single phase transformer by OC and SC tests.

Experiment 5: DC generator characteristics.

Experiment 6: Speed control of DC shunt motor.

Experiment 7: Study of running & reversing of three-phase induction motor.

Experiment 8: Study of single-phase energy meter.

Experiment 9: Study of Diode Characteristics.

Experiment 10: Determination of common base 7 common emitter characteristics of a transistor.

Experiment 11: Study of various logic gates.

Experiment 12: To study a half wave and full wave rectifier circuits with and without capacitor filter and determination of ripple factor.

AUTOMATIC CONTROL (ME-1401)

UNIT 1: Introduction-Introduction to control, open-loop control, feedback control. System modeling: Modeling of electromechanical systems, Modeling of dynamic systems, State-space modeling,Modeling and simulation of dynamic systems in Matlab/Simulink.

Laplace transform: Properties of Laplace transform, Laplace transforms of electromechanical systems, Laplace transform of state equations, Transfer functions, Poles, zeros. Representation of multiple subsystems: Block diagrams, Signal flow graphs. 8(L)
UNIT 2: Sensors and Transducers-Characteristics, contact and non-contact type, pressure switches, proximity and position sensors. Actuators: solenoids, hydraulic and pneumatic actuators, valves and circuits. 4(L)
UNIT 3: Time response patterns-Response of first and second order systems, System response versus pole and zero location, approximation of high order system by low order system. Stability analysis: Stability analysis using the Routh-Hurwitz test. Feedback systems: Steady state and tracking analysis, The PID compensator, Tuning rules of PID compensator. 8(L)
UNIT 4: Root locus analysis-Sketching a root locus, Selection of gain from the root locus, Controller design using the root locus: Lead compensation, Lag compensation. 6(L)
UNIT 5: Frequency response of linear systems-Frequency response analysis, Bode plot techniques, Stability Analysis: The Nyquist theorem, Stability Margins, Closed loop frequency response, Frequency domain compensation techniques: Lead and lag compensators. 6(L)
UNIT 6: Linear discrete time systems-Z-transform, mathematical modeling, stability analysis, steady-state error, dynamic performance of discrete time systems 8(L)
Text/Reference Books:

- Ogata, K., Modern Control Engineering, Pearson Education.
- Gopal, M., Control Systems: Principles and Design, Tata McGraw-Hill.
- Raven, F. H., Automatic Control Engineering, McGraw-Hill.
- Nagrath, I. J. and Gopal, M., Control Systems Engineering, New Age International.
- Kuo, B. C. and Golnaraghi, F., Automatic Control Systems, Wiley.
- Franklin, G. F., Powell, J. D., and Emami-Naeini, A., Feedback Control of Dynamic Systems, Prentice-Hall.

INDUSTRIAL ENGINEERING (ME-1402)
UNIT 1: Introduction, Engineering Economy and Costing-Cost Analysis, Break-even Analysis, Methods of Depreciation, Productivity Concepts and Measurements. 8(L)
UNIT 2: Job evaluation, Benefits of Job evaluation, Methods of Job evaluation, Merit Rating, Methods of Merit Rating, Requirements for success of Merit Rating System, Objectives of a Good Wage-Incentive Plan, Basis of a Good Wage-Incentive Plan, Types of Wage-Incentive Plans. 10(L)
UNIT 3: Work Measurement, Time Study, PMTS, Work Sampling, Method Study, Micro Motion Study, Principles of Motion Economy. 10(L)
UNIT 4: Material Handling System-principles, types, and devices. 7(L)
UNIT 5: Maintenance Management-Probabilistic Failure and Repair Times, Preventive Maintenance and Replacement, Total Preventive Maintenance, Concurrent Engineering- steps and CE Environment. 10(L)
Text/Reference Books:

- Turner, W.C., et. Al, 1993, "Introduction to Industrial and System Engineering", Prentice Hall.
- Del Mar, Donald ,"Operations and industrial management: designing and managing for productivity", McGraw-Hill,2007
- Ralph M. Barnes, "Motion and Time Study: Design and Measurement of Work", Wiley Publishers
- Chandler Allen Phillips, "Human Factors Engineering", John Wiley and Sons, New York,
- S.K. HajraChoudhary, Nirjhar Roy, and A. K. HajraChoudhary, "Production Management: An integrated approach to Industrial Engineering", Media Promoters and Publishers.

MEASUREMENT AND METROLOGY (ME-1403)
UNIT 1: Introduction to measurement and measuring instrument, generalized measuring system and functional elements, static and dynamic performance, characteristics of measurement devices, concept of error, sources of error, statistical analysis of errors. 6(L)
UNIT 2: Sensors and transducers- types and their characteristics, measurement of pressure, direct acting and elastic pressure transducers, measurement of very low pressures. Strain measurement- types of strain gauges and their working, strain gauge circuits, temperature strain rosettes. 5(L)
UNIT 3: Measurement of force and torque, temperature measurement by thermometers, bimetallic thermocouples, thermistors and pyrometers. Measurement of flow, vibration and noise measurement, seismic instruments.Data acquisition system. 5(L)
UNIT 4: Standards of liner measurement, line and end standards, system of limits and fits, linear and angular measurement devices and systems, limit gauges and their design. 6(L)
UNIT 5: Measurements of geometric forms like straightness, flatness, roughness and circularity, optical projectors, tool , makers microscope, autocollimators, principle and use of interferometry, optical flat interferometers, laser interferometers. Comparators-types, working principles and magnification range, measurement of screw threads and gears. 6(L)
UNIT6: Surface texture-quantitative evaluation of surface roughness and its measurement, introduction to CMM, in-process gauging systems, inspection- in-process and final inspection, sampling and 100% inspection, sampling plans. 6(L)
Text/Reference Books:

- Beckwith Thomas G., Mechanical Measurement, Narosa Publishing House.
- Doeblein, E.O., Measurement Systems: Application and Design, McGraw Hill.
- Hume, K.J., Engineering Metrology, MacDonald and Co.
- Gupta, I.C., Engineering Metrology, DhanpatRai& Sons.
- Bewoor, A.K. and Kulkarni, V. A., Metrology & Measurement, Tata McGraw-Hill Education Pvt. Ltd.
- Sawhney, A.K. and Mahajan, M., A text book of measurement and metrology, DhanpatRai& Co.

FLUID MECHANICS (AM-1401)
UNIT 1: Introduction to Fluid Mechanics-Statics and Kinematics Fluid and continuum, Physical properties of fluids, Types of fluid flows, Rheology of fluids.Manometers, pressure transducers, pressure on plane and curved surfaces, centre of pressure, fluid masses

subjected to linear acceleration and uniform rotation about an axis.Kinematics of Fluid flow: steadiness, uniformity, rotational and irrotational flows, streamline, streakline, pathline, continuity equation, stream function and velocity potential, applications of potential flow. 8(L)

UNIT 2: Dynamics Of Fluid Flow and Dimensional Analysis Euler's Equation of motion along a streamline and its integration, Bernoulli's equation and its applications, momentum equation and its application to pipe bends.Dimensional Analysis, Buckingham's Pi theorem, important dimensionless numbers and their physical significance, geometric, kinematic and dynamic similarity, model studies, Hydraulic similitude. 8(L)

UNIT 3: Laminar and Turbulent Flows-Equation of motion for laminar flow through pipes, Stokes law, transition from laminar to turbulent flow, types of turbulent flow, isotropic and homogenous turbulence, scale and intensity of turbulence, eddy viscosity, Prandtl's mixing length theory, velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, minor losses, pipe in series and parallel, power transmission through a pipe, three reservoir problems and pipe network. 10(L)

UNIT4: Hydrodynamic Boundary Layer- Introduction with a historical background, boundary layer, displacement and momentum thickness, boundary layer over a flat plate, Prandtl boundary layer equation, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub-layer, separation and its control, drag and lift, drag on a sphere, 2D cylinder and airfoil, Magnus effect. 8(L)

UNIT5: Measurement Techniques-Flow measurement by Pitot tube, orifice, Venturi, nozzle, and bend meter, rotameter, notches and weirs, hot-wire anemometer, LDV and PIV, Turbine flowmeter, Vortex shedding flowmeter, magnetic flowmeter, Doppler Ultrasonic flowmeter, Coriolisflowmeter etc. 4(L)

UNIT6: Introduction to Hydraulic Machines-Introduction to Hydroelectric power station and its components, Classification of turbines and pumps, similarity laws and specific speed, efficiency, cavitation. 4(L)

Text/Reference Books:

- Fox, R.W., McDonald, A.T., Introduction to Fluid Mechanics, 7th edition, Wiley India.
- Ojha, C.S.P., Berndtsson, R., Chandramouli, P.N., Fluid Mechanics and Machinery, Oxford University Press, New Delhi.
- Majumdar, B., Fluid Mechanics with Laboratory Manual, PHI Learning, New Delhi.
- Som, S.K. and Biswas G, Introduction of Fluid Mechanics & Fluid Machines, TMH, New Delhi.
- Mohanty, A.K., Fluid Mechanics, PHI Learning, New Delhi.
- Shames, I.H., Mechanics of Fluids, McGraw Hill, International Students Edition.
- Agarwal, S.K., Fluid Mechanics and Machinery, TMH, New Delhi.
- Rathakrishnan E., Instrumentation, Measurements and Experiments in Fluids, CRC Press, New York.
- Garde, R.J., Fluid Mechanics through Problems, New Age International Pvt. Ltd, New Delhi.
- Lal, J., Hydraulic Machines, Metropolitan Book Co. Pvt. Ltd., Delhi.

HEAT AND MASS TRANSFER (ME-1405)

UNIT 1: Introduction to Heat Transfer-Concepts of the mechanisms of heat flows; Conduction, convection and radiation; Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism. 2(L)

Conduction-One-dimensional general differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems; Initial and boundary conditions. 3(L)

Steady State one-dimensional Heat conduction-Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation; Thermal resistance concept; Analogy between heat and electricity flow; Thermal contact resistance; Critical thickness of insulation. 3(L)

Two dimensional steady state heat conduction-solution by Numerical Relaxation method. 2(L)

UNIT 2: Fins-Heat transfer from extended surfaces, Fins of uniform cross-sectional area; Errors of measurement of temperature in thermometer wells. 3(L)

Transient Conduction-Transient heat conduction; Lumped heat capacity method; Time constant; Unsteady state heat conduction in one dimension only, Heisler charts. 4(L)

UNIT 3: Convective heat transfer fundamentals-Newton's law of cooling, Types of convective heat transfer, Laminar and Turbulent flows, Hydrodynamic boundary layer, Thermal boundary layer, Non-dimensional numbers, Buckingham Pi Theorem. 3(L)

Forced Convection-Flow over a flat plate; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow across a single cylinder and a sphere; Flow inside ducts; Empirical heat transfer relations; Relation between fluid friction and heat transfer; Liquid metal heat transfer. 5(L)

Natural Convection-Physical mechanism of natural convection; Buoyant force; Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere; Combined free and forced convection. 3(L)

UNIT4: Thermal Radiation-Basic radiation concepts; Radiation properties of surfaces; Black body radiation Planck's law, Wein's displacement law, Stefan Boltzmann law, Kirchoff's law; ; Gray body; Shape factor; Black-body radiation; Radiation exchange between diffuse non black bodies in an enclosure; Radiation shields; Radiation combined with conduction and convection. 6(L)

UNIT 5: Heat Exchanger-Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers. 3(L)

Condensation and Boiling-Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical surfaces and on outside & inside of a horizontal tube; Effect of non-condensable gases; Dropwise condensation; Heat pipes; Boiling modes, pool boiling; Hysteresis in boiling curve; Forced convective boiling. 3(L)

Introduction to Mass Transfer-Introduction; Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film. 2(L)

Text/Reference Books:

- Heat and Mass Transfer (In SI units) A practical approach By Yunus A. Cengel, TMH Education pvt. Ltd.
- Heat Transfer By J.P. Holman, McGraw-Hill International edition.
- Fundamentals of engineering Heat & Mass transfer, BySachdeva,R.C., New Age International (P) Ltd. Publishers
- Principles of Heat Transfer by Frank Kreith, McGraw-Hill Book co.
- Fundamentals of Momentum, Heat and Mass Transfer By James R.Welty; John Wiley &Sons (Pvt). Ltd.
- Fundamentals of Heat & Mass transfer, By Incroperaa F.P. Dewitt.D.P., John Wiley & Sons (Pvt). Ltd.
- Heat Transfer, By Y.V.C. Rao, University Press.
- Heat Transfer, By R. Yadav, Central Publishing House, Allahabad.

DYNAMICS OF MACHINES (AM-1402)

UNIT 1: Static and Dynamic Force Analysis-Static Force Analysis of Planer Mechanisms, Dynamic Force Analysis Including Inertia And Frictional Forces of Planer Mechanisms. 8(L)

Turning Moment & Flywheel-Turning Moment Diagram for Engines and Speed Fluctuation, Flywheel. 4(L)

UNIT 2: Balancing of Rotating Masses-Static Balance, Dynamic Balance, Balancing of Rotating Masses, Two Plane Balancing, Graphical and Analytical Methods, Balancing of Rotors, Balancing Machines. 5(L)

Balancing of Reciprocating Masses-Balancing of Single Cylinder Engine, Balancing of Multi Cylinder; Inline, Radial and V Type Engines, Firing Order. 3(L)

UNIT 3: Governor-Introduction, Types of Governors, Characteristics of Centrifugal Governors, Gravity Controlled and Spring Controlled Governors, Hunting of Centrifugal Governors, Inertia Governors. 6(L)

UNIT 4: Gyroscopic Motion-Gyroscopes, Gyroscopic Forces and Couples, Gyroscopic Stabilization, Ship, Plane Stabilization, Stability of Four Wheel and Two Wheel Vehicles Moving on Curved Paths. 6(L)

UNIT 5: Mechanical Vibration-Vibration of Mechanical Systems, Types of Vibration; Lumped Parameter Models, Linearization of System Elements, Degrees of Freedom, Types of Restoration and Dissipation Mechanisms, Types of Excitation.Free Undamped Vibration of Single Degree of Freedom Systems, Determination of Natural Frequency, Equivalent Inertia and Stiffness, Energy Method.Free Vibration with Viscous Damping, Critical Damping and A Periodic Motion, Logarithmic Decrement, Systems with Coulomb Damping.Forced Vibration with Harmonic Excitation, Undamped Systems and Resonance, Viscously Damped Systems, Systems with Base Excitation, Transmissibility and Vibration Isolation, Whirling of Shafts and Critical Speed. 8(L)

Text/Reference Books:

- The Theory of Machines by Thomas Bevan, CBS Publishers & Distributors.
- Theory of Machines and Mechanisms by John J. Uicker, Jr. Gordon R. Pennock& Joseph E. Shigley, Oxford University Press, New York.
- Theory of Mechanisms and Machines by Dr.JagdishLal, Metropoliton Book Co. Pvt. Ltd.
- Theory of Machines by S.S. Ratan, Tata McGraw-Hill

MEASUREMENT AND METROLOGY (LAB) (ME-1451)

Measurement (Lab)

Experiment 1: Study of displacement and current characteristics in Linear variable differential transformer (LVDT)

Experiment 2: Find the relationship between displacement and change in signal generated due to Capacitive type transducer (Proximity tutor)

Experiment 3: To draw the calibration graph for the Bimetallic transducer using a thermometer as standard and determine the time constant for the transducer

Experiment 4: Find the relationship between displacement and change in signal generated due to Strain gauge

Experiment 5: To calibrate the given force measuring elastic transducer for compression and tensile loads

Experiment 6: To plot the calibration graph between the temperature and RTD readings

Experiment 7: To study the variation of light intensity with distance from source with a luxmeter

Experiment 8: Calibration of Bourdon pressure gauge for (i) above atmospheric pressure conditions, and (ii) below atmospheric pressure conditions.

Metrology (Lab)

Experiment 1: To measure the screw parameters i.e. external diameter, pitch, flank angle by using Tool makers microscope

Experiment 2: To make the study and use of micrometer and depth gauge

Experiment 3: To measure the angle of a given taper specimen with the help of a clinometers first and then calculate the accurate value using a Sine bar.

Experiment 4: To determine the outside and core diameter of a given specimen with the help of Floating carriage micrometer.

Experiment 5: To determine the diameter of a specimen and the error in given specimen with the help of passameter and slip gauges.

AUTOMATIC CONTROL (LAB) (ME-1452)

Experiment 1: Dynamic response of systems using transfer-function approach in MATLAB®

Experiment 2: Dynamic response of systems using transfer-function approach in Simulink®

Experiment 3: Dynamic response of systems using State-Space approach in MATLAB®

Experiment 4: Dynamic response of systems using State-Space approach in Simulink®

Experiment 5: Closed-loop control of systems with PID controller using transfer-function and State-Space approaches in MATLAB®

Experiment 6: Closed-loop control of systems with PID controller using transfer-function and State-Space approaches approach in Simulink®

Experiment 7: Closed-loop control of systems using Root-Locus design in MATLAB®

Experiment 8: Frequency response of systems in MATLAB®

Experiment 9: Dynamic response of systems with digital control in MATLAB®

Experiment 10: Dynamic response of systems with digital control in Simulink®

THERMAL ENGINEERING (LAB-I) (ME-1453)

Experiment 1: Study of the heat transfer in pin fin apparatus

Experiment 2: Study of the heat transfer in natural convection apparatus

Experiment 3: Study of the heat transfer in the forced convection apparatus

Experiment 4: Study of the Stefen Boltzman apparatus and estimation of Stefen Boltzman's constant

Experiment 5: Study of the heat transfer in drop-wise and film wise condensation.

Experiment 6: To estimate the thermal conductivity of metal bar

Experiment 7: Study of the heat transfer through composite wall

Experiment 8: Study of heat transfer behaviour in Heat pipe apparatus

Experiment 9: Study of the emmisivity measurement apparatus

Experiment 10: To estimate the thermal conductivity of insulating powder

Experiment 11: To study the Heat transfer in lagged pipe apparatus

Experiment 12: To estimate effectiveness in Shell-and-Tube Heat Exchanger

Experiment 13: To estimate effectiveness in double pipe heat exchangers

FLUID MECHANICS & HYDRAULIC MACHINES (LAB) (AM-1451)

Pre-requisite: Fluid Mechanics/ Fluid Flow Operations

Experiment 1: To verify the momentum equation using the experimental set-up on diffusion of submerged air jet.

Experiment 2: To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.

Experiment 3: To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.

Experiment 4: To study the variation of friction factor 'f' for turbulent flow in commercial pipes.

Experiment 5: To calibrate an orifice meter, venturimeter, and bend meter and study the variation of the co-efficient of discharge with the Reynolds number.

Experiment 6: To study the impact of jets in a flat plate.

Experiment 7: To study performance of a Pelton wheel/ Francis turbine/ Kaplan Turbine.

Experiment 8: To study performance of two Centrifugal pumps connected in series and parallel.

Experiment 9: To study performance of a Reciprocating pump.

Text/Reference Books:

- Singh, S. Experiments in Fluid Mechanics, PHI Learning, New Delhi.
- Prakash, M. N. S., Experiments in Hydraulics and Hydraulic Machines: Theory and Procedures, PHI Learning, New Delhi.
- Majumdar, B., Fluid Mechanics with Laboratory Manual, PHI Learning, New Delhi.

COMPUTER AIDED DESIGN (ME-1501)

UNIT 1: Definitions, Historical Development. Nameable and Unnameable shapes, Explicit and Implicit Equations, Intrinsic Equations, Parametric Equations, Coordinate Systems.Design of Curves: Algebraic and Geometric Forms, Parametric space of a curve, Blending functions, Reparametrization, Truncating, Extending and subdividing, Space curve, Four point form, Straight lines, Spline Curves, Bezier Curves, B-spline Curves, Rational Polynomials, introduction to NURBS. 12(L)

UNIT 2: Geometric Transformation and Projection: Transformations: Translation, Rotation, Scaling Symmetry and Reflection, Homogeneous Transformations. Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformation. 6(L)

UNIT 3: Design of Surfaces: Algebraic and Geometric form, Tangent and Twist Vectors, Normal, Parametric space of a surface, Blending Functions, Reparametrization of a surface patch, subdividing, Sixteen Point form, Four Curve Form, Plane surface, Cylindrical Surface, Ruled surface, Surface of Revolution. Bezier Surface, B-Spline Surface. 8(L)

UNIT 4: Design of Solids and Solid modeling schemes. Solid Modelling Fundamentals: Topology of Closed Paths, Piecewise flat surfaces, topology of closed curved surfaces, Generalized Concept of boundary, Set theory, Boolean operators, Set-membership Classification, Euler operators, Formal Modelling Criteria. Solid Model Construction: Graph Based methods, Boolean models, Instances and Parameterized Shapes, Cell Decomposition and spatial-Occupancy Enumeration, Sweep Representation, Constructive Solid Geometry, Boundary Representation.Assemble Modelling. 12(L)

UNIT 5: Data transfer formats: Neutral data format, IGES, STEP and XML. Applications of Solid Models: Rapid Prototyping, FEM, Medical Applications. 4(L)

Text/Reference Books:

- Geometric Modelling: Michael E. Mortenson, John Wiley, 2006
- Mathematical Elements of Computer Graphics: Roger and Adams, McGraw Hill, 1994.
- CAD CAM Theory and Practice: I. Zeid, McGraw Hill, 1994.

MACHINE DESIGN-I (ME-1502)

UNIT 1: General Introduction and Selection of Materials-Definition, Methods, Standards in Design and Selection of Preferred Size, BIS system of Designation of Steels, Steels and Alloys, Plastics and Rubbers. 5(L)

UNIT 2: Design against Static and Fluctuating Load-Concept of Three Dimensional State of Stress and Strain, Stress-Strain Relationship, Principle Stresses, Stress Concentration, Stress Concentration Factor and Notch Sensitivity Factor, Factor of Safety, Theories of Failure, Fluctuating Stress, Fatigue Failure, Endurance Limit, Design for Finite and Infinite Life, Soderberg and Goodman Criteria. 9(L)

UNIT 3: Shafts, keys and coupling-Design of Shafts against Static and Fluctuating Load, Strength and Rigidity Design, Design of Square and Flat Keys and Splines, Rigid and Flexible Couplings. 5(L)

UNIT 4: Power Screws and Joints-Form of Threads, Square Threads, Trapezoidal Threads, Stresses in Screw, Design of Screw Jack, Screwed Joints, Riveted Joints, Welded Joint and Eccentric Loading of above Joints, Design for Fatigue Loading. 9(L)

UNIT 5: Mechanical Springs-Helical Springs, Stress Equations, Deflection Equation, Design against Static and Fatigue Loading, Multi Leaf Springs, Spiral Springs. 7(L)

UNIT 6: Belts, Brakes and Clutches-Flat Belts, V Belts, Static Analysis of Brakes and Clutches, Internal Expanding and External Contracting Rim Brakes and Clutches, Band type Brakes and Clutches, Frictional contact Axial Clutches, Disc Brakes, Cone Clutches and Brakes 7(L)

Text/Reference Books:

- Machine Design An Integrated Approach by R. L. Norton, Pearson Prentice Hall
- Mechanical Engineering Design by J. E. Shigley, McGraw-Hill
- Design of Machine Element by V. B. Bhandari, Tata McGraw-Hill
- Design Data – PSG College of Technology

MANUFACTURING SCIENCE AND TECHNOLOGY-I (ME-1503)

UNIT 1: Metal Casting Science and Technology-Need and Classification; Expendable Green Sand Mould Metal Casting: Preparation, Composition, Properties and Testing of Green Sand; Function, Materials, Allowances and Types of Patterns; Function and Types of Cores; Core prints and Chaplets; Molding Methods; Gating Design; Cooling and Solidification-Mechanism and Rate; Riser Design and Placement; Expendable Precision Sand Mould Metal Castings: Shell Mould Casting, Vacuum Mould Casting and CO_2Mould Casting; Investment Casting (Lost Wax) and Evaporative Casting (Lost Foam); Expendable Plaster Mould (Antioch process) and Ceramic Mould (Shaw process) Casting; Permanent Metal Mould Metal Casting: Gravity Die and Pressure Die Casting, Vacuum Die and Slush Die Casting; Special Metal Casting Processes: Centrifugal, Continuous, Squeeze and Chilled Metal Casting; Casting Defects and Inspection of Casting; 9(L)

UNIT 2: Plastic Moulding Science and Technology- Classification of Moulding Processes, Extrusion and Injection Moulding, Compression and Transfer Moulding, Blow and Rotational Moulding; Glass-working Science and Technology:Raw material preparation; shaping of Piece Ware and Flat and Tubular glass; Powder Metallurgy Science and Technology: Powder preparation; Blending and/or Mixing of Powders, Compacting and Sintering of powders; Hot Isostatic Pressing (HIP), Powder Injection Moulding (PIM), and Electro-Spark Pressing (ESP) 6(L)

UNIT 3: Massive Metal Forming Science and Technology-Need and Classification, Elastic and Plastic deformation-Yield and Flow; Rolling: Classification of Rolling, Process geometry and Analysis of Plate rolling for Rolling load and power calculations; Rolling mills and Roll pass design; Defects in Rolled Products; Forging: Classification of Forging, Process Geometry and Analysis of Strip and Disc forging for Forging Load and Power calculations; Defects in Forged Products; Drawing: Process Geometry and Analysis of Wire and Sheet Drawing for Load and Power calculations, Maximum Reduction Possible. Extrusion: Classification, Process Geometry and Analysis of Rod and Sheet Extrusion for Load and Power calculations, Maximum Reduction Possible; Defects in Extruded Product. 12(L)

UNIT 4: Sheet Metal Forming Science and Technology-Need and classification; Blank preparation by sheet cutting; Press Forming: Bending and Drawing- Process Geometry and Calculation for Force and Power; Impulse Forming: Explosive forming, Electro-hydraulic forming and Electro-magnetic forming; Laser Forming: Laser Bending and Laser Drawing. 6(L)

UNIT 5: Rapid Prototyping Science and Technology-Need and Classification of Rapid Prototyping Processes; Process Principle, Equipments and Applications of Stereo Lithography(SLA), Solid Ground Curing (SGC), Selective Laser Sintering (SLS) and Three Dimensional Printing (TDP), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM).Surface Coating Science and Technology: Need and Classification; Process Principle, Equipments and Applications of Physical Vapour Deposition (PVD), Chemical Vapour Deposition (CVD), Electro-Plating, Electroless-Plating, Powder Coatings, Thermal Coating and Chemical Coating; Choice of coating materials and processes; Testing of surface coatings 6(L)

Text/Reference Books:

- Manufacturing Science by Ghosh and Mallik, East West Press Pvt. Ltd., New Delhi
- Fundamentals of Modern Manufacturing by M. P. Groover, John Wiley and Sons, New Delhi
- Fundamentals of Metal Forming Processes by B. L. Juneja, New Age International Ltd., New Delhi
- Manufacturing Engineering and Technology by Kalpakjian and Schmid, Pearson Education Pvt. Ltd. New Delhi

STEAM POWER ENGINEERING (ME-1504)

UNIT 1: Introduction-Introduction to the subject , review of Carnot and Rankine Cycles, Effects of operating condition on thermal efficiency of Rankine cycle, Methods of increasing thermal efficiency, Efficiencies, Requirement of Ideal working fluid, Binary Vapour Cycle, Reheating and Regenerating Feed Heating Cycles, Feed Heater, Deaerators. 6(L)

UNIT 2: Nozzles and Diffusers-Introduction, Effects of Flow of Wet Steam in Nozzles, Classification, Steady Flow Energy Equation through Nozzles, Momentum Equation, Efficiencies, Critical Flow in Nozzles, Physical Meaning of Critical Pressure, General Relationship Between Area, velocity and pressure, Supersaturated Flow in Nozzles, Effects of variation of Back pressure in Nozzles, Introduction to Diffusers, Types, Pressure Recovery and Losses. 8(L)

UNIT 3: Flow of Steam Through steam turbines-Principles of Working, Classification, Computing of Steam Turbine, Velocity Diagram for Impulse and Reaction Turbines, Power Output, Axial trust, Diagram Efficiency, Optimum Value of Blade to steam Speed Ratio. 6(L)

UNIT 4: Turbine Performance and Constructional details-Losses in Steam Turbine State Point Locus and Reheat factor, Governing of Steam Turbine, Constructional Details, Material of Steam Turbine Components. 4(L)

UNIT 5: Steam Condensers-Introduction, Condensers Classification, Condensers and Vacuum Efficiency, Cooling Ponds and Cooling Towers, Constructional details. 4(L)

UNIT 6: Steam Generators-Modern Trends in Design , Heat Absorption in Water Tube Boilers, Circulation in Downcommer and Riser, Steam Drum and Internal details , Modern boilers, Fluidized Bed Boilers , Fuel Handling and Ash handling System , Control , Mounting and Accessories , Performances. 6(L)

Text/Reference Books:

- Steam and Gas turbines and power Plant Engineering by R.Yadav, Central publishing House, Allahabad
- Steam Turbine : Theory and practices By W.J Kearton,Sir Isaac pitman And Sons Ltd. London
- Steam turbines by Shlyakhin P, Foreign language Publishing House, Moscow
- Steam Turbines by Church E F, McGraw Hill Book Company Inc. New York
- Applied Thermo Sciences by Shyam K Agrawal, Viva Books Pvt. Ltd. New Delhi
- Fundamentals of classical Thermodynamics By Gordon J,VanWhlwn and Richard E, Sountag , John Wiley and sons, New York
- Fundamental of Engineering Thermodynamics By Michael J, Moran and Howard N Shapiro John Wiley E Sons, New York
- Power Plant Engineering By PK Nag, Tata McGra Hill
- British Electricity International , London (CSEG), Modern Power Station practices, Vol (I-VIII), Pergamon Press ,Oxford.
- Combined Heat and Power by J H Horlock , Pergamon Press, Oxford

PRINCIPLES OF MANAGEMENT (HS-1501)

UNIT 1: Introduction to Management-Definition of Management – Science or Art – Management and Administration, Functions of Management – Types of Business Organization. Levels of management and Managerial skills 5(L)

UNIT 2: School of Management Thoughts-Evolution of Management thoughts, classical approach, neo- classical approach, contribution of Taylor, Weber and Fayol, modern approach. 6(L)

UNIT3: Planning-Nature & Purpose – Steps involved in Planning ,Objectives, Setting Objectives, Process of Managing by Objectives ,Strategies, Policies & Planning Premises Forecasting Decision-making. 8(L)

UNIT 4: Organizing-Nature and Purpose – Formal and informal organization – Organization Chart – Structure and Process – Departmentation by difference strategies – Line and Staff authority – Benefits and Limitations – De-Centralization and Delegation of Authority – Staffing – Selection Process-Techniques-HRD-Managerial-Effectiveness. **Directing:** Scope – Human Factors – Creativity and Innovation – Harmonizing Objectives – Leadership – Types of Leadership Motivation – Hierarchy of needs – Motivation theories – Motivational Techniques – Job Enrichment – Communication – Process of Communication – Barriers and Breakdown – Effective Communication – Electronic media in Communication. 11(L)

UNIT 5: Controlling-System and process of Controlling – Requirements for effective control – The Budget as Control Technique – Information Technology in Controlling – Use of computers in handling the information – Productivity – Problems and Management – Control of Overall Performance.Coordination. 5(L)

UNIT 6: Organisational Behaviour-Organisational change, Conflict Management and Stress Management Functional management: Human Resource Management, Financial management, Marketing Management. 5(L)

Text/Reference Books:

- Tripathy PC and Reddy PN, "Principles of Management", Tata McGraw-Hill, 1999.
- Decenzo David, Robbin Stephen A, "Personnel and Human Reasons Management", Prentice Hall of India, 1996
- JAF Stomer, Freeman R. E and Daniel R Gilbert, "Management", Pearson Education, Sixth Edition, 2004.
- Fraidoon Mazda, "Engineering Management", Addison Wesley, 2000.
- Harold Kooritz& Heinz Weihrich "Essentials of Management", Tata McGraw-Hill, 1998
- Joseph L Massie "Essentials of Management", Prentice Hall of India, (Pearson) Fourth Edition, 2003

COMPUTER AIDED DESIGN (LAB) (ME-1551)

Experiment 1: Design of Hermite curves

Experiment 2: Design of Bezier curves

Experiment 3: Design of B-Spline curves

Experiment 4: Geometric transformation on curves.

Experiment 5: Design of Bi-cubic Surfaces

Experiment 6: Design of Bezier surfaces

Experiment 7: Design of B-Spline Surfaces of surfaces.

Experiment 8: Transformations and projection

Experiment 9: Solid Modeling of few objects

Text/Reference Books:

- RudraPratap , Getting started with MATLAB: A quick introduction for scientists and engineers. Oxford Series.

MACHINE DESIGN (LAB –I) (ME-1552)

Experiment 1: Assembly drawing of machine elements using AutoCAD/Solid works

a) Threaded joints.
b) Cotter and Knuckle joint.
c) Couplings.
d) Screw Jack.
e) Tailstock.
f) Plummer block.
g) Rams bottom safety value.
h) Cylinder relief value.
i) Blow-off cock.
j) Tool post.
k) Gear box.

MANUFACTURING TECHNOLOGY (LAB-I) (ME-1553)

Experiment 1: Design and Preparation of a wooden pattern for the given dimensions of a casting of V- block made of Cast Iron/Steel

Experiment 2: Preparation of machine mould as per the dimensions of a given part and study of moulding methods used in Foundry Shop.

Experiment 3: To find green compression and shear strength of a given sample of green sand.

Experiment 4: To find shatter index of a given sample of green sand.

Experiment 5: To find the moisture content in a given sample of green sand.

Experiment 6: Study of Sieve Shaker and to find Grain Fineness Number for a given sample of foundry sand.

Experiment 7: Study of Permeability Tester and to find Permeability Number for a given sample of foundry sand

Experiment 8: Determination of sheet length and bending force required for forming the given 'Z' section.

Experiment 9: Study of Power Press and Power Hammer

Experiment 10: Study of Laser Beam Machine.

THERMAL ENGINEERING (LAB – II) (ME-1554)

Experiment 1: Study and performance of Nestler Boiler (To find the equivalent evaporation, Boiler efficiency and prepare the heat balance).

Experiment 2: Study and performance of Steam Turbine

Experiment 3: Study and performance of surface condenser

Experiment 4: Study and performance of complete steam power plant

Experiment 5: To find the dryness fraction of wet steam using separation throttling calorimeter.

Experiment 6: Study and performance of vertical steam engine

Experiment 7: Study of 600 Rovers Gas Turbine and to draw the air fuel, lubrication and power cycles.

Experiment 8: Study and performance of two stage reciprocating air compressor.

Experiment 9: Study of steam boiler models of Lancashire, locomotive and Babcock & Wilcox.

Experiment 10: Study of simple Impulse turbine and Parson's reaction turbine models

COMPUTER AIDED MANUFACTURING (ME-1601)

UNIT 1: Introduction-N.C. System: Definition, applications, Role of Computers in Manufacturing. Current trends in Manufacturing Engineering - Group Technology - Design for Manufacturing and Assembly - Process Planning Techniques Concurrent Engineering - Rapid prototyping.**Numerical control in CAM:** Definition, Historical background, basic components of NC system, Classification, fundamentals of NC, Procedure, Co-ordinate system, motion control systems, Advantages of NC system; Features of CNC Machine tools, Economics of NC machining centers. 9(L)

UNIT 2: Introduction to automation and need and future on NC systems and CAM. Advantage and disadvantages. Features in NC Machines: Difference between ordinary and NC machine tools. Methods for improving Accuracy and Productivity, drives 6(L)

UNIT 3: Computer Numerical Control-Principle of operation of CNC, Features of CNC, and Development in CNC systems, Adaptive Control, Direct Numerical Control (DNC) Standard Communication Interfaces, Programmable Logic Controllers (PLCs) Communication networks, New development in NC. Constructional Features of CNC Machines: Design considerations of CNC machines for improving machining accuracy-Structural members-Slideways - Sides linear bearings - Ball screws - Spindle drives and feed drives - work holding devices and tool holding devices -Automatic Tool changers. Principles of Operation-Machining Centers - Tooling for CNC machines. 12(L)

UNIT 5: NC Part Programming-(a) Manual (word address format) programming. Examples, Drilling and Milling (b) Higher level programming. **Feed Back Devices:** stepping motors, Feedback devices such as encoder, counting devices, Digital to Analog converter and vice versa**; Interpolators-** Principle, Digital Differential Analyzer. Linear Interpolator, Circular Interpolator and its software interpolator. 6(L)

UNIT 6: Control of NC System-Open and closed loops. Automatic control of closed loops with encoder & tachometers. Speed variation of DC motor. Adaptive control.Computer Integrated Manufacturing System- Manufacturing cell, Transfer lines. FMS, CIM, CAD/CAM concept. 6(L)

Text/Reference Books:

- Automation, Production Systems and Computer Integrated Manufacturing by M.P. Grover, PHI.

- Principal of Computer Integrated Manufacturing by S.Kant Vajpayee.
- Numerical Control and Computer Aided Manufacturing, Kundra, Rao and Tiwari, TMH.
- Computer Control of Manufacturing Systems by YoramKoren, McGraw-Hill Book Company
- CNC – Machining Techniques - Vol. 1, 2 & 3 by G. T. Smith, Verlag

MACHINE DESIGN II (ME-1602)

UNIT 1: Surface Failure-Introduction, Surface geometry, mating surfaces, friction, wear, corrosion wear, surface fatigue, general contact, dynamic contact stresses, surface fatigue failure, designing to avoid surface failure. **Spur Gears:** Kinematicsof gears, Conjugate Action, Standard tooth systems for spur gears, Profile shifted gears, Involutometry, gear cutting methods, Modes of gear failure, Spur gear tooth force analysis, Tooth bending stress – AGMA procedure, Bending fatigue strength – AGMA procedure, Buckingham equation for dynamic load on gears , Buckingham contact stress equation, Contact stress –AGMA procedure , Surface fatigue strength – AGMA procedure , Gear materials. 9(L)

UNIT 2: Helical Gears-Kinematics, geometry and nomenclature, force analysis, Design of helical gears: bending stress, contact stress, Crossed helical gears Worm Gears: Geometry and nomenclature, Force analysis, Friction analysis and efficiency, thermal capacity, bending and surface strength, power rating efficiency, worm gear standards and proportions. 6(L)

UNIT 3: Bevel Gears-Introduction, Geometry and terminology, Force analysis, Bending stress analysis, Contact stress analysis, Permissible bending fatigue stress, Permissible contact fatigue stress Spiral bevel gears, hypoid gears. 6(L)

UNIT 4: Antifriction bearing-Types of ball bearings, roller bearings, needle bearings, friction life of bearings, reliability considerations, selection of ball bearings, roller bearing, tapered roller bearing, thrust bearing, lubrication and sealing, Mounting of bearings. 6(L)

UNIT 5: Lubrication and sliding bearings-Type of lubrication, viscosity, hydrodynamic theory of lubrication, types of bearing, design of bearing using design charts, boundary lubrication, hydrostatic bearing, hydrodynamic thrust bearings. 7(L)

UNIT 6: System Design-Introduction, Design and design process, Design axioms (Independence and Information) and corollaries, Case studies: Design of products/Systems 6(L)

Text/Reference Books:

- Joseph E. Shigley, "Mechanical Engineering Design", McGraw Hill Publications.
- Richard M. Phelan, "Fundamentals of machine design" Tata Mc-graw Hill pub.
- Robert L. Norton, "Machine Design: An Integrated approach" Prentice Hall
- Robert C Juvinall and Kurt M. Marshek, " Fundamentals of Machine Component Design, Wiley-India
- Nam P. Suh, "Principles of Design", Oxford University Press, 1990.
- V. B. Bhandari, "Design of Machine Elements" 3rd Ed., Tata McGraw Hill

MANUFACTURING SCIENCE AND TECHNOLOGY-II (ME-1603)

UNIT 1: Metal Cutting Principle-Mechanism of Chip Formation; Types of Chips; Orthogonal and Oblique cutting, Cutting Forces and Merchant Circle Diagram, Shear angle and Friction angle, Shear Velocity and Chip Velocity, Length of shear and friction plane , Stresses in shear and friction plane, Energy in shear and friction plane, Strains in shear and friction plane, Temperature in shear and friction plane; Cutting Tools and Fluids: Cutting Tool Materials, Cutting Tool Life, Cutting Tool Geometries, and Cutting Fluid Applications 6(L)

UNIT 2:Cutting Machining Operations-Cutting Tool Technology, Machine Tool Technology and Holding Tool Technology, Process Geometry, Cutting Conditions, Calculation of Material Removal Rate (MRR), Surface Roughness (Ra), Cutting Forces and Power for Turning and related operations; Drilling and related operations; Milling and Gear Cutting, Shaping and Planning; Broaching and Sawing operations; Economics of Machining by Cutting 12(L)

UNIT 3: Abrasive Machining Operations-Features, Need and Classifications of Abrasive Machining; Abrasive Grinding- Wheel Specification, Wheel Life; Balancing, Truing and Dressing of Wheels; Classifications of Abrasive Grinding Processes; Chipping action in grinding, Calculation of Grinding Time and Material Removal Rate, Forces and Power, Heat and Temperature; Working Principle and Applications of grinding processes for prismatic and rotational surfaces; Abrasive Finishing-Conventional abrasive finishing-Honing, Lapping, Polishing and Buffing; Modern Abrasive Finishing - Abrasive Flow Finishing and Magnetic Abrasive Finishing 12(L)

UNIT 4: Advanced Machining Operations-Need and Classification of Erosion based Machining Processes; Process Principle, Equipments and Applications of Electro-Discharge Machining (EDM) and Beam Machining Processes (e.g. LBM, EBM, IBM,); Electro-Chemical Machining (ECM) and Chemical Machining Processes (e.g. CHM, PCM, BCM), Ultra-Sonic Machining (USM) and Jet Machining Processes (AJM, WJM, AWJM), Introduction to Hybrid Machining Processes 6(L)

UNIT 5: Welding Science and Technology-Need and Classifications of Joining Processes; Solid Welding-Diffusion, Friction, Forge and Roll Welding; Explosive and Ultra-sonic Welding; Fusion Resistance Welding- Spot, Projection and Seam welding, Resistant Butt and Flash Butt welding; High Frequency Resistance and High Frequency Induction welding; Fusion Arc Welding- Non consumable electrode arc welding- CAW, GTAW, PAW and Consumable electrode arc welding-SMAW and GMAW, SAW and ESW; Twin electrode arc welding-twin carbon and tungsten; Fusion Gas Welding: Oxy Acetylene and Oxy Hydrogen; Thermit Welding; Fusion Beam Welding: LBW and EBW; Welding Defects and Inspection; Characteristics and applications of Brazing and Soldering 6(L)

Text/Reference Books:

- Manufacturing Science by **Ghosh and Mallik,** East West Press Pvt. Ltd., New Delhi
- Fundamentals of Modern Manufacturing by **M. P. Groover,** John Wiley and Sons, New Delhi
- Introduction to Machining Science by **G. K. Lal,** New Age International Ltd., New Delhi
- Manufacturing Engineering and Technology by **Kalpakjian and Schmid,** Pearson Education Pvt. Ltd. New Delhi

AUTOMOBILE ENGINEERING (ME-1604)

UNIT 1: Introduction to auto vehicles, various systems of automobiles. Power transmission necessities, Advantages and disadvantages, Recent trends, Purpose of clutch, types of clutches and their working. 8(L)

UNIT 2: Resistance calculation, Engine power calculation, Necessity of gear box, types of gear boxes, sliding mesh, constant mesh, synchromesh gear box, Transaxle, Automatic transmission, 8(L)

UNIT 3: Universal coupling, telescopic joint and propeller shaft.Purpose of differential, types of differential and their construction, type of axles, Suspension systems: type of chassis, dependent and independent suspension, coil and leaf spring suspension, shock absorbers. 8(L)

UNIT 4: Steering system: definition of true steering, Ackerman's steering linkages and steering gear boxes. Wheel alignment, Centre Point Steering, caster, camber, king pin inclinationTyres, wheels 8(L)

UNIT 5: Braking system: Mechanical, Hydraulic, vacuum and pneumatic brake, their merits and demerits, types of brake, drum and disc type, Tires, Wheels.Road safety, Influence of vehicle characteristic on accidents. 8(L)

Text/Reference Books:

- The Motor Vehicle: by- Newton and Steed,
- Automotive Mechanics: by- Heitner J.
- Advanced Vehicle Technology- HEINZ HEISLER
- Any other referencediscussed in class for specific topics.

INTERNAL COMBUSTION ENGINE (ME-1605)

UNIT 1: Overview and Basics of Engine Operation, Engine Geometry, Performance Parameters, Ideal Cycle Analysis, Combustion Stoichiometry, Fuel-air Cycle Model 6(L)

UNIT 2: Gas Exchange: 4-Stroke, Gas Exchange: 2-Stroke, Turbocharging, Mixture Preparation, Fuel Injection System in Diesel Engine 7(L)

UNIT 3: Ignition System, Spark-ignition Engine Combustion, Knock, Diesel Combustion 7(L)

UNIT 4: SI Engine Emissions, Diesel Emissions Emission Control Technology, Engine Heat Transfer 6(L)

UNIT 5: 2-Stroke and 4-Stroke Spark Engine Performance and Testing, Diesel Engine Performance and Testing, Alternative fuels. 7(L)

UNIT 6: Overview and Basics of Gas Turbine and Compressor Operation, Classification, Ideal Cycles, Design Point Performance Calculations, Comparative Performance of Practical Cycles, Combined Cycle and Cogeneration Schemes. 7(L)

Text/Reference Books:

- Heywood, John B. Internal Combustion EngineFundamentals. New York: McGraw-Hill, 1988. ISBN: 9780070286375
- I. C. Engine by V. Ganeshan
- I. C. Engines and Air Pollution by R. Yadav, II Edition. 2004, Central Publishing House
- Fundamental of Internal combustion Engine by Gill, Smith, Ziurys
- Internal Combustion Engine by Willard W. Pulkrabek
- Gas Turbine Theory by Cohen and Rogers

COMMUNICATION SKILL WORKSHOP (HS-1601)

Experiment 1: Art of communication: What is communication, good communication and effective communication, barriers and filters, activity on barriers and filters.

Experiment 2: Body language: verbal and non –verbal behavior interpretation, activity on non-verbal communication.

Experiment 3: Active listening. Active listening quiz.

Experiment 4: Feedback: How to give and receive feedback, Activity on feedback.

Experiment 5: Hidden date of communication: Feelings. Activity on how to handale feelings.

Experiment 6: Practical skills: assertiveness, activity on assertiveness, self-confidence, activity.

Experiment 7: In the world of teams: the team concept, element of teamwork. Team formation, effective team, exercise on team, Team players, activity.

Experiment 8: Discussions, decisions and presentations: Structured and un-structured group discussions. Activity on each.

Experiment 9: Adapting to Corporate life: exercise on grooming and dressing, getting ready for interview.

Experiment 10: Business Etiquette/Dining etiquette.

COMPUTER AIDED MANUFACTURING (LAB) (ME-1651)

Experiment 1: Study of CNC Lathe and prepare a Part programming using GM codes for a given part drawing and verify it on computer.

Experiment 2: Study of CNC Drilling and prepare a Part programming using GM codes for a given part drawing and verify it on computer.

Experiment 3: Study of CNC Milling and prepare a Part programming using GM codes for a given part drawing and verify it on computer.

Experiment 4: Prepare a Part programming Manuscript using GM codes for a given part drawing and verify it.

Experiment 5: Write a program for a given part drawing using "APT" language.

Experiment 6: Study of HMT CNC TRAIN MASTER Lathe.

Experiment 7: Study of HMT CNC TRAIN MASTER Machining Centre.

Experiment 8: Study of PMT CNC Lathe.

Experiment 9: Study of various types of Automatic Tool changers.

Experiment 10: Study of different components of robot.

Experiment 11: Programming on HMT Trainer Lathe.

Experiment 12: Programming on HMT milling machine.

MACHINE DESIGN (LAB – II) (ME-1652)

Experiment 1: Development of algorithm and program for design of shaft, keys and coupling.

Experiment 2: Development of algorithm and program for design of Power screw/bolt nut.

Experiment 3: Development of algorithm and program for design of springs.

Experiment 4: Two dimensional computer drafting of single gear set with involute tooth profile in meshing condition: Knowledge of computer graphics facility on C/C+ development of algorithm.
Experiment 5: Development of algorithm and program for design of spur/spiral/helical gear set. Design problem of spur gear on solid works.
Experiment 6: Development of algorithm and program for design of bevel gear set. Design Problem of bevel gear on solid works.
Experiment 7: Development of algorithm and program for design of hydrodynamic bearing. Design problem of hydrodynamic bearing on solid works.
Experiment 8: Development of algorithm and program for selection design of ball bearing.
Experiment 9: Some case studies on Axiomatic Design of Suh.

MANUFACTURING TECHNOLOGY (LAB – II) (ME-1653)

Experiment 1: Preparation of a SINGLE POINT CUTTING TOOL as per the given tool specification. Also write the process sheet for the same.
Experiment 2: To make a job as per drawing on the CAPSTAN LATHE. Write the process sheet and draw the sketches of the machine tool and tools used.
Experiment 3: To make a job as per drawing using RADIAL DRILLING MACHINE. Write the process sheet and draw the sketches of the machine tool and tools used.
Experiment 4: Study of Indexing Mechanism for Gear Cutting and to cut gear on a gear blank using Indexing Mechanism on HORIZONTAL MILLING MACHINE. Write the process sheet and draw the sketches of the machine tool and tools used.
Experiment 5: To make a slot as per drawing using VERTICAL MILLING MACHINE. Write the process sheet and draw the sketches of the machine tool and tools used.
Experiment 6: To make a job as per drawing using CYLINDRICAL GRINDING MACHINE. Write the process sheet and draw the Sketches of the machine tool and tools used.
Experiment 7: To make a job as per drawing using SURFACE GRINDING MACHINE. Write the process sheet and draw the Sketches of the machine tool and tools used.
Experiment 8: Study of SHAPER, PLANER and SLOTTER
Experiment 9: Study of MIG WELDING MACHINE and preparation of T-joint. Study the welding defects induced. Also draw the sketches of the tools used.
Experiment 10: Demonstration and study about CUTTING, DRILLING AND WELDING operation on LASER BEAM MACHINE
Experiment 11: Study of ELECTRICAL DISCHARGE MACHINE

THERMAL ENGINEERING (LAB – III) (ME-1654)

Experiment 1: Study of Four Stroke and Two stroke Spark and Diesel Engine model.
Experiment 2: To draw Valve Timing Diagram of Diesel and Petrol Engine.
Experiment 3: To find out IP of the engine using Morse Test. on four-cylinder petrol engine
Experiment 4: To conduct a performance test of Multi cylinder Diesel engine.
Experiment 5: To conduct a performance test on four-cylinder petrol engine, to find out the efficiency of the engine and draw heat balance sheet.
Experiment 6: To know the A/F Ratio variation with load for a diesel engine.
Experiment 7: Heat release analysis of single cylinder SI engine using in-cylinder pressure data.
Experiment 8: Performance and emission test of a vehicle on a Chassis Dynamometer
Experiment 9: To conduct a performance test on a variable compression ratio engine with change in compression ratio
Experiment 10: To conduct a study of transmission system of both rear and front wheel drive vehicle
Experiment 11: To conduct a study of automatic transmission system
Experiment 12: To conduct a study of various steering systems
Experiment 13: To conduct a study of various suspension systems
Experiment 14: To conduct a study of chassis of a four wheel vehicle.

REFRIGERATION AND AIR CONDITIONING (ME-1701)

UNIT 1: Refrigeration-Introduction, methods of refrigeration, Applications, Carnot refrigeration cycle, Unit of refrigeration capacity, Coefficient of Performance, Heat Pumps 5(L)
UNIT 2: Vapour compression system-Analysis of ideal vapour compression cycle, Use of T-s and p-h charts, Effect of pressure changes, sub cooling of condensate and superheating of suction vapour on COP, Actual Vapour-Compression cycle, Cascade refrigeration systems 8(L)
UNIT 3: Vapour Absorption system-Comparison between absorption and compression systems, Water-Lithium Bromide and Ammonia –water absorption systems, Single-effect and double-effect systems. 4(L)
UNIT 4: Air refrigeration cycle: Brayton refrigeration cycle and its analysis, Aircraft refrigeration systems. 4(L)
UNIT 5: Refrigerants-Classification and nomenclature, Desirable properties of refrigerants, conventional and CFC free (ozone friendly) refrigerants. 3(L)
UNIT 6: Psychrometry-Psychrometric terms and definitions, Psychrometric processes, comfort chart. 7(L)
UNIT 7: Air-conditioning systems-Cooling and heating loads calculations, Apparatus Dew Point and By-pass factor of cooling coils, window, split and central air-conditioning systems. 6(L)

Text/Reference Books:

- Refrigeration and Air-conditioning by C.P.Arora, Tata McGraw-Hill
- Principles of refrigeration by Roy J Dossat, Prentice Hall
- Refrigeration and Air-conditioning by Manohar Prasad, New Age International
- Refrigerant Tables and Charts by Banwait&Laroiya ,Birla Publications.

ECONOMICS (HS-1701)

UNIT 1: Introduction to Economics-Nature and Scope of Economics, Significance, Branches of Economics, Micro and Macro, fundamental concepts. Objectives of a firm. 6(L)

UNIT 2: Utility Analysis-cardinal and ordinal view, laws. Demand Analysis; Law of Demand, Exceptions to the law of Demand, Determinants of Demand. Elasticity of Demand- Price, Income, Cross and Advertising Elasticity; Uses of Elasticity of Demand for managerial decision making, measurement of Elasticity of Demand. Demand forecasting meaning, significance and methods. 8(L)

UNIT 3: Supply Analysis-Law of Supply, Supply Elasticity; Analysis and its uses for managerial decision making. Production concepts & analysis; Production function, single variable-law of variable proportion, two variable-Law of returns to scale. Cost concept and analysis, short-run and long-run cost curves and its managerial use. 8(L)

UNIT 4: Market Equilibrium and Average Revenue Concept. Market Structure-Perfect Competition, features, determination of price under perfect competition. Monopoly: Feature, pricing under monopoly, Price Discrimination. Monopolistic: Features, pricing under monopolistic competition, product differentiation. Oligopoly: Features, kinked demand curve, cartels, price leadership. 8(L)

UNIT 5: Pricing Strategies-Price determination, full cost pricing, product line pricing, price skimming, penetration pricing. 4(L)

UNIT 6: Indian Economy-National Income; Concepts and various methods of its measurement, Inflation, types and causes, Business Cycle. 6(L)

Text/Reference Books:

- Damodaran Suma – Managerial Economics (Oxford 2006)
- Hirschey Mark – Economics for Managers (Thomson, India Edition, 2007)
- Dominick Salvatore - Managerial Economics (Oxford, 2007))
- Mithani D.M. - Principles of Economics (Himalaya Publishing House, 2005).
- Dwivedi D.N. - Managerial Economics (Vikas Publication, 7th Edition)

PROFESSIONAL ELECTIVE – I

OPTIMIZATION METHODS IN ENGINEERING (ME-1731)

UNIT 1: Introduction-Optimization Problem Formulation, Design Variables, Constraints, Objective Function, Variable Bounds, Engineering Optimization Problems, Optimization Algorithms. 3(L)

UNIT 2: Single Variable Optimization Problems-Optimality Criterion, Bracketing Methods: Exhaustive Search Method, Bounding Phase Method. Region Elimination Methods-Interval Halving Method, Fibonacci Search Method, Golden Section Search Method. Point Estimation Method-Successive Quadratic Estimation Method. Gradient Based Methods-One of the followings-Newton-Raphson Method, Bisection Method, Secant Method, Cubic Search Method. 10(L)

UNIT 3: Multivariable Optimization Algorithms-Optimality Criteria, Unidirectional Search, Direct Search Methods: Any two of the followings-Evolutionary optimization method, Simplex Search Method, Hooke-Jeeves pattern search method, Powell's Conjugate Direction Method. **Gradient Based Methods**-Cauchy's Steepest Descent Method. Newton's method, Marquardt's Method. Conjugate Gradient Method, Variable-metric Method. 10(L)

UNIT 4: Constrained Optimization Algorithms, Kuhn Tucker Conditions, Transformation Methods-Penalty Function Method, Method of Multipliers. Sensitivity analysis. 5(L)

UNIT 5: Specialized Algorithms, Integer Programming-Penalty Function Method, Branch and Bound Method., Geometric Programming. 5(L)

UNIT 6: Non-Traditional Optimization Algorithms-Genetic Algorithms: Working Principle, Differences between Gas and traditional methods, GAs for constrained optimization. Other GA operators. Simulated Annealing-Analogy, Algorithm, Application. 7(L)

Text/Reference Books:

- Kalyanmoy Deb, 2010. Optimization for engineering design: algorithms and examples. Prentice-Hall of India Private Limited, New Delhi.
- Singiresu S Rao, 2009. Engineering optimization: theory and practice. Fourth Edition, New Age International(P) Limited Publishers, New Delhi.
- A. Ravindran, K. M. Ragsdell, G. V. Reklaitis, 2006. Engineering optimization - methods and applications. Second Edition, John Wiley & Sons, Inc. Andreas Antoniou and Wu-Sheeng Lu, 2007. Practical Optimization: Algorithms and applications, Springer Science+Business Media, LLC

DYNAMIC DESIGN OF MECHANICAL SYSTEMS (ME-1732)

UNIT 1: Introduction to modal testing-Overview of dynamic design and modal analysis. Use of MATLAB for solving vibration engineering problems. Basics of modal analysis and presentation and properties of FRF data for SDOF system, undamped multi-degrees-of-freedom systems(MDOF), proportional damping, hysteretic damping, viscous damping, characteristics and presentation of MDOF FRF data. 8(L)

UNIT 2: Mobility measurement techniques-Basic measurement system, structure preparation, excitation of the structure, transducers and amplifiers, analyzers, digital signal processing, use of different excitation types, calibration, mass cancellation. 8(L)

UNIT 3: Modal parameter extraction methods-System identification techniques (SDOF and MDOF), Preliminary checks of FRF data, SDOF modal analysis – Peak amplitude, circle-fit method, inverse method, residuals, introduction to MDOF curve-fitting procedure – extension of SDOF method. 8(L)

UNIT 4: Derivation of Mathematical models: Modal models, display of modal model, response models, spatial models, mobility skeletons and system models. 8(L)

UNIT 5: Application: comparison of experiment and predication, correction or adjustment of models. Structural modifications and its optimization. Response predication and force determination. Application of modal analysis to real structures. Case studies. 8(L)

Text/Reference Books:

- Modal Analysis: by Jimin He and Zhi-Fang Fu, 2001, Butterworth-Heinemann, Woburn, MA, USA.
- Modal testing; Theory, Practice and application, second edition, D J Ewins, research studies Press Ltd., Balddock Hertfordshire, England.
- Fundamental of mechanical Vibration, 1993, S grahm Kelly, McGraw-Hill Intl. Editions.
- Mechanical Vibration, 1990, S S Rao, Addition-Wesley publishing company.

ADVANCED MANUFACTURING PROCESSES (ME-1734)

UNIT 1: Introduction-Need and classification of unconventional manufacturing processes, brief overview. 1(L)

UNIT 2: Unconventional Machining Processes-Process Principle, Analysis and Applications of Electric Discharge Machining,

Laser Beam Machining, Electron Beam Machining, Ion Beam Machining, Plasma Beam Machining, Ultra-Sonic Machining, Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ice Jet Machining, Electrochemical Machining, Chemical Machining, Bio Chemical Machining. Hybrid Machining Processes: Electrochemical Discharge Machining, Electro-Chemical Abrasive Grinding, Electro Discharge Abrasive Grinding. 15(L)

UNIT 3: Unconventional Finishing Processes-Need, classification, process principle and applications of Abrasive Flow Finishing, Magnetic Abrasive Flow Finishing, Magnetic Abrasive Finishing, Electrogel Magnetic Abrasive Finishing, Magneto-Rheological Finishing. 6(L)

UNIT 4: Unconventional Welding Processes-Laser Beam Welding, Electron Beam Welding, Ultra-Sonic Welding, Plasma Arc Welding, Explosive Welding, Under Water Welding, Welding in Space, Micro Welding Processes. 6(L)

UNIT 5: Generative Manufacturing Processes-Concept of generative manufacturing, need and Classification, Process principle and Applications of Selective Laser Sintering, Fused Deposition Manufacturing, SterioLithography, Ballistic Particle Manufacturing, Three Dimensional Printing, Laminated Object Manufacturing. 9(L)

UNIT 6: Unconventional Forming Processes-Explosive forming, Electro hydraulic forming, Electro- magnetic forming, Laser Bending, Powder rolling, Spray rolling, Hydro forming, Hydrostatic and Powder extrusion, powder, rotary and isothermal forming. 6(L)

Text/Reference Books:

- Non Traditional Manufacturing Processes by G.F. Benedict, Marcel Dekker Inc, New York
- Advanced Machining Processes by V.K. Jain, Allied Publisher Bombay
- Advanced Machining Methods by J.A.McGough, Chapman and Hall, London
- New technology by Bhattacharaya
- Modern Machining Process by Aditya
- Manufacturing Science by Ghosh and Malik, EWP Private Ltd.
- Modern Machining Processes by Pandey and Shan, TMH Publication, New Delhi
- Solid Freedom Manufacturing by D. Kochan
- Advanced Machining Processes by Hassan Abdel-Gawad El-Hofy

KNOWLEDGE MANAGEMENT (ME-1735)

UNIT 1: Define Data, Information, and knowledge. 2(L)
UNIT 2: Study the different methods for conversion of data into information. 3(L)
UNIT 3: Difference between data, information and knowledge. 2(L)
UNIT 4: Different methods for conversion of data into information. 4(L)
UNIT 5: Types of knowledge. 1(L)
UNIT 6: Define knowledge management. 2(L)
UNIT 7: Knowledge management framework and value propositions for knowledge management implementation. 4(L)
UNIT 8: Knowledge management Enablers for implementation, knowledge management barriers for implementation. 4(L)
UNIT 9: Knowledge management processes and knowledge management technologies. 4(L)
UNIT 10: Selection criteria for knowledge management team members. 2(L)
Knowledge management is an essential survival imperative. 1(L)
UNIT 11: Knowledge sharing enablers and knowledge sharing barriers. 4(L)
UNIT 12: Categorization of knowledge sharing barriers: group/individual, organizational, and technological. 4(L)
UNIT 13: Application of ISM methodology, Similarity coefficient methodology, AHP methodology for the categorization, similarity and quantify. The critical variables. 3(L)

Text/Reference Books:

- Knowledge Management Tool Kits by Tiwana.
- Knowledge Management Systems By R. Maier
- Working Knowledge By Devenport & Prusak
- Knowledge Management By Gamble and Black Well
- Knowledge Retention Strategies & Solutions By Jay Liebowitz**.**

REFRIGERATION AND AIR CONDITIONING (ME-1736)

UNIT 1: Refrigeration-Introduction to refrigeration system: Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration capacity, C.O.P., applications. Air refrigeration cycle, Bell Coleman air refrigeration cycle, Brayton refrigeration cycle, optimum C.O.P. & pressure ratio, air craft refrigeration system, classification of air craft refrigeration system, Actual power for refrigeration system, Dry Air Rated Temperature [DART]. 8(L)

UNIT 2: Refrigerants-Classification, Nomenclature, Desirable properties of refrigerants, common refrigerants secondary refrigerants and CFC free refrigerants. 4(L)

UNIT 3: Vapor Compression System- Single stage system, Analysis of vapor compression cycle, Effect of pressure change on C.O.P. use of T-S and p-h chart, Effect of subcooling of condensate on C.O.P. and capacity, effect of super heating of vapor-compression constructional details of Refrigerator and Air conditioners. Multi stage compression. 7(L)

UNIT 4: Vapor-Absorption System-Working Principle of continuous Absorption System, compression between Absorption & compression system. Theory of mixtures, Temp-concentration Diagram, Enthalpy concentration diagram. Adiabatic mixing of two systems, Lithium-Bromide water-vapor absorption system. Working principle, compression with Ammonia-water system. 7(L)

UNIT 5: Air Conditioning-Introduction to air-conditioning, psychrometric terms, Definitions, Adiabatic saturation & Thermodynamic, web-bulb temperature, psychrometers use of psychrometric chart, Air conditioning requirement for comfort and industrial processes, comfort chart & comfort zones, cooling towers, cooling & heating load calculations. 7(L)

UNIT 6: Refrigeration Equipment & Application-Expansion device, Duct design. Food preservation cold storage, refrigerators, freezers, ice plant, water coolers, thermal analysis for human body. Automotive air conditioning-brief overview. Introduction to solar radiation distributions. Empirical methods to evaluate heat transfer through walls & roofs, infiltration, passive heating & cooling of buildings. 7(L)

Text/Reference Books:

- Refrigeration and Air-conditioning by C.P.Arora, Tata McGraw-Hill
- Principles of refrigeration by Roy J. Dossat, Prentice Hall
- Refrigeration and Air-conditioning by Manohar Prasad, New Age International
- Refrigerant Tables and Charts by Kothandaraman, New Age International.

QUALITY ENGINEERING (ME-1737)

UNIT 1: Introduction-Concept of quality, basic statistical concepts, Control of accuracy and precision, Process capability, standardization and interchangeability; Statistical Quality Control: Objectives, Applications, organization, cost aspects, theory of statistical tolerance. 6(L)

UNIT 2: Control Charts-General theory of Control Charts, Group Control Charts. Shewhart control chart for process control; Control Charts for variables such as X, R Control Charts for charts for attributes such as c and p charts; Acceptance control chart; Cumulative Sum Control Charts; Subgroup selection; Process Capability, Cause-Effect and Pareto diagrams. 12(L)

UNIT 3: Acceptance Sampling-Multiple and Sequential Sampling Plans, Multi-Continuous Sampling Plan, Acceptance Sampling by Variables, Advantages limitations. Sampling plans using different Criteria. Comparison of various types of sampling plans. Rectifying Inspection. 12(L)

UNIT 4: Reliability, Availability and Maintainability-Introduction to reliability, Bathtub curve, Series and Parallel system; MTBF, Evaluation of Availability and Maintainability. 6(L)

UNIT 5: Quality Design-Design of experiment concept, System, Parameter and Tolerance Design; Concept of Robust Design, Taguchi Concept-Orthogonal Arrays and S/N ratio. 4(L)

Text/Reference Books:

- Statistical Quality Control; Eugene L. Grant, Richard S. Leavenworth, Tata Mc Graw Hill, 2000
- Statistical Quality control; A Modern Introduction 6th Edition ,, Douglas C. Montgomery, 2010
- Introduction to quality control, Jamieson A, Reston, 2004

MODELING AND SIMULATION IN ENGINEERING (ME-1739)

UNIT 1: Fundamental aspects of modeling and simulation-Technical and Commercial aspects, Continuous and Discrete Systems, types of modeling- Analytical, experimental, mechanistic, numerical, AI based and stochastic, Monte Carlo Simulation, AI based and stochastic, Model testing. 8(L)

UNIT 2: Steps in Simulation Study-Simulation Examples Such as Queuing and Inventory Systems, Simulation General Principles, Simulation Software 8(L)

UNIT 3: Statistical Models in Simulation-Discrete and Continuous, Poisson and Empirical Distributions. 7(L)

UNIT 4: Random-Number Generation and Random-Variate Generation, Input Modeling, Generation of Arriving Processes. 5(L)

UNIT 5: Verification and Validation of Simulation Models-Output Data Analysis for a Single System, Comparing Alternative System Configurations. 8(L)

UNIT 6: Applications in design and manufacturing-case Studies with Simulation Packages. 5(L)

Text/Reference Books:

- Averill M Law, 2008. Simulation Modeling and Analysis. Fourth Edition, Tata McGraw-Hill Publishing Company Limited, Delhi.
- Geoffrey Gordon, 2005. System Simulation. Second Edition, Prentice-Hall of India Private Ltd., New Delhi, India.
- Jerry Banks, John S. Carson II, Barry L. Nelson and David M. Nicol. 2005. Discrete-Event System Simulation, Fourth Edition, Pearson Education (Singapore) Private Limited, Indian Branch, Delhi.
- Chung, A. C., 2004. Simulation Modeling Handbook - A Practical Approach. CRC Press LLC, Florida, USA.
- Robinson S., 2004. Simulation: The Practice of Model Development and Use, John Wiley & Sons, Ltd., England.

PRESSURE VESSEL DESIGN (ME-1740)

UNIT 1: Basic principles-Elastic analysis of shells of revolution, membrane solutions, spherical and cylindrical shells, Junctions of shells of different geometry, Limit analysis, Shakedown. 6(L)

UNIT 2: Pressure vessel branches-Radial nozzle in spherical shell, stress concentration factors due to combined loadings, design methods to reduce SCF, nonradial nozzles in spherical shells, Junction analysis of radial and non-radial nozzles in cylindrical shells. 6(L)

UNIT 3: Pressure vessel ends-different design forms. 6(L)

UNIT 4: Flanges-Stress analysis and design methods. 4(L)

UNIT 5: Local loading and local attachments-Supports design. Creep and fatigue in thin pressure vessels and its components. Pressure vessel design codes. 6(L)

UNIT 6: Thickwall design-monoblock cylinders and spheres, multiplayer constructions. Pre-stressing of thick shells, shrink fit construction, wire and ribbon wound cylinders, Plastic radial expansion autofrettaging. Thermal stress, creep and stress rupture; Dynamic and fatigue behaviour. 10(L)

UNIT 7: Case studies-Vessels for special purposes. Computer aided design of pressure vessels. 2(L)

Text/Reference Books:

- Harvey J F, 'Pressure vessel design' CBS publication
- Brownell. L. E & Young. E. D, 'Process equipment design', Wiley Eastern Ltd., India
- ASME Pressure Vessel and Boiler code, Section VIII Div 1 & 2, 2003
- American standard code for pressure piping , B 31.1
- Henry H Bednar, Pressure vessel Design Hand book, CBS publishers and distributors
- Stanley M Wales, Chemical Process equipment, selection and design, Butterworths, series in Chemical Engineering,1988
- William.j.,Bees,"Approximate methods in the Design and Analysis of pressure vessels and piping", ASME Pressure vessels and piping conference,1997

PROFESSIONAL ELECTIVE-II

FINITE ELEMENT METHODS IN ENGINEERING (ME-1741)

UNIT 1: Approaches of FEM- Discrete, Variational and Weighted Residual. 7(L)

UNIT 2: Direct Problems- Spring, Hydraulic Network, Resistance Network and Truss Systems. 4(L)

UNIT 3: 1-D Field and Beam Bending Problems-Formulation using Galerkin and Rayleigh-Ritz approaches, Derivation of elemental equations and their assembly, Solution and its post processing. 8(L)

UNIT 4: 2-D and Axisymetric Field and Stress Problems-Formulation using Galerkin and Rayleigh-Ritz approaches, Derivation of elemental equations and their assembly, Solution and its post processing. 8(L)

UNIT 5: 3-D Field and Stress Problems-Formulation using Galerkin and Rayleigh-Ritz approaches, Derivation of elemental equations and their assembly, Solution and its post processing; Eigen value and time dependent problems; Discussion about preprocessors, postprocessors and finite element packages. 10(L)

Text/Reference Books:

- Kenneth H. Huebner, Donald L. Dewhirst, Doughlas E. Smith, The *Finite Element Method* for Engineers, Wiley, fourth edition.
- J. N. Reddy, An Introduction to the Finite Element Method, Tata McGraw-Hill Education, third edition.
- Singiresu S Rao, Finite Element Method in Engineering, Elsevier India, fourth edition.
- Klaus-Jrgen Bathe, Finite Element Procedures, PHI Learning, 1st Edition.
- David S. Malkus, Michael E. Plesha, Robert D. Cook, Robert J. Witt, Concepts and Applications of Finite Element Analysis, Wiley, 4th Edition.
- Ashok D. Belegundu, Tirupathi R. Chandrupatla, Introduction to Finite Elements in Engineering, PHI Learning, 3rd Edition.
- K. Morgan, O. C. Zienkiewicz, Finite Elements and Approximation, Dover publication, 1st Edition.

FUELS COMBUSTION AND POLLUTION (ME-1742)

UNIT 1: Chemistry of Combustion-Combustion and its Chemistry, Heat, Types of Fuel, Molecularity and order of reaction, Rates of reaction, Arrhenius equation. Conservation equations of mass, momentum, energy and species for a multicomponent system. 8(L)

UNIT 2: Combustion of gaseous fuel jets-Premixed and diffusion flames, Laminar and turbulent flames. Concepts of kinetically controlled and diffusion controlled reactions, Flammability limits, Ignition, Burning velocity, Flame structure and Stability for laminar flames. 10(L)

UNIT 3: Liquid Fuel combustion-Atomization of liquid, Various atomizers and their performances Evaporation of droplets in high temperature gas streams, Simple model of droplet burning, Physical and mathematical models of spray flames. 8(L)

UNIT 4: Combustion of Solids-Description of carbon sphere combustion, Diffusional theory of carbon combustion of pulverized coal. 5(L)

UNIT 5: Pollution-Pollutant formation in various combustion processes and their controlling measures. 4(L)

Text/Reference Books:

- An Introduction to Combustion: Concepts and Applications by Stephen R. Turns
- Combustion Engineering by G. L. Borman, K. W. Ragland

ROBOTICS (ME-1743)

UNIT 1: Introduction-Automation and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications – classification by coordinate system and control system. 4(L)

UNIT 2: Components of the Industrial Robotics-Function line diagram representation of robot arms, common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, determination of the end effectors, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices. 6(L)

UNIT 3: Actuators-Introduction – Characteristics of actuating systems – Comparison of actuating systems – Hydraulic devices – Pneumatic devices – Electric motors and stepper motors – Microprocessor control of electric motors. 6(L)

UNIT 4: Introduction, General Description of Robot Manipulator, Mathematical Preliminaries on Vectors & Matrices, Homogenous Representation of Objects, Robotic Manipulator Joint Co-Ordinate System, Euler Angle & Euler Transformations, Roll-Pitch-Yaw(RPY) Transformation, Relative Transformation, Direct & Inverse Kinematics' Solution, D H Representation & Displacement Matrices for Standard Configurations, Geometrical Approach to Inverse Kinematics. Homogeneous Robotic Differential Transformation: Introduction, Jacobian Transformation in Robotic Manipulation. 8(L)

UNIT 5: Sensors–Introduction – Sensor characteristics ,Various Sensors and their Classification, Use of Sensors and Sensor Based System in Robotics, – Position sensors – Velocity sensors – Acceleration sensors – Force and pressure sensors – Torque sensors – Microswitches – Light and Infrared sensors – Touch and Tactile sensors – Proximity sensors – Range-finders – Sniff sensors – Vision systems – Voice Recognition devices – Voice synthesizers – Remote center compliance device. Machine Vision System, Description, Sensing, Digitizing, Image Processing and Analysis and Application of Machine Vision System, Robotic Assembly Sensors and Intelligent Sensors. 8(L)

UNIT 6: Introduction, Various Teaching Methods, Task Programming, Survey of Robot Level Programming Languages, A Robot Program as a Path in Space, Motion Interpolation, WAIT, SIGNAL & DELAY Commands, Branching, Robot Language Structure, various Textual Robot Languages Such as VAL II, RAIL, AML and their Features, Typical Programming Examples such as Palletizing, Loading a Machine Trajectory planning and avoidance of obstacles, path planning, Skew motion, joint integrated motion straight line motion – Robot programming, languages and software packages. 6(L)

Text/Reference Books:

- Mittal RK, Nagrath IJ; Robotics and Control; TMH
- Groover M.P,Weiss M, Nagel,OdreyNG; Industrial Robotics-The Appl; TMH
- Groover M.P; CAM and Automation; PHI Learning
- Spong Mark and Vidyasagar; Robot Modelling and control; Wiley India
- Yoshikava ; Foundations of Robotics- analysis and Control; PHI Learning;
- Murphy ; Introduction to AI Robotics; PHI Learning
- FU KS, Gonzalez RC, Lee CSG; Robotics –Control, sensing…; TMH
- Shimon, K; Handbook of Industrial Robots; John Wiley & Sons,.
- Ghosal Ashitava; Robotics Fundamental concepts and analysis; Oxford
- Saha S; Introduction to Robotics; TMH
- Yu Kozyhev; Industrial Robots Handbook; MIR Pub.

ADVANCED WELDING TECHNOLOGY (ME-1744)

UNIT 1: Introduction-Review of Conventional Welding Processes; Introduction to Advanced Welding Processes; Welding of different Metals and Plastics; Welding of Dissimilar Metals. 3(L)

UNIT 2: Solid State Welding-Physics and Technology of Explosive, Ultrasonic and Diffusion Welding; Detail description of Friction Sire Welding Process 3(L)

UNIT 3: Resistance Welding Processes and Equipments-Fundamentals of Heat and Pressure in Resistance Welding; Spot Welding-Heat balance, Material aspects, and Equipments; Power Sources for Spot Welding; Welding Electrodes; Resistance Upset Butt Welding and Flash But Welding; Resistance welding of tubes. 6(L)

UNIT 4: Gas Welding Processes and Equipments-Various Gas Welding Processes e.g. Oxyacetylene Oxy-hydrogen welding processes; Types of Flames; Welding Filler metal rods and Fluxes; Gas Welding Equipments-Cylinder Types, Pressure Regulator, Welding Nozzles. 3(L)

UNIT 5: Arc Welding Processes and Equipments-Various arc welding processes and equipments; Physics of Arc Welding-Arc Mechanism, Types, Characteristics; Mechanism and Types of Arc Blow; Mechanism and Types of Metal Transfer; Geometry and Features of Weld Bead; Heat and Temperature effect in Arc Welding-Fusion, Cooling and Solidification of weld metal; Thermal,

Mechanical and Metallurgical aspects of Arc welding; Generation of Residual Stresses and its relieving methods. 12(L)
UNIT 6: Radiant Energy Welding Processes-Laser Beam and Electron Beam Welding processes and their applications; Mechanism of Key-hole formation and Modeling of Heat and its effect. 6(L)
UNIT 7: Special Welding Techniques: Underwater welding; Welding of Pipelines and Piping; Under space welding; Magnetically impelled arc welding; Electromagnetic pulse welding; High velocity projectile impact welding. 3(L)
UNIT 8: Design principles of welded structures; Weld cracking and prevention; Testing and Inspection of Welds; Weld Quality; Life Prediction of Welded Structures; Fundamentals of welding automation, Welding sensors and data acquisition; Principles of robotic welding. 6(L)

Text/Reference Books:

- Modern Welding Technology by H.B. Cary
- Welding Process Technology by P.T.Houldcroft
- Principles of Welding: Processes,Physics,Chemistry and Metallurgy by R.W.Messler
- Welding and Welding Technology by R.L.Little
- Welding Engineering by B.E.Rossi
- Welding Technology and Design by V.M. Radhakrishnan
- The Physics of Welding by J. F. Lancaster
- Welding Science and Technology by Md Imbrahim Khan
- Welding Handbook: Welding Processes by A. O'Brien

RELIABILITY ENGINEERING (ME-1745)

UNIT 1: Elements of probability theory-Elements of statistical theory.Some general stochastic processes. Statistical failure models. System reliability.reliability improvemt.Maintanability and availability.fault tree analysis,Failure mode effect analysis.Reliability physics models. 6(L)
UNIT 2: Optimization techniques for systems reliability with redundancy.Heuristic methods applied to optimal system reliability.Dynamic programming applied to optimal system relaibility.Discrete maximum principle applied to optimal; system relaibility. 8(L)
UNIT 3: Sequential unconstrained minimization techniques.Generalised reduced gradient method.Method of Lagrangain multiplier and Kuhn-Tucjer conditions applied to optimal system reliability.Generalized Lagrangian function. Geometric and integer programming methods applied to optimal system relaibility.Other methods to system reliability optimization problems.Determination of component reliability and redundancy for optimum system reliability. 8(L)
UNIT 4: Point and interval estimation procedure for life time distributions.Testing reliability hypotheses.Bayes methods in reliability. Design and analysis of life test experiments. Accelerated life testing.Non-parametric methods. 8(L)
UNIT 5: Introduction to engineering design-design morphology - production process & material selection. Concept of load, strength optimization and safety. Reliability principles, product life cycle, design and development, risk reliability, product liability. Failure analysis techniques,Case histories of failures.Quality Control.Design for maintenance. Ergonomics in design, Probabilistic concept in design. Cost evaluation and economic decision making.Case studies of reliability design process in allied engineering systems (Electrical, Aeronautical, Mechanical, Civil etc.). 6(L)
UNIT 6: Detail Part Consideration :- Component reliability ,derating, failure analysis of passive components and integrated circuits, Accelerated testing, Electrostatic Discharge, VLSI reliability issues. 4(L)

Text/Reference Books:

- Reliability in Engineering Design PaperBack K.C. Kapur, L.R. Lamberson, wiley,2009
- Practical Reliability Engineering 4th Edition, Patrick D.T. O. Connor, Wiley, 2008
- Quality and Reliability Engineering, Tirupathi R. Chandrupatla, Cambridge University Press, 2009

NON-CONVENTIONAL ENERGY RESOURCES (ME-1746)

UNIT 1: Introduction-the energy crisis – causes and options, renewable and non-renewable forms of energy and their characteristics, availability of renewable energy and land area requirements. 4(L)
UNIT 2: Biomass energy-thermo-chemical and biological conversion to solid, liquid and gaseous fuels; production of bioethanol, biogas and producer gas. 7(L)
UNIT 3: Ocean, wave and tidal energy-Ocean thermal energy conversion – closed and open cycles and their limitations, Wave energy and its conversion through oscillating water column, Tidal energy – nature of the tides and tidal barrages for power generation. 7(L)
UNIT 4: Wind energy-power in the wind, site selection, maximum power coefficient, wind turbine types – horizontal axis and vertical axis machines, performance of wind machines. 6(L)
UNIT 5: Geothermal energy-hot aquifers and hot dry rock systems. 6(L)
UNIT 6: Solar energy-(i) solar radiation at the earth's surface, flat-plate and concentrating collectors, solar ponds and energy storage, solar thermal power generation.(ii) Solar photovoltaic power generation: monocrystalline, polycrystalline and amorphous silicon modules and their production technology. 8(L)

Text/Reference Books:

- 'Advanced Renewable Energy Sources' by G.N. Tiwari and R.K. Mishra 2012, RSC Publishing, Cambridge, U.K.
- 'Renewable Energy Sources and Emerging Technologies' by D.P. Kothari, K.C. Singal and Rakesh Ranjan, PHI Learning Pvt. Ltd., New Delhi.
- 'Biogas systems: Pricnciples and Applications' by K.M. Mittal 1996, New age International limited publishers, New Delhi.
- 'Wind Energy Comes of Age' by Gipe P. 1995, John Wiley and sons, New York.
- 'Solar Energy–Fundaments, Design, Modeling & Applications' by G.N. Tiwari 2002, Narosa Publishing House, New Delhi, India.
- 'Solar Energy Engineering' by S. Kalogirou, Academic Press.
- 'Solar Photovoltaics: Fundamentals, Technologies and Applications' by Chetan Singh Solanki 2012, PHI Learning Pvt. Ltd., New Delhi.

CAD OF THERMAL SYSTEMS (ME-1747)

UNIT 1: Study of the design aspects. 2(L)
UNIT 2: Fluid flow and heat transfer characteristics and materials requirements of at least two of the following types of heat exchange equipment: Liquid-to-liquid. Liquid -to-gas and gas-to-gas heat exchangers. 12(L)
UNIT 3: Cooling tower, Familiarity with the use of the design related international/national and other codes. 6(L)
UNIT 4: Preparation of necessary computer programs for designing the thermal system. 12(L)

UNIT 5: Learning of the techniques for presenting design features of the thermal equipment. 10(L)

Text/Reference Books:

- Design of Thermal Systems By Wilbert F. Stoecker (Tata McGraw-Hill Education)
- Design and Optimization of Thermal Systems By Yogesh Jaluria (CRC Press Taylor & Francis Group)
- Thermal Design and Optimization By Adrian Bejan, George Tsatsaronis, Michael Moran (John Wiley and Sons, Inc.)
- Design & Simulation of Thermal Systems By N.V. Suryanarayana and Oner Arici (McGraw-Hill)
- Heat Transfer in Process Engineering By Dduardo Cao (McGraw Hill Professional)
- Engineering Thermo fluids: Thermodynamics, Fluid Mechanics, and Heat Transfer By Mahmoud Massoud(Springer)
- FORTRAN 77 and Numerical Methods By C. Xavier (New Age Int. (P) Ltd.)
- Numerical Heat Transfer and Fluid Flow By Suhas V. Patankar (Hemisphere Pub. Corp.)
- An Introduction to computational Fluid Dynamics The Finite Volume Method By H. Versteeg and Malalasekra (Pearson)

ADVANCED AUTOMOBILE ENGINEERING (ME-1748)

UNIT 1: Introduction and overview –Beginnings Growth and refinement. 3(L)

UNIT 2: Prime movers–types-advantages & limitations of different fuel based prime movers - alternative technologies. Comparison on Well to wheel basis. 4(L)

UNIT 3: Types of suspension & Drive- front mounted engines- rear mounted drive- advantages and limitations, rear and mid mounted engines drive, front wheel drive- types of design- advantages and disadvantages, four wheel drive advantages and disadvantages 6(L)

UNIT 4: Automotive vehicle safety, basic concepts of vehicle safety, fail safe, alternative designs, safety factors, designs for uncertainty, crash testing 4(L)

UNIT 5: Introduction to Traffic Engineering-Highway Engineering- geometric design of highways – Accident causes. 4(L)

UNIT 6: Tyres & Wheels requirements, Wheel travel & Elastokinematics 6(L)

UNIT 7: Steering-systems-types-limitations. Hydraulic, electro hydraulic and electrical power steering, steering column, steering damper. 4(L)

UNIT 8: Springing-comfort requirements- weights and axle loads, Shock absorbers, spring damper units. 4(L)

UNIT 9: Chassis–Vehicle and body centre of gravity and handling properties, axle weight and axle centre of gravity, body weight and body centre of gravity, Braking behavior –stability, anti dive control, traction behavior. 6(L)

UNIT 10: Future-vehicle safety, techno legal issues- ethics, testing of automotive components, failure investigations- (to be continued with topic. 4(L)

Text/Reference Books:

- The Automotive Chassis by J. Reimpell, H Stoll- SAE International
- The Motor Vehicle: by- Newton and Steed
- Automotive vehicle safety – George A Peters & Barbara J Peters
- Automotive Engineering Fundamentals – Richard Stone and J K Ball
- Chassis design – Principles and Analysis
- Electric Vehicle Technology Explained – James Larminie, John Lowry
- Highway Design & Traffic Safety Engineering Handbook Ruediger Lamm
- The handbook of road safety measures- Rune Elvik, Alena Hoye

Along with the above following is also desired to follow:

Various trade magazines on automobile published nationally and internationally.

A watchful eye on news paper reports on automobile related accidents for the purpose of analyzing the cause of accident such that the accident can be reduced in the society.

Visit to automobile repair shops for the feel of Engineering.

Motor vehicle acts and rules being enforced from time to time available from law book stores.

Production catalogue from various automobile manufactures and if possible the service manual of the vehicles.

During the course students are required to work on projects allotted to them.

CONCURRENT ENGINEERING (ME-1749)

UNIT 1: Meaning and Purpose of Concurrent Engineering. 5(L)

UNIT 2: Techniques of Concurrent Engineering. 5(L)

UNIT 3: Quality Function Deployment (QFD). 4(L)

UNIT 4: Design for manufacture (DFM). 4(L)

UNIT 5: Design for assembly (DFA). 4(L)

UNIT 6: Taguchi method for Robust design (TMRD). 4(L)

UNIT 7: Failure mode and effect analysis (FMEA). 4(L)

UNIT 8: Design for reliability. 3(L)

UNIT 9: Design for Maintainability. 3(L)

UNIT 10: Design for serviceability. 3(L)

Text/Reference Books:

- Concurrent Engineering Fundamentals: Integrated Product and Process Organization, Biren Prasad, Publisher: Prentice Hall
- Concurrent Engineering, John R. Hartley, Publisher: Productivity Press
- Concurrent Engineering: Contemporary Issues and Modern Design Tools, Hamid R. Parsaei, H. R. Parsaei, W. G. Sullivan, Publisher: Springer
- Concurrent Engineering: Automation, Tools, and Techniques, Andrew Kusiak, Kusiak, Publisher: Wiley-Interscience
- Concurrent Engineering Effectiveness, Jeffrey K. Liker, Mitchell Fleischer, Publisher: Hanser Gardner Publications
- Concurrent Engineering: Tools and Technologies for Mechanical System Design, Edward J. Haug, Publisher: Springer
- Successful Implementation of Concurrent Engineering Products and Processes, Sammy G. Shina, Publisher: John Wiley & Sons

NOISE AND VIBRATION (ME-1750)

UNIT 1: Noise-Random aspects of noise, traffic noise community noise, automobile noise, jet noise, aircraft noise. 4(L)

UNIT 2: Sonic bang, acoustic fatigue. Industrial noise, noise in piping system. 6(L)

UNIT 3: Noise in machines and components of reciprocating and rotating machines. 4(L)

UNIT 4: Noise control systems-types and design of exhaust mufflers, sound absorbing materials. 6(L)

UNIT 5: Noise measurement and instrumentation-Effect of noise on human beings. 3(L)

UNIT 6: Vibration-Systems with one degree of freedom, Free and forced vibration, torsional vibration. Analysis by Rayleigh's method. Stodola method and iterative method of Holtzer. Analysis and application of forced vibration in steady state as well as transient state, self excited vibrations. Free vibrations of systems with several degrees of freedom. Free vibration of elastic bodies, Free longitudinal vibrations of Prismatic bar, orthogonality principle. 6(L)

MAJOR PROJECT (STAGE – 1) (ME-1791)

THERMAL ENGINEERING (LAB-IV) (ME-1751)
Experiment 1: Study of vapour compression refrigeration tutor
Experiment 2: Study and performance of air refrigeration system
Experiment 3: Study of air conditioner tutor and window air conditioner.
Experiment 4: Study of vapour absorption system
Experiment 5: Study and performance of desert cooler
Experiment 6: Study and performance of vortex tube refrigerator tutor
Experiment 7: Study and performance of steam jet refrigeration system

PRODUCT DESIGN AND DEVELOPMENT (ME-1801)

UNIT 1: Introduction-Introduction to product design, Significance of product design, product design and development process, sequential Engineering design method, the challenges of product development, Development Process and Organizations-Generic Development Process, Concept Development, Adapting the generic PD process flows, AMF development Process, Product Development Organizations, The AMF Organization. 10(L)

UNIT 2: Product Planning and Identifying Customer Needs-Product Planning process, Interpret raw data in terms of customers need, organize needs in hierarchy and establish the relative importance of needs, review of the process. Product Specifications-Establish target specifications, setting final specifications. 10(L)

UNIT 3: Concept Generation-Activities of concept generation, clarifying problem, search both internally and externally, explore the output, Concept Selection-Overview, concept screening and concept scoring, methods of selection. Concept Testing-Elements of testing: qualitative and quantitative methods including survey, measurement of customers' response. Product Architecture-Modular and Integral architecture, implications, establishing the architecture, Delayed differentiation, Platform Planning. Industrial Design-Assessing need for industrial design, Impact of industrial Design, industrial design process, management of industrial design process, assessing quality of industrial design. 10(L)

UNIT 4: Embodiment Design: Design for Manufacturing, prototyping. Robust Design. Intellectual Property and Environmental Guidelines-Intellectual Property: Elements and outline, patenting procedures, claim procedure, Environmental regulations from government, ISO system. 10(L)

Text/Reference Books:

- Ulrich K. T, and Eppinger S. D, Product Design and Development, Tata McGraw Hill
- Otto K, and Wood K, Product Design, Pearson
- Engineering of creativity: introduction to TRIZ methodology of inventive Problem Solving, By Semyon D. Savransky, CRC Press.

PROFESSIONAL ELECTIVE – III

DESIGN AGAINST FATIGUE AND FRACTURE (ME-1831)

Fracture of Cracked Members

UNIT 1: Introduction-cracks as stress raisers, behavior at crack tips in real materials, effects of cracks on strength, effect of cracks on brittle versus ductile behaviors. 8(L)

UNIT 2: Mathematics concepts of-strain energy release rate, G., stress intensity factor K. 8(L)

UNIT 3: Application of k to design & analysis-mathematical form used to express K, cases of special interest for practical applications, discussion. 8(L)

UNIT 4: Fracture toughness values and trends-trends of KIC with material, effects of temperature and loading rate, micro structural influences on KIC. 6(L)

UNIT 5: Plastic zone size and plasticity limitation on LEFM-plastic zone size for plane stress, plastic zone size for plane strain, plasticity limitation on LEFM. 4(L)

UNIT 6: Standard test methods for-fracture toughness testing, effect of thickness on fracture behavior. 6(L)

Text/Reference Books:

- Fracture Mechanics: Fundamentals and Applications, T.L.Anderson, CRC Press
- Fundamentals of Fracture Mechanics, J.F.Knott, Butterworths
- Metal Fatigue in Engineering, Stephens, Fatemi, Fuchs and Stephens, John Wily
- Fatigue Damage, Crack Growth and Life Prediction, F.Ellyin, Chapman & Hall
- Elementary Engineering Fracture Mechanics. D. Broek, Kluwer Academic
- Fracture Mechanics with an introduction to micromechanics, Gross and Seelig, Springer
- Elements of Fracture Mechanics, Prashant Kumar, Tata McGraw Hill
- Deformation and Fracture Mechanics of Engineering, Materials R.W. Hertzberg, John Wiley

OPERATIONS RESEARCH (ME-1832)

UNIT 1: Basics of Operations Research-Development of Operations Research, Definition of Operations Research, Characteristics of Operations Research, Scope of Operations Research, Operations Research and Decision-Making, Scope of Operations Research in Management, Scope of OR in Financial Management ,Application of various OR Techniques, Objective of Operations Research. 2(L)

UNIT 2: Inventory Control-Necessity for Maintaining Inventory, Inventory Costs, Inventory Control Problem, Classification of Fixed Order Quality Inventory Models, Inventory Models with Deterministic Demand, Model 1(a).Classical EOQ Model(Demand Rate Uniform, Replenishment Rate Infinite),Model 1(b).(Demand Rate Non-Uniform, Replenishment Rate Infinite),Model 1(c).(Demand Rate Uniform, Replenishment Rate finite),Model 2(a).(Demand Rate Uniform, Replenishment Rate infinite, shortage allowed),Model 2(b). (Demand Rate Uniform, Production Rate finite, shortage allowed),Inventory Models with Probabilistic Demand, Inventory. 4(L)

UNIT 3: Linear Programming-Introduction, Formulation of Linear Programming problems, Graphical Method of Solution, The General Linear Programming problem, Canonical and Standard Forms of Linear Programming Problem, Theory of Simplex Method, Analytical Method or Trial and Error Method, The Simplex Method(Technique or Algorithm),Artificial Variables Techniques, The Big-M Method, The Two-Phase Method. 8(L)

UNIT 4: The Transportation Model-Introduction to the Model, Definition of the Transportation Model, Matrix Terminology, Formulation and solution of Transportation Models, Variants in Transportation Problems, Additional Problems. 6(L)

UNIT 5: The Assignment Model-Definition of the Assignment Model, Mathematical Representation of the Assignment Model, Comparison with the Assignment Model, The Hungarian Method for Solution of the Assignment Problems, Formulation and solution of the Assignment Models, Variations of the Assignment Problem, The Travelling Salesman Problem. 4(L)

UNIT 6: Game Theory-Game theory, Formulate two-person zero-sum game, Solve a simple game, Solve mixed strategy games using graphical method and LP ,Describe reduction using dominated strategy, Introduce saddle point condition, Formulation of Two-person Zero-sum game,. Solution of simple games, Mixed strategy games, Solving using Graphical Method, Solving Using LP, Reduction using Dominated Strategies, Saddle point Condition, Examples. 6(L)

UNIT 7: Sequencing Models-Sequencing problems, Assumptions in Sequencing Problems, Processing n Jobs through one Machine, Processing n Jobs through two Machines, Processing n Jobs through three Machines, Processing two Jobs through m Machines, Processing n Jobs through m Machines, Problems related to Sequencing(Routing Problems in Networks),Minimal Path Problem. 4(L)

UNIT 8: Network Analysis-Network models, Identify the situation in which minimum spanning tree algorithm can be used, Identify the situation in which shortest path algorithm can be used, Identify the situation in which maximal flow algorithm can be used, Draw network diagram Analyze the network using Earliest Start Time(ES) Latest Start Time (LS) , Earliest Event Time(ET), Latest Event

Time(LT), Identify critical path by calculating Total Float (TF) of each activity. Apply PERT using Optimistic, Most likely, pessimistic times of activities, Find the probability of completing the project, Identify the simple rules of crashing the projects with cost consideration., Minimal spanning tree problem, Shortest route problem, Maximal flow problem, Critical Path Method (CPM), Program Evaluation and Review Technique(PERT), Network representation of simple projects.. Critical path computation,, Construction of time schedule,. Crashing of project duration. 6(L)

Text/Reference Books:

- Operations Research : Principles and Practice 2nd Edition, Ravindran, Solberg, Phillips, Wiley, 2008
- Introduction to Operations Research 9th Edition, Ferald J. Lieberman, Badhibrata Nag, Tata McGraw Hill, 2011
- Operations Research 2nd Edition Paperback R. Panneerselvam, PHI, 2011
- Operations Research, an Introduction by Hamdy Taha
- Introduction to Operations Research by Hillier & Lieberman
- Operations Research by V K Kapur

SOLAR ENERGY AND ITS APPLICATIONS (ME-1833)

UNIT 1: The energy crisis: causes and options, renewable and non-renewable forms of energy and their characteristics, solar energy option – availability and land area requirements. 4(L)

UNIT 2: Solar radiation outside the earth's atmosphere and at the earth's surface, instruments for measuring solar radiation, solar radiation geometry, basic earth-sun angles, flux on tilted surfaces. 8(L)

UNIT 3: Liquid flat-plate collectors-design and performance parameters, solar air heaters, concentrating collectors, solar ponds and energy storage. 8(L)

UNIT 4: Solar thermal power generation-low, medium and high temperature cycles, solar cooling, drying and desalination, solar air and water heating, solar passive architecture. 8(L)

UNIT 5: Solar photovoltaic power generation-monocrystalline, polycrystalline and amorphous cells, Fabrication and performance of SPV modules. 8(L)

UNIT 6: Indirect methods of solar energy utilization-biomass, wind, wave and ocean thermal energy conversion technologies. Economic considerations. 6(L)

Text/Reference Books:

- 'Solar Energy–Fundaments, Design, Modeling & Applications' by G.N. Tiwari 2002, Narosa Publishing House, New Delhi, India.
- 'Solar Energy Engineering' by S. Kalogirou, Academic Press.
- 'Heat & Mass transfer' by Y.A. Cengel, Mcgraw Hill.
- 'Solar Engineering of Thermal Processes' by J.A. Duffie and W.A. Beckman 1991. John Wiley and Sons Inc., New York.
- 'Solar Energy- Principles of Thermal Collection and Storage' – by Sukhatme, Tata Mcgraw Hill.
- 'Solar Energy- Fundamentals and Applications' by Garg and Prakash, Tata Mcgraw Hill.
- 'Advanced Renewable Energy Sources' by G.N. Tiwari and R.K. Mishra 2012, RSC Publishing, Cambridge, U.K.
- 'Solar Photovoltaics: Fundamentals, Technologies and Applications' by Chetan Singh Solanki 2012, PHI Learning Pvt. Ltd., New Delhi.

MECHATRONICS (ME-1834)

UNIT 1: Fundamentals of Mechatronics, definitions and Concepts. 4(L)

UNIT 2: Conventional vs. Mechatronics Systems. 4(L)

UNIT 3: Need of Mechatronics in Mechanical Engineering. 4(L)

UNIT 4: Sensors and Transducers with Special reference to Mechatronics. 10(L)

UNIT 5: Signals System and actuating devices. 8(L)

UNIT 6: Real time interfacing. 6(L)

UNIT 7: Applications of Mechatronics in Manufacturing and Automation Case Studies. 4(L)

Text/Reference Books:

- Alciatore, D.G. and Histand, M.B. "Introduction to Mechatronics and Measurement System" Tata McGraw Hill
- Bolton" W. "Mechatronics, electronic control system in Mechanical and Electrical Engineering Pearson Education.
- Hsu, H.P. "Signals and Systems" McGraw Hill.
- Horowitz and Hill " The Art of Electronics" Cambridge Press.
- The Mechatronics Handbook, CRC Press.
- Stiffler, A.K. " Design with Microprocessors for Mechanical Engineering" McGraw Hill.

METAL FORMING (ME-1835)

UNIT 1: Fundamentals of Elasticity, Plasticity and Viscoplastcity, Stress and strain invariant. 6(L)

UNIT 2: Elesticity-State of stress and strain, stress-strain relations, strain-displacement relations. 6(L)

UNIT 3: Plasticity and Viscoplasticity-Yield criterion, effective stress and strain, state of plastic strain, Plastic strain rate, Flow rule, Effective strain rate, plastic anisotropy and viscoplasticity (determination of load and power) concept of solid and flow formulations. 6(L)

UNIT 4: Analysis of Deformation Processes using SSM, UBM & SLM. 6(L)

UNIT 5: Plain strain Problems-Drawing and Extrusion of sheet, Rolling and forging of strips. 6(L)

UNIT 6: Axisymmetric Problems-Drawing and Extrusion of bar and tube, forging of solid and Hallow disc. 4(L)

UNIT 7: Sheet metal problems-Axisymmetric deep drawing and stretching. 4(L)

Text/Reference Books:

- Avitzur, B., 'Metal Forming: Processes and Analysis,' Tata McGraw Hill.
- Beadle, J. D., 'Metal Forming,' The Macmillan Press Limited, U.K.
- Rowe, G.W., 'Principles of Industrial Metalworking Processes,' Edward Arnold (Publishers) Ltd.
- Dieter, G.E., 'Mechanical Metallurgy,' McGraw Hill Book Company.
- Wagoner, R.H., Chenot, J.L., 'Metal Forming Analysis,' Cambridge University Press, 2001.
- Wagoner, R.H., Chenot, J.L., 'Metal Forming Analysis,' Cambridge University Press, 2001

COMPUTER-INTEGRATED MANUFACTURING (ME-1840)

UNIT 1: Introduction to Computer Integrated Manufacturing and Manufacturing Enterprise-Fundamentals of Automation in Manufacturing Systems, Manufacturing Systems: concept Objectives, Types and Trends; concepts of Mechanization, Automation and Integration, Manufacturing enterprise, Manufacturing Systems Manufacturing Cells, Group technology and cellular Manufacturing, Flexible Manufacturing Systems Automated Manufacturing Systems, Concept of CAD/CAM and CIMS. 8(L)

UNIT 2: The design elements and production engineering-product design & production engineering, Design Automation and computer aided Engineering (CAE) 6(L)

UNIT 3: Managing the enterprise resources-Introduction to production operation planning, Planning and Scheduling Functions in CIM System, Aggregate Production Planning (APP), Master Production Schedule (MPS), Material Requirement Planning (MRP), Capacity Requirement Panning (CRP), Manufacturing Resource Planning (MRP-II), Just – In –time Production Systems and Concept of Enterprise Resource Planning (ERP). 10(L)

UNIT 4: Enabling processes and systems for modern-Manufacturing Production Process machines and system Production Machine and systems control Quality and Human Resource issues in manufacturing 6(L)

UNIT 5: Introduction to Advanced Manufacturing System-Lean Manufacturing Systems, Agile Manufacturing systems, Reconfigurable Manufacturing systems, Holonic Manufacturing Systems and Agent-Based Manufacturing Systems, Automated Material Handling Systems- Industrial Robots Conveyors AGVs, Automatic Storage and Retrieval Systems. 10(L)

Text/Reference Books:

- James A. Rehg and Henry W. Kraebber, 2005. Computer-Integrated Manufacturing. Second Edition, Pearson (Singapore) Private Ltd., Delhi.
- Milell P. Groover, 2005, Automation Production Systems and Computer-Integrated Manufacturing. Second Edition, Pearson (Singapore) Private Ltd., Delhi.
- A Allavudeen and N. Venketeswaran, 2008 computer Integrated manufacturing , Prentice- Hall India Pvt Ltd. New Delhi.
- Andrew Kusiak, 1990. Intelligent Manufacturing Systems, Englewood Cliffs, New Jersey: Prentice Hall.
- N. Viswanadham and Y Narahari 1998 Performance Modeling of Automated Manufacturing System. Prentice- Hall India Pvt Ltd. New Delhi

PROFESSIONAL ELECTIVE – IV

PRECISION ENGINEERING (ME-1842)

UNIT 1: History, Basic concepts, Dynamic characteristics of device Elements like bearings, locks and stops. 5(L)

UNIT 2: Concepts of coupling clutches, energy storing elements etc. 8(L)

UNIT 3: Gear, Wedge, Screw and linkage mechanism Instruments for displacement, velocity acceleration, force and torque. 12(L)

UNIT 4: Precision systems like video discs and d rives, laser printer etc. 6(L)

UNIT 5: Design considerations for environments cooling electronic equipment. 5(L)

UNIT 6: Systematic approach for design. 4(L)

Text/Reference Books:

- Elements of precision Engineering By R Raman, Oxford & IBH, 1984
- Precision Engineering By V C Venkatesh
- Norio Tariguchi,- Nano Technology " Oxford university, Press, 1996.
- Principles of precision engineering , By Hiromu Nakazawa
- Journals and Articles on Precision Engineering From Internet
- Any other reference material referred in the class.

RAPID PROTOTYPING (ME-1843)

UNIT 1: Introduction-Phases of Prototyping. Fundamentals of R.P. Classification of R.P. Processes, Rapid Prototyping Process: Automated Processes, Difference between Additive and Subtractive Processes, Process Chain, steps involved in R.P. 12(L)

UNIT 2: Types of R.P. systems-Liquid Based, Solid Based, & Powder Based. 8(L)

UNIT 3: Data Formats in R.P. 4(L)

UNIT 4: Application of R.P. in Manufacturing and Rapid Tooling. 4(L)

UNIT 5: Evaluation and Benchmarking 4(L)

UNIT 6: Modeling practice on softwares such as IDEAS, UNIGRAPHICS, ProE, etc. 8(L)

Text/Reference Books:

- Chua C. k and L. K. Fai: Rapid Prototyping and Applications in Manufacturing, John Wiley, 1997
- P.F. Jacobs ED Rapid Prototyping and Manufacturing, Fundamentals of Stereo lithography, Society of Manuf. Engrs. Dearborn MI, 1992.
- I. Gibson Ed Software Solutions for Rapid Prototyping Professional Engineering Publications, London, 2002.
- P.K. Vennuvinod and Weiyin Ma; Rapid Prototyping Laser Base and Other Technologies, Kluwer Academic Press, 2004.
- Bjorke; Layer Manufacturing, Tapir Publisher, 1992.
- M. Burns; Automated Fabrication Improving Productivity in Manufacturing Prentice Hall, 1993.
- D. Kochan ; Solid Freeform Fabrication, Elsevier, 1993.
- K.G. Cooper, Rapid Prototyping Technology Selection and Application Marcel Dekker Ny 2001.
- L.Lu.et al Laser Induced Materials and Processes for Rapid Prototyping , Kluwer Publications, 2001.

TOTAL QUALITY MANAGEMENT (ME-1844)

UNIT 1: Concept of quality, quality control and quality management. 4(L)

UNIT 2: Science of quality, human resources and quality. 3(L)

UNIT 3: Quality organization and management: 3(L)

UNIT 4: Quality manual, quality cost, quality related tasks. 3(L)

UNIT 5: Quality information system: Planning, hardware-software. 3(L)

UNIT 6: Statistical process control and quality deployment techniques. 9(L)

UNIT 7: Controlling quality through measurement and through counting. 4(L)

UNIT 8: Quality system and I.S.O. 9000 series, Quality assurance. 4(L)

UNIT 9: Reports on quality, quality audit, quality training, Newer quality management approaches. 4(L)

UNIT 10: Quality tools. 3(L)

Text/Reference Books:

- Total Quality Management 3rd Edition Dale H. Besterfield, Carol Besterfield Michna, Mary Besterfield Sacre, Glen H. Bester field, Hemant Urdhwareshe, Rashmi Urdhwareshe, Pearson, 2010.

- Total Quality Management 1st Edition, L. Suganthi, Anand A. Samuel, PHI Learning, 2009
- Total Quality Management (TQM), R. Ashley Rawlins, Autherhouse, 2008

TOOL DESIGN (ME-1845)

UNIT 1: Broad Classification-of Tools-Cutting tools, Dies , Holding and Measuring tools. Design of Cutting Tools-Single Point and multi-pint cutting tools. 2(L)

UNIT 3: Single Point Cutting Tools-Classification, Nomenclature, geometry, design of single point tools for lathes, shapers, planers etc. Chip breakers and their design. 8(L)

UNIT 4: Multipoint Cutting Tools-Classification and specification, nomenclature, Design of drills, milling cutters, broaches, taps etc. 8(L)

UNIT 5: Design of Form Tools-Flat and circular form tools, their design and application. 4(L)

UNIT 6: Design of Dies-Classification of dies, Design of Dies for Bulk metal Deformation-Wire Drawing, Extrusion, Forging and Rolling; Design of Dies for Sheet metal: Blanking and Piercing, Bending and Deep-drawing; Design of Dies used for Casting and Molding, Powder Metallurgy die design; 8(L)

UNIT 7: Design of Jigs and Fixtures-Classification of Jigs and Fixtures, Fundamental Principles of design of Jigs and Fixtures, Location and Clamping in Jigs and fixtures, Simple design for drilling Jigs, Milling fixtures etc. Indexing Jigs and fixtures. 6(L)

UNIT 8: Design of limit Gauges-Classification, Selection of materials for gauges, Design of Plug gauges, Snap Gauges, Screw gauges, etc. 4(L)

Text/Reference Books:

- Donaldson, C., LeCain, G.H., Goold, V.C., 'Tool Design', Tata McGraw Hill, 1980.
- Pollack, H.W. Tool Design, Reston Publishing Company, Inc. 1966
- Kempster, M.H.A. Principles of Jig and Tool Design, English University Press Ltd.
- Dowd, A. A. Tool Engineering Jigs and Fixtures, McGraw-Hill Book Co. NewYork & London.
- Pandey, P.C., Singh, C.K., Production Engineering Sciences, Standard Publishers, Delhi, 2001.
- Sharma, P.C., 'A Textbook of Production Engineering', S. Chand, Limited, 2008.
- Mehta, N.K., 'Machine Tool Design', Tata McGraw-Hill, 1984.
- Tool Engineers handbook, American Society of Tool and Manufacturing Engineers, McGraw-Hill Book Co., 1949 - 2070 pages.

SUPPLY CHAIN MANAGEMENT (ME-1846)

UNIT 1: Introduction to Supply Chain Management, Understanding the Supply Chain. 2(L)

UNIT 2: Supply Chain Performance: Competitive and Supply Chain Strategies, achieving Strategic Fit and Scope of Strategic Fit. 6(L)

UNIT 3: Supply Chain Drivers and Metrics: Drivers of Supply Chain Performance, Framework for structuring Drivers, Facilities, Inventory, Transportation, Information, Sourcing and Pricing, Case Study: Seven-Eleven Japan Company. 5(L)

UNIT 4: Planning Demand and Supply In a Supply Chain: Demand Forecasting in a Supply Chain, Aggregate Planning in a Supply Chain. 5(L)

UNIT 5: Management of Inventory in a Global Supply chain. 5(L)

UNIT 6: Role of Information Technology in supply chain, e-procurement. 5(L)

UNIT 7: Factors influencing logistics and decisions. 5(L)

UNIT 8: Benchmarking and performance measurement. 5(L)

Text/Reference Books:

- Supply Chain Management: Strategy, Planning & Operation- Sunil Chopra & Peter Meindle- Pearson Prentice Hall Publication.
- Logistical Management: The integrated Supply Chain Process- Donald J. Bowersox & David J. Closs- TMH Publication.
- Supply Chain Management – Maretin Christopher
- World Class Supply Management: The key to Supply Chain Management- Burt, Dobler and Straling – TMH Publication.
- Logistics and Supply Management – D K Agarwal – MacMillan Publication
- Supply Chain Management in the 21st Century- B. S. Sahay- MacMillan Publication.
- Supply Chain Management: Theories & Practices – R P Mohanty and S. G. Deshmukh- Biztantra Publication.
- e-Procurement: From Strategy to Implementation- Dale Neef- Prentice Hall Publication.

ENERGY MANAGEMENT (ME-1850)

UNIT 1: Introduction, energy crisis - causes and options, renewable and non-renewable forms of energy and their characteristics. 6(L)

UNIT 2: The energy-economy link, patterns of energy use in developed and developing countries, the electricity-economy link for developing economics. 6(L)

UNIT 3: Environmental aspects of energy resource utilization, combustion generated air pollution, global warming due to (a) green house effect (b) use of non-equilibrium energy sources i.e. nuclear and fossil fuels, acid rain, fly ash disposal, radioactive pollution and nuclear waste disposal. 6(L)

UNIT 4: Energy conservation, Energy auditing, process energy and gross energy requirements, energy recovery: insulation, heat recovery: heat pumps, combined heat and power plants (cogeneration and tri-generation systems), Solar Passive architecture and solar water heating. 12(L)

UNIT 5: Sustainable energy supply options, biofuels and solar photovoltaic power generation. 6(L)

UNIT 6: Case studies in energy management. 4(L)

Text/Reference Books:

- Energy for a sustainable world, by Goldemberg et al, Wiley Eastern.
- Energy efficiency, by Eastop and Croft, Longman Scientific and Technical.
- www.bee-india.nic.in, Bureau of energy efficiency, Ministry of power, Govt. of India.
- Solar Energy, by Sukhatme, Tata McGraw Hill.

MAJOR PROJECT (STAGE – 2) (ME-1891)