SYLLABI

for

B.Tech. Programme

in

Mechanical Engineering

(2019 Onwards)

DEPARTMENT OF

MECHANICAL ENGINEERING

National Institute Of Technology Manipur
Imphal - 795001
India

DEPARTMENT OF MECHANICAL ENGINEERING

B. Tech. SYLLABUS

SEMESTER III

Code	Subject	Lecture	Tutorial	Practical	Credit
MA201	Mathematics III	3	0	0	6
ME201	Engineering Thermodynamics	3	1	0	8
ME203	Strength of Materials	3	0	0	6
ME205	Engineering Materials	3	0	0	6
ME207	Fluid Mechanics	3	0	0	6
Practical					
ME231	Machine Drawing	0	0	5	5
ME233	Strength of Materials Lab	0	0	3	3
SA201	NSS 1/NSO 1/NCC 1	0	0	2	0
Total		**15**	**1**	**10**	**40**

SEMESTER IV

Code	Subject	Lecture	Tutorial	Practical	Credit
MA202	Numerical Methods	3	0	0	6
ME202	Mechanical measurements and Metrology	3	0	0	6
ME204	Kinematics of Machinery	2	1	0	6
ME206	Turbomachines	3	1	0	8
ME208	Manufacturing Technology I	3	1	0	8
Practical					
ME232	Measurements and Metrology Lab	0	0	3	3
ME234	Manufacturing Technology Lab-I	0	0	3	3
ME236	Fluid Mechanics & Turbomachinery Lab	0	0	3	3
SA202	NSS 2/NSO 2/NCC 2	0	0	2	0
Total		**14**	**3**	**11**	**43**

SEMESTER V

Code	Subject	Lecture	Tutorial	Practical	Credit
ME301	Heat and Mass Transfer	3	1	0	8
ME303	Manufacturing Technology II	3	0	0	6
ME305	Dynamics of Machinery	3	1	0	8
ME307	Thermal Engineering I	3	0	0	6
ME309	Design of Machine Elements I	3	0	0	6
Practical					
ME331	Heat Transfer Lab	0	0	3	3
ME333	Manufacturing Technology Lab II	0	0	3	3
ME335	Dynamics of Machines Lab	0	0	3	3
Total		15	2	9	43

SEMESTER VI

Code	Subject	Lecture	Tutorial	Practical	Credit
ME302	Mechatronics	2	1	0	6
ME304	Automobile Engineering	3	0	0	6
ME306	Refrigeration and Air Conditioning	3	0	0	6
ME308	Thermal Engineering II	3	1	0	8
ME310	Design of Machine Elements II	3	1	0	8
Practical					
ME332	Mechatronics Lab	0	0	3	3
ME334	Automobile Engineering Lab	0	0	3	3
ME336	Thermal Engineering Lab	0	0	3	3
Total		14	3	9	43

SEMESTER VII

Code	Subject	Lecture	Tutorial	Practical	Credit
HS401	Industrial Economics	2	0	0	4
ME401	Industrial Engineering and Operations Research	3	0	0	6
ME403	CAD/CAM	3	1	0	8
ME4XX	Departmental Elective I	3	0	0	6
ME4XX	Departmental Elective II	3	0	0	6
Practical					
ME431	CAD/CAM Lab	0	0	3	3
ME433	Project Work I	0	0	3	3
Total		**14**	**1**	**6**	**36**

SEMESTER VIII

Code	Subject	Lecture	Tutorial	Practical	Credit
HS402	Management Principles & Concepts	2	0	0	4
ME4XX	Departmental Elective III	3	0	0	6
ME4XX	Departmental Elective IV	3	0	0	6
XXXXX	Open Elective	3	0	0	6
Practical					
ME431	Project Work II	0	0	9	9
Total		**11**	**0**	**9**	**31**

Credits for I Year	: 80
Credits for Mechanical Engineering (III to VIII Semester)	: 227
Total Credits	: 307

LIST OF DEPARTMENTAL ELECTIVES

DEPARTMENTAL ELECTIVE I

Code	Subject	Lecture	Tutorial	Practical	Credit
ME451	Introduction to Finite Element Method	3	0	0	6
ME453	Energy Conservation	3	0	0	6
ME455	Control Systems	3	0	0	6
ME457	Welding Engineering	3	0	0	6
ME469	Introduction of Two-Phase flow	3	0	0	6
ME471	Elements of Product Design	3	0	0	6
ME473	Materials handling	3	0	0	6
ME475	Elements of Plastic Technology	3	0	0	6
ME477	Production system and control	3	0	0	6

DEPARTMENTAL ELECTIVE II

Code	Subject	Lecture	Tutorial	Practical	Credit
ME459	Introduction to Power Plant Engineering	3	0	0	6
ME461	Advanced Manufacturing Processes	3	0	0	6
ME463	Introduction to Combustion Engineering	3	0	0	6
ME465	Optimization Engineering	3	0	0	6
ME467	Non-Destructive Testing	3	0	0	6
ME481	Introduction of Turbulent Flow	3	0	0	6
ME483	Work System Design	3	0	0	6
ME485	Reliability Engineering	3	0	0	6

DEPARTMENTAL ELECTIVE III

Code	Subject	Lecture	Tutorial	Practical	Credit
ME452	Cryogenics Engineering	3	0	0	6
ME454	Renewable Energy Engineering	3	0	0	6
ME456	Tribology of Bearings	3	0	0	6
ME458	Non-Traditional Machining	3	0	0	6
ME 480	Statistical Process Control	3	0	0	6

DEPARTMENTAL ELECTIVE IV

Code	Subject	Lecture	Tutorial	Practical	Credit
ME460	Industrial Safety	3	0	0	6
ME462	Mechanical Vibration	3	0	0	6
ME464	Introduction to Computational Fluid Dynamics	3	0	0	6
ME466	Introduction to Advanced I. C. Engines	3	0	0	6
ME468	Robotics & Industrial Automation	3	0	0	6
ME470	Industrial Quality Management	3	0	0	6

OPEN ELECTIVE

Open Electives are subjects/Electives offered in any departments, and a student can opt these electives provided the electives are related to his/her areas.

SEMESTER III

ME201 ENGINEERING THERMODYNAMICS (3-1-0-8)

Thermodynamic systems; States, processes, heat and work; Zeroth law; First law; Properties of pure substances and steam, Mollier diagram; Second law, Carnot cycle, entropy, corollaries of the second law; Application of first and second laws to closed and open systems; irreversibility and availability, exergy analysis; Thermodynamic relations; Properties of mixtures of ideal gases; Vapour power cycles - Rankine cycle - Effect of pressure and temperature on rankine cycle -Reheat cycle - Regenerative cycle - Air standard power cycles - Assumptions regarding air standard cycles - Otto , Diesel , dual, Stirling and Brayton cycles. Third Law of Thermodynamics.

Text:

1. **Fundamentals of Thermodynamics**, Sonntag, R.E., Borgnakke, C., and Van Wylen, G.J., 6th Ed., John Wiley, 2003.
2. **Thermodynamics: An Engineering Approach**, Cengal, Y.A., and Boles, M.A, 5th Ed., McGraw-Hill, 2006.

References:

1. **Engineering Thermodynamics**, Nag, P.K., 3rd Ed., Tata McGraw-Hill, 2005.
2. **Fundamentals of Engineering Thermodynamics**, J P Howell and P O Buckius, McGraw Hill, 1992.
3. **Engineering Thermodynamics Work and Heat Transfer**, G F C Rogers and Y R Mayhew, 4th Ed., Pearson 2003.

ME203 STRENGTH OF MATERIALS (3-0-0-6)

Axial and shear stresses and strains – Elasticity, Hook's law – Lateral strain – Poisson's ratio – Volumetric strain – Elastic constants – Stress in composite bars. Strain energy, impact and suddenly applied loads. Thin cylindrical and spherical shells subjected to internal pressure. Principal stresses and their planes. Plane of maximum shear – Mohr's circle of stresses. Thick cylinders – Lame's equation, shrink fit. Compound cylinders. Shear force and bending moment diagrams for beams subjected to different types of loads – Theory of simple bending and assumptions. Leaf spring, shear stress. Deflection – The moment area method, Macaulay's method – superposition (statically determinate beams only). Torsion of solid and hollow circular shafts – Power transmission, strength and stiffness of shafts. Stress and defection in open helical spring. Introduction to buckling of columns.

Texts:

1. **Mechanics of Materials,** Timoshenko, S.P., Gere, M.J., C.B.S., Publishers, 2011.
2. **Strength of Materials,** Ramamurtham, S., Dhanpat Rai Publications, 2005.

References:

1. **Mechanics of Materials,** Beer, Johnston, DeWolf, Mazurek, Tata McGraw Hill, 2013
2. **Engineering Mechanics of Solids,** Popov, E.P., Prentice-Hall, 1999.
3. **Elements of Strength of Materials,** Timoshenko, S., and Young D.H., Tata McGraw Hill, 2006.
4. **Mechanics of Structures,** S.B. Junaikar, Charotar Publishers, 2010.

ME205 ENGINEERING MATERIALS (3-0-0-6)

Atomic Arrangement and Phase Diagrams - Structure of metals and alloys: Phase diagram: phase rules. Phase Diagrams and Ferrous Alloys Fe- FeC diagram, Critical temperature - Plain carbon steel and other steels. Heat Treatment of steel, CCT diagrams, austempering, martempering, ausforrning. Surface hardening process - non - ferrous alloys. Testing of Materials I - Properties evaluated by tensile testing procedure, Engineering stress strain curve vs. true stress-strain curve, stress strain curve for typical materials. Hardness testing. Testing of Materials II - Impact testing, Fracture toughness. Fatigue testing: Creep testing. General classifications, properties and applications of alloy steels, tool steels, stainless steels, cast irons, copper base alloys, Aluminum base alloys, Nickel base alloys, composites, ceramics and polymers.

Texts:

1. **Introduction to Physical Metallurgy,** Avner, S.H., 2nd Ed., Tata McGraw-Hill, 1997.
2. **Mechanical Metallurgy,** Dieter, G.E., McGraw-Hill, 1988.

References:

1. **Physical Metallurgy** V. Singh, , Standard Publishers, 1999
2. **Physical Metallurgy for Engineers,** Donald S. Clark, and Wilbur R. Varney, East-West Press, 1999.
3. **Testing of Metallic Materials,** Suriyanarayana, A.V.K, Tata McGraw-Hill, 2001.
4. **Material Science and Engineering and Introduction,** W.D. Callister, Wiley, 2002.
5. **HeatTreatments: Principles and Techniques,** T.V. Rajan, C.P. Sharma and A. Sharma, Prentice Hall, 1997

ME207 FLUID MECHANICS (3-1-0-8)

Basic concepts - Fluid properties - Basic hydrostatic equation - Manometry - Submerged and floating bodies. Pressure at a point - Hydrostatic equations for incompressible and compressible fluids Manometers - Hydrostatic force on a submerged plane and curved surfaces - Buoyancy and equilibrium of floating bodies - Metacentre - Fluid in rigid motion bodies. Fluid dynamics; integral and differential formulations - Continuity equation - Navier-Stokes equations. Laminar and turbulent flows - Some exact solutions of Navier-Stokes equations – Flow through pipes. Fluid rotation and deformation - Stream function - Condition of irrotationality - Governing equations of potential flow - Laplace equation. Boundary layer concept - Prandtl's equation - Drag on flat plates - Buckingham π-theorem - Dimensionless numbers.

Texts:

1. **Introduction to Fluid Mechanics,** Fox, R.W. and McDonald, A.T., 6th Ed., John Wiley, 2003.
2. **Fluid Mechanics**, White, F.M., 5th Ed., McGraw-Hill, 2003.
3. **A Textbook of Fluid Mechanics and Hydraulic Machines,** Bansal, R.K., 9th Edition, Lakshmi Publications, 2010.

References:

1. **Fluid Mechanics,** Y. A. Cengel and J.M. Cimbala, Tata McGraw-Hill, 2006.
2. **Fundamentals of Fluid Mechanics,** B.R. Munson, D.F. Young and T.H. Okhiishi, 5th Ed., Wiley India Edition, 2002.

3. **Fluid Mechanics,** J.F. Douglas, J.M. Gasiorek, J. A. Swaffield and L.B. Jack, Pearson Education, 2008.
4. **Fluid Mechanics and Machinery, 1/e**, Ojha, P.N. Chandramouli & R. Berndtsson, Oxford University Press, 2010.
1. **Fluid Mechanics,** D.S. Kumar, S. K. Kataria & Sons, 2009.**Manufacturing Processes for Engineering Materials,** S Kalpakjian and S R Schmid, Pearson Education, 2009.
2. **Production Technology,** Jain R.K., Khanna Publishers, 2001.
3. **Elements of Workshop Technology, Vol-II**, Hajra Choudhry, Media Promoters & Publishers, 1994.

ME231 MACHINE DRAWING (0-0-5-5)

Assembly and Part Drawings of simple assemblies and subassemblies of machine parts viz.,couplings, clutches, bearings, gear assemblies, I.C. Engine components, valves, machine tools, etc.; IS/ISO codes; Limits, tolerances and Fits, Surface finish; Symbols for weldments, process flow, electrical and instrumentation units. Introduction to computer aided drafting package to make 2-D drawings. Introduction to solid modellers.

Texts:

1. **Machine Drawing,** Bhatt, N.D., Charotar Publishing House, 2003.
2. **Machine Drawing,** Sidheswar, N., Kannaiah, P. and Sastry, V.V.S., Tata McGraw Hill, 2000.
3. **SP 46: 1988 Engineering Drawing Practice for School and Colleges.** Bureau of Indian Standards.

References:

1. **Engineering Drawing with CAD Applications,** Ostrowsky, O., ELBS, 1995.
2. **Production Drawing,** Kannaiah, P., New Age International, 2009.
3. **Text Book of Machine Drawing,** V. Lakshmi Narayana and M. L. Mathur, M/s Jain Brothers, 2010.
4. **A Text Book of Machine Drawing,** Dhawan, R.K., S. Chand & Company, 1996.

ME233 STRENGTH OF MATERIALS LAB (0-0-3-3)

Study of Stress-Strain characteristics of Steel - Tension test - Compression Test - Strain measurement - Ductility Tests - Shear Test - Hardness Tests - Torsion Test - Bending Test – Impact Test - Test on Spring.

SEMESTER IV

ME202 MECHANICAL MEASUREMENTS AND METROLOGY (3-0-0-6)

Standards - Errors in measurements - Calibration - Basic electrical transducers, force, torque, strain, speed, pressure, flow, temperature and heat flux measurement, pollution measurement – Metrology; Length measurements; Vernier calliper and Vernier height gauge - Angle measurements; Sine bar, clinometers, angle gauges, Vernier bevel protector - Comparators; Their types, relative merits and limitations, use of comparators, construction of Mechanical, electrical & optical comparators - Limits, fits and tolerances - Interferometry - Surface finish; terminology and measurements - Optical measuring instruments. Measurement of screw thread and gear elements - Acceptance test for machines.

Texts:

1. **Experimental Methods for Engineers,** Holman, J.P., Tata McGraw Hill Book Company, New Delhi, 2010.
2. **Mechanical Measurements,**Thomas G. Beckwith and Lewis Buck, Narosa Publishing House, 2009.

References:

1. **Measurement Systems - Applications and Design,** Ernest O. Doeblin, Tata McGraw Hill Book Company, New Delhi, 2011.
2. **Engineering Metrology,** Jain R K, 3rd Ed., Khanna Publishers, Delhi (1998).
3. **Theory and Design for Mechanical Measurements,** Figliola, Richard S, & Beasley, Donald E, 3rd Ed., John Wiley & Sons Inc.
4. **Handbook of Industrial Metrology,** American Society of Tool and Manufacturing Engineers, Prentice Hall of India Pvt. Ltd.

Mechanical Measurements, T.G. Beckwith, R.D. Marangoni and J.H. Lienhard, 5th Ed., Addison Wesley, 1993.

ME204 KINEMATICS OF MACHINERY (2-1-0-6)

Mechanisms - classification of mechanisms, Kinematic inversions - Grashoff's law -Inversions of slider crank mechanism, Coupler curves, spatial mechanisms - Straight-line generators. Slider crank mechanisms and four bar mechanism; Velocities of points on a rigid body -relative velocity - velocity polygon Acceleration of points on a rigid body - relative acceleration - acceleration polygon - Coriolis acceleration - analytical method . Chebyshcv spacing for precision positions - Structural error - Overlay method – Complex curve synthesis - Roberts Chebyshev theorem - Frudenstine's equation; Analytical synthesis using complex algebra; synthesis of dwell mechanism. Classification of cam and follower - displacement diagrams - Graphical layouts of cam profiles. Derivatives of follower motion. High speed cams standard motions. Plate cams with flat face and roller followers. Terminology and definitions - law of gearing - profile for gears - Involute gearing -Interchangeability - Interference and undercutting. Contact ratio. Standard and stub gear teeth. Contact ratio. Gear trains - types - Parallel axis gear trains. Epicyclic gear trains.

Texts:

1. **Theory of Machines and Mechanisms,** J. J Uicker (Jr), G. R Pennock and J. E Shigley, 3rd Ed., Oxford International Student Edition, 2009.

2. **Mechanism and Machine Theory,** J. S. Rao, R. V. Dukkipat, 2nd Ed., New Age International, 2008.

References:

1. **Kinematics, Dynamics and Design of Machinery,** K. J, Waldron and G. L Kinzel, 2nd Ed., Wiley Student Edition, 2004.
2. **Theory of Mechanisms and Machines,** A.Ghosh and A. K. Mallik, 3rd Ed., East West Press Pvt. Ltd, 2009.
3. **Theory of Machines,** S. S. Rattan, 3rd Ed., Tata McGraw Hill, 2009.
4. **Kinematics and Dynamics of Machinery,** R. L. Norton, Tata McGraw Hill, 2009.
5. **Mechanism Design, Analysis and Synthesis Volume 1,** G. Erdman and G. N. Sandor, PHI, Inc., 1997.
6. **Theory of Machines,** T. Bevan, CBS Publishers and Distributors, 1984.
7. **Theory of Machines,** R.S. Khurmi and J.K. Gupta, S. Chand Publishing, 2010.

ME206 TURBOMACHINES (3-0-0-6)

Introduction - Classification - Dimensional analysis - Specific speed - Basic laws and equations. Hydraulic turbines; Pelton, Francis, and Kaplan turbines - Turbine efficiencies - Cavitation in turbines. Centrifugal pumps; theory, components, and characteristics - Cavitation - Axial flow pumps - Pump system matching. Centrifugal and axial flow compressors; slip, surging and chocking. Steam Turbine: impulse and reaction stage, degree of reaction, velocity triangle, velocity and pressure compounding, efficiencies, reheat factor, governing, nozzles - Gas turbine; basic cycle and multi-staging - Power and efficiency calculations. Combustion Chambers; Jet Propulsion.

Texts:

1. **Fluid Mechanics and Thermodynamics of Turbomachines,** Dixon, S.L., 5th Ed., Butterworth-Heinemann, 2005.
2. **Hydraulic and Compressible Flow Turbomachines,** Sayers, A.T., CBLS, 2003.
3. **A Textbook of Fluid Mechanics and Hydraulic Machines,** Bansal, R.K., 9th Edition, Lakshmi Publications, 2010.

References:

1. **Gas Turbine Theory,** H.I.H Saravanamuttoo, G.F.C. Rogers and H. Cohen, 4th Ed., Pearson, 2003.
2. **Fluid Dynamics and Heat Transfer of Turbomachinery,** Lakshminarayana, B., Wiley-Interscience, 1995.
3. **Fluid Mechanics,** F. M. White, 6th Ed., Tata McGraw-Hill, 2008
4. **Introduction to Fluid Mechanics,** R.W. Fox, A.T. McDonald and P.J. Pritchard, 6th Ed., John Wiley, 2004
5. **Fundamentals of Fluid Mechanics,** B.R. Munson, D.F. Young, and T.H. Okhiishi, 5th Ed., Wiley India Edition, 2002
6. **Modern Compressible Flow,** J. D. Anderson (Jr.), McGraw-Hill International Ed., 1990.
7. **Fluid Mechanics,** Y. A. Cengel and J.M. Cimbala, Tata McGraw-Hill, 2006.
8. **Gas Turbines,** Ganesan, V., 2nd Ed., Tata McGraw-Hill, 2003.

ME208 MANUFACTURING TECHNOLOGY I (3-0-0-6)

Introduction to manufacturing processes: Moulding materials and their requirements; Patterns: Types and various pattern materials. Casting processes: Various casting methods, viz., sand casting investment casting, pressure die casting, centrifugal casting, continuous casting, thin roll casting; Mould design; Casting defects and their remedies. Metal joining processes: brazing, soldering, welding; Solid state welding methods; resistance welding; arc welding; submerged arc welding; inert gas welding; Welding defects, inspection. Metal forming Processes: Various metal forming techniques and their analysis, viz., forging, rolling, extrusion, wire drawing, sheet metal working, spinning, swaging, thread rolling; Super plastic deformation; Metal forming defects. Powder metallurgy and its applications.

Texts:

1. **Manufacturing Science,** A Ghosh and A K Mallik, Wiley Eastern, 1986.
2. **Manufacturing Technology: Foundry, Forming and Welding,** P N Rao, Tata McGraw Hill, 2008.

References:

4. **Principles of Manufacturing Materials and Processes,** J S Campbell, Tata McGraw Hill, 1995.
5. **Solidification Processing,** F C Flemmings, Tata McGraw Hill, 1982
6. **Production Engineering Sciences,** P C Pandey and C K Singh, Standard Publishers Ltd., 2003.

ME232 MEASUREMENTS AND METROLOGY LAB (0-0-3-3)

Calibration of LVDT, thermocouple, pressure gauges, Strain Gauges and flow meters. Use of various metrological tools like slip, angle gauge, feeler, taper, fillet, thread gauges, estimation of internal dimensions Measurements on precision instruments; sine bar, CMM - Universal measuring microscope, Profile projector - Electronic comparator, optical flat, surface roughness - Gear tooth thickness - MAAG gear tester.

ME234 MANUFACTURING TECHNOLOGY LAB I (0-0-3-3)

Introduction to machine tools and machining processes; Types of cutting tools; Selection of cutting speeds and feed; Lathe – Simple / Step / Taper Turning, Thread Cutting, Drilling and Boring. Shaping – V – Cutting Milling – Job requiring Indexing. Hobbing – Spur Gear Cutting Grinding – Surface / Cylindrical grinding CNC Lathe – Simple Turing, Step Turning, Thread Turing Machining Center – A typical job production.

ME236 FLUID MECHANICS & TURBOMACHINERY LAB (0-0-3-3)

Determination of pipe friction. Calibration of venturimeter, orifice-meter and water-meter. Determination of discharge coefficients for notches and weirs. Determination of viscosity of fluid. Determination of minor losses. Determination of discharge coefficients for mouthpiece and orifice. Flow through helical coils. Determination of metacentric height. Laminar and turbulent flow; Application of momentum equations.
Performance Tests of Pumps and turbines.

SEMESTER V

ME301 HEAT AND MASS TRANSFER (3-1-0-8)

Modes of heat transfer; Conduction: 1-D and 2-D steady conduction; 1-D unsteady conduction-Lumped capacitance and analytical methods; Fins. Convection: fundamentals, order of magnitude analysis of momentum and energy equations; hydrodynamic and thermal boundary layers; dimensional analysis; free and forced convection; external and internal flows; heat transfer with phase change. Radiation: Stefan-Boltzmann law; Planck's law; emissivity and absorptivity; radiant exchange between black surfaces. Heat exchangers: LMTD and e − NTU methods; heat transfer enhancement techniques. Mass transfer: molecular diffusion; Fick's law; analogy between heat and mass transfer; evaluation of mass transfer coefficients by dimensional analysis.

Texts:

1. **Fundamentals of Heat and Mass Transfer,** Incropera, F.P. and Dewitt, D.P., 5th Ed., John Wiley,2002.
2. **Heat Transfer,** Holman, J.P., 9th Ed., Tata McGraw-Hill, 2004.

References:

1. **Heat Transfer - A Basic Approach,** Ozisik, M.N., McGraw-Hill, 1985.
2. **Heat Transfer - A Practical Approach,** Cengel, Y.A., McGraw-Hill, 1998.
3. **Convective Heat Transfer,** Bejan, A., 3rd Ed., John Wiley and Sons, 2004.
4. **Principles of Heat Transfer,** Kreith F., and Von, M. S., 6th Ed., Brook and Cole Publication, 2001.

ME303 MANUFACTURING TECHNOLOGY II (3-0-0-6)

Metal Cutting: Mechanics, tools (material, temperature, wear, and life considerations), geometry and chip formation; surface finish and machinability; optimization; Machine tool: Generation and machining principles; Setting and Operations on machines: lathe, milling (including indexing), shaping, slotting, planing, drilling, boring, broaching, grinding (cylindrical, surface, centreless), thread rolling and gear cutting machines; Tooling: Jigs and fixtures, principles of location and clamping; Batch production: CNC machines; Finishing: Micro finishing (honing, lapping, super finishing); Unconventional methods: electro-chemical, electro-discharge, ultrasonic, LASER, electron beam, water jet machining etc.; Rapid prototyping and rapid tooling.

Texts:

1. **Manufacturing Science,** A Ghosh and A K Mallik, Wiley Eastern, 1986.
2. **Introduction to Machining Science,** G K Lal, New Age International Pvt. Ltd., 2007.

References:

1. **Production Technology,** HM T Publication, Tata McGraw Hill, 1980.
2. **Metal Cutting Principles,** M C Shaw, MIT Press, 2004.
3. **Nonconventional Machining,** P K Mishra, Narosa Publishing House, 1997.
4. **Production Technology,** R.K. Jain, Khanna Publishers, 2001.
5. **Elements of Workshop Technology, Vol – II**, Hajra Choudhry, Media Promoters & Publishers, 1994.

ME305 DYNAMICS OF MACHINERY (3-1-0-8)

Static and dynamic force analysis of mechanisms - Flywheel function and design. Balancing of rotating masses in one and in several planes - Balancing of reciprocating masses – Single and multi-cylinder engines. Governors; gravity and spring controlled governors - Gyroscopic effect. Vibration; free and forced vibrations - Single degree and multi-degree freedom systems. Vibration control - Passive and active control.

Texts:

1. **Theory of Machines and Mechanisms,** J. J Uicker (Jr), G. R Pennock and J. E Shigley, 3rd Ed., Oxford International Student Edition, 2009.
2. **Mechanism and Machine Theory,** J. S. Rao, R. V. Dukkipat, 2nd Ed., New Age International, 2008.

References:

1. **Kinematics, Dynamics and Design of Machinery,** K. J, Waldron and G. L Kinzel, 2nd Ed., Wiley Student Edition, 2004.
2. **Theory of Mechanisms and Machines,** A.Ghosh and A. K. Mallik, 3rd Ed., East West Press Pvt. Ltd, 2009.
3. **Theory of Machines,** S. S. Rattan, 3rd Ed., Tata McGraw Hill, 2009.
4. **Kinematics and Dynamics of Machinery,** R. L. Norton, Tata McGraw Hill, 2009.
5. **Mechanism Design, Analysis and Synthesis Volume 1,** G. Erdman and G. N. Sandor, PHI, Inc., 1997.
6. **Theory of Machines,** T. Bevan, CBS Publishers and Distributors, 1984.
7. **Theory of Machines,** R.S. Khurmi and J.K. Gupta, S. Chand Publishing, 2010.

ME307 THERMAL ENGINEERING I (3-0-0-6)

Vapour Power Cycles: Carnot cycle, Rankine cycle, reheat cycle, regenerative cycle, steam cycles for nuclear power plant, back-pressure and extraction turbines and cogeneration, low-temperature power cycles, ideal working fluid and binary/multi-fluid cycles; Steam Generator: subcritical and supercritical boilers, fluidized bed boilers, fire-tube and water-tube boilers, mountings and accessories; Condenser; Cooling Tower: hygrometry and psychrometric chart.

Texts:

1. **Engineering Thermodynamics Work and Heat Transfer,** G.F.C Rogers and Y. R. Mayhew, 4th, Ed., Pearson, 2003.
2. **Applied Thermodynamics for Engineering Technologists,** T.D. Eastop and A. McConkey, 5th Ed., Pearson, 2003.

References:

1. **Fundamentals of Engineering Thermodynamics,** M.J. Moran and H N Shapiro, 3rd Ed., John Wiley, 1995.
2. **Power Plant Technology,** M.M. El Wakil, McGraw Hill International, 1992.
3. **Power Plant Engineering,** P.K. Nag, 2nd Ed., Tata McGraw Hill, 2002.
4. **Power Station Engineering and Economy,** W.A. Vopat, B.G.A. Skrotzki, Tata McGraw Hill, New Delhi, 1999.
5. **Thermal Engineering,** R.K. Rajput, Laxmi Publications, New Delhi, 2006.

ME309 DESIGN OF MACHINE ELEMENTS I (3-0-0-6)

Mechanical engineering design - Design considerations - Material selection - Modes of failure - Theories of failure - Endurance limit - Stress concentration - Factor of safety. Design of shafts and couplings - Design of cotter and knuckle joints. Helical and leaf springs. Fasteners and keys - Design of welded joints - Fillet and butt welds - Design of riveted joints. Design of sliding contact bearings - Selection of rolling contact bearings.

Text:

1. **Machine Design,** Sundararajamoorthy, T.V. and Shanmugam, N., Anuradha Agencies, 2003.
2. **Mechanical Engineering Design,** Shigley, J.E., Charles, R.M. and Richard, G.B., 7th Ed., McGraw-Hill, 2004.

References:

1. **Machine Design**, R.S. Khurmi and J.K. Gupta, S. Chand Publishing, 2010.
2. **Design of Machine Elements,** Bhandari, B., 3rd Ed., Tata McGraw Hill, New Delhi, 2009.
3. **Machine Design: An Integrated Approach,** Norton, R.L., 2nd Ed., Pearson, 2004.

ME331 HEAT AND MASS TRANSFER LAB (0-0-3-3)

Experiments in conduction, free and forced convection, radiation and heat exchangers.

ME333 MANUFACTURING TECHNOLOGY LAB II (0-0-3-3)

Introduction to machine tools and machining processes; Types of cutting tools; Selection of cutting speeds and feed; Lathe – Simple / Step / Taper Turning, Thread Cutting, Drilling and Boring. Shaping – V – Cutting Milling – Job requiring Indexing. Hobbing – Spur Gear Cutting Grinding – Surface / Cylindrical grinding CNC Lathe – Simple Turing, Step Turning, Thread Turing Machining Center – A typical job production.

ME335 DYNAMICS OF MACHINES LAB (0-0-3-3)

Balancing. Measurement of moment of inertia of rigid bodies. Gyroscope. Jump speed of a cam. Mechanical vibrations: Bifilar, trifilar, compound pendulums. Damping: damping and critical damping coefficients, logarithmic decrement, coulomb damping, Natural frequencies of coupled pendulum.

SEMESTER VI

ME302 MECHATRONICS (3-0-0-6)

INTRODUCTION: Introduction to Mechantronics-Systems-Measurement Systems-Control Systems-Mechatronics Approach. SENSORS AND TRANSDUCERS: Introduction-Performance, Terminology-Displacement, Position and Proximity-Velocity and Motion Fluid Pressure-Temperature Sensors-Light Sensors-Selection of Sensors-Signal Processing. 8085 MICROPROCESSOR: Introduction-Architecture-Pin Configuration-Instruction set-Programming of Microprocessors using 8085 instructions-Interfacing input and output devices-Interfacing D/A converters and A/D converters-Applications- Temperature control-Stepper motor control-Traffic light controller. PROGRAMMABLE LOGIC CONTROLLERS: Introduction-Basic structure-Input/Output Processing-Programming-Mnemonics-Timers, Internal relays and counters-Data handling-Analog Input/Output-Selection of a PLC. DESIGN AND MECHATRONICS: Stages in Designing mechatronic systems - Traditional and Mechatronic design -Possible design solutions-Case studies of mechatronic systems - Pick and place robot - automatic car park system -engine management system.

Texts:

1. **Mechatronics,** Longman, W. Bolton, Second Edition, 1999.
2. **Introduction to Mechatronics and Measurement Systems,** Michael B. Histand and David G. Alciatore, McGraw Hill International Editions, 1999.

References:

1. **Mechatronics,** HMT Ltd., Tata McGraw Hill Publishing Co. Ltd., 1998.
2. **Mechatronics**, Dan Necsulescu, Pearson Education Asia, 2002 (Indian reprint).
3. **Mechatronics System Design,** Devdas Shetty and Richard, A. K., Vikas Publishing House Private Ltd., New Delhi, 2002.

ME304 AUTOMOBILE ENGINEERING (3-0-0-6)

General classification of vehicles - Power unit - All components of power unit. Steering systems - Power steering - Wheel and suspension systems - Transmission system; clutches, couplings, gear boxes, and torque converters. Axles - Differentials - Mechanical, hydraulic, and pneumatic brakes - Power brakes – Four wheel drive. Electrical systems; construction, operation, and maintenance of batteries - Starter motors. Lighting and electrical accessories - Panel board instruments - Automobile air conditioning - troubleshooting.

Texts:

1. **Automotive Engineering, Vol. I & II,** Kirpal Singh, Standard Publishers, New Delhi, 2002
2. **Automotive Mechanics Principle and Practice,** Heitner, J. 2nd Ed., Affiliated East-West Press Ltd., 1974.

References:

1. **The Motor Vehicle,** Newton, K., Steeds, W., and Garrett, T.K., Butterworths, 1989.
2. **Automotive mechanics,** William H., Crouse & Donald L Anglin, 10th Edition Tata McGraw Hill Publishing Company Ltd., 2007.
3. **Automotive Mechanics,** S. Srinivasan, 2nd Ed., Tata McGraw Hill, 2003

ME306 REFRIGERATION AND AIR CONDITIONING (3-0-0-6)

Introduction about Refrigeration – Definitions of various terms. Methods of refrigeration. Air refrigeration system. Bell – Coleman cycle. Introduction about Air-craft Air Conditioning. Analysis of Vapour compression cycle, Modifications to basic cycle. Multi pressure systems. Multi-evaporator system and Cascade systems. Properties of refrigerants. Selection of refrigerants. Discussion of components of V.C system, Servicing. Vacuumizing and charging of refrigerant. Introduction to cryogenics. Psychrometry – Definitions for properties. Introduction to cooling load calculations. Comfort conditions. Effective temperature concept. Air-conditioning systems – discussion about the central plant with direct evaporator and chiller applications, Ice plant, refrigerators. Food preservation, IQF technique and freeze drying etc. Cold storage and thermal insulation.

Texts:

1. **Refrigeration and Air-conditioning,** Arora, C. P., 3rd Edition, Tata McGraw Hill Publications, New Delhi, 2008.
2. **Principles of Refrigeration,** Roy, J. Dossat, 4th Edition, Pearson. 2010.

References

1. **Refrigeration and Air-Conditioning,** Stoecker and Jones, Tata McGraw Hill Publications, New Delhi, 2008.
2. **Refrigeration and Air Conditioning,** Manohar Prasad, New Age International, 2004.
3. **Refrigeration and Air-Conditioning,** Arora, S.C. and Domkundwar, S, Dhanpat Rai Publication, 2010

ME308 THERMAL ENGINEERING II (3-0-0-6)

Reciprocating air compressors - types - construction - work of compression without clearance - effect of clearance – Multistaging - optimum intermediate pressure for perfect inter cooling - Compressor efficiencies and mean effective pressure. Working of two and four stroke engines - valve and port timing diagrams - Deviation of engine indicator diagram from air standard cycles - Fuel air cycles and their analysis, Comparison of air standard and fuel air cycles - Losses in actual cycles. I.C. engines fuels and rating -SI engine air fuel mixture requirements - Performance curve of an automobile carburettor - Diesel injection systems - types - Jerk type pump – Injection pump governors. Types of nozzles - Introduction to petrol injection. Battery Ignition - magneto ignition and transistorized coil ignition - Combustion in SI engines - Knock in SI engines - effect of engine variable on knock - Combustion in CI engines - knock in CI engines - combustion chambers for SI and CI engines. I.C. Engine testing - Measurement of friction power - Indicated power - Electronic Indicator- Brake power - dynamometers - Instruments for measuring emission of NOx , CO, Unburnt HC and smoke - engine efficiencies - Heat balance - Scavenging in two stroke engines.

Texts:

1. **Engineering Thermodynamics Work and Heat Transfer,** G. F. C. Rogers and Y. R. Mayhew, 4th Ed., Pearson, 2001.
2. **Applied Thermodynamics for Engineering Technologists,** T. D. Eastop and A. McConkey, W. W. Pulkrabek, Engineering Fundamentals of the Internal Combustion Engine, PHI, 2002.

References:

1. **Gas Turbine Theory,** H. I. H Saravanamuttoo, G. F. C. Rogers and H. Cohen, 4th Ed., Pearson, 2003.
2. **Internal Combustion Engines,** C. R. Fergusan and A. T. Kirkpatrick, John Wiley & Sons, 2001.
3. **Thermal Engineering,** R.K. Rajput, Laxmi Publications, New Delhi, 2006.

ME310 DESIGN OF MACHNE ELEMENTS II (3-1-0-8)

Introduction to transmission elements - Positive and friction based drives. Importance of friction based drives - Design of flat and V-belts - Design of rope and chain drives. Design of brakes and clutches. Design of spur and helical gears based on contact and beam strength. Design of bevel and worm gears. Design of multi-speed gearbox - Preparation of ray diagram and kinematic arrangement diagram for multi-speed gearbox.

Text:

1. **Machine Design,** Sundararajamoorthy, T.V. and Shanmugam, N., Anuradha Agencies, 2003.
2. **Mechanical Engineering Design,** Shigley, J.E., Charles, R.M. and Richard, G.B., 7th Ed., McGraw-Hill, 2004.

References:

1. **Machine Design**, R.S. Khurmi and J.K. Gupta, S. Chand Publishing, 2010.
2. **Design of Machine Elements,** Bhandari, B., 3rd Ed., Tata McGraw Hill, New Delhi, 2009.
3. **Machine Design: An Integrated Approach,** Norton, R.L., 2nd Ed., Pearson, 2004.

ME332 MECHATRONICS LAB (0-0-3-3)

Verification of basic specifications of operation amplifier from data sheet; OP-amp Ck1amplifier (inverting and Non-inverting) P-amp Ck2 wave form generation (square wave, triangular wave); OP-amp Ck3 Integrator, Differentiator; OP-amp Ck4 V-I converter & I-V converter. Study of transducers: RTD + Signal Conditioning Circuit; Study of LVDT with accessory chip; Study of Digital Gates - SOP realization. Study of Microprocessor instruction set; Simple programs using 8085 microprocessor -Addition, Use of functions, Peripheral chips, Waveform generation. Usage of interrupts, Stepper motor control, Key board interface, Heater control; Study of PLC; Study of tools such as PSPICE; Usage of simulators (any other microprocessor)

ME334 AUTOMOBILE ENGINEERING LAB (0-0-3-3)

Study on engine components. Fuel systems. Ignition systems - Transmission systems - Steering systems. Suspension and braking systems. Wheel Alignment and Wheel Balancing of automobile vehicle. Layout of electrical wiring - Light and heavy vehicles.

ME336 THERMAL ENGINEERING LAB (0-0-3-3)

Property determination for fuels and lubrication oil. Study and performance testing of IC engines. Study and performance testing of air compressor. Emission measurements.
Study and performance tests on refrigeration.
Study and performance tests on air conditioning test rig.

SEMESTER VII

HS403 INDUSTRIAL ECONOMICS (2-0-0-4)

Demand and Supply – Forecasting techniques – Cost and Revenues. Competitive nature of the firms – Keynesian economics – National income. Trade cycle – Inflation – Index numbers – Capital budgeting – Cash flow analysis – Balance sheet. Risk and Decision Making – Technological Change in Global Economy – Locating the Firm in a global economy – Taxes and Decision Making. Exchange Rate determination – Marketing – Product life cycle – Marketing research – Branding – Personality – Motivation – Leadership – Working in Teams.

Texts:

1. **Business Economics,** Adhikary Manab, Excel Books, 2004.
2. **Macro Economics Theory & Policy,** Dwivedi, D.N., Tata McGraw-Hill, 2005.

References:

1. **Soundarapandian Jayavel,** Aczel D. Amir, Complete Business Statistics, Tata McGraw-Hill, 2005.
2. **Organizational Behaviour,** Robins P. Stephen, Prentice-Hall, 2002.

ME401 INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH (3-0-0-6)

Introduction, Production Planning and Control, Product design, Value analysis and value engineering, Plant location and layout, Equipment selection, Maintenance planning, Job, batch, and flow production methods, Group technology, Work study, Time and motion study, Incentive schemes, Work/job evaluation, Inventory control, Manufacturing planning: MRP, MRP-II, JIT, CIM, Quality control, Statistical process control, Acceptance sampling, Total quality management, Taguchi's Quality engineering. Forecasting, Scheduling and loading, Line balancing, Break-even analysis. Introduction to operations research, linear programming, Graphical method, Simplex method, Dual problem, dual simplex method, Concept of unit worth of resource, sensitivity analysis, Transportation problems, Assignment problems, Network models: CPM and PERT, Queuing theory.

Texts:

1. **Production, Planning and Inventory Control,**S. L. Narasimhan, D. W. McLeavey, and P. J. Billington, Prentice Hall, 1997.
2. **Production Systems: Planning, Analysis and Control,** J. L. Riggs, 3rd Ed., Wiley, 1981.

References:

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

ME403 CAD/CAM (3-0-0-6)

Principles of Computer Aided Design (CAD): Computer configuration for CAD applications, Computer peripherals for CAD. Fundamentals of Computer Graphics: Two dimensional transformation, three

dimensional transformation and projections. PLANE CURVES AND SPACE CURVES: Surface description and generation. Hidden line algorithms for wire frame modeling. Solid modeling. Introduction to Computer Aided Drafting and Analysis Softwares such Auto CAD, PRO ENGINEER, ANSYS, etc. CAD System utilization and application.

Computer Aided Manufacturing (CAM): Introduction; Numerical control of machine tools, nomenclature, types, features, MCU. Transducers: Tooling for N.C. Machines, ISO G & M Codes, N.C. part programming, tool setting, cutter compensation, parametric programming, APT language structure, APT Geometry, motion commands, post processor commands, repetitive programming, compilation and control commands. Introduction to Computer Aided Process Planning; Introduction to Flexible Manufacturing Systems.

Texts:

1. **CAD/CAM Theory and Practice,** Ibrahim Zeid and Sivasubramanian, R., Tata McGraw Hill Publications, New Delhi, 2009.
2. **Automation, Production Systems & Computer Integrated Manufacturing.** Groover M.P.," Prentice Hall, 1989.

References:

1. **Computer Control of Manufacturing Systems,** Yoram Koren, McGraw Hill Student edition, 2005.
2. **CAD / CAM Principles and Applications,** Rao, P.N., McGraw Hill Publishers, New Delhi, 2010.
3. **Mathematical Elements for Computer Graphics**, Rogers David F. and Alan Adams J., McGraw Hill, 1990.
4. **Numerical Control and Computer Aided Manufacturing**, Kundra T. K., Rao P. N. and Tewari M. K., Tata McGraw Hill, 1990.
5. **Computer Aided Design,** Krishnamoorthy C.S. and Rajeev S., Narosa Publishing House, 1991.
6. **Computer Aided Design and Manufacturing**, Groover M.P. and Zimmers E.W., Prentice Hall India, 1997.
7. **Computer Aided Manufacturing,** Elanchezhian C, Selwyn Sunder T and Shanmuga Sundar G., Laxmi Publications, New Delhi, 2006.
8. **CNC Programming,** Sinha S. K., Galgotia Publications, 2004.

ME431 CAD/CAM LAB (0-0-3-3)

1. Drafting practice using drafting package for drawing option.
2. Drafting practice using drafting package for modify option.
3. Drafting practice using drafting package for dimensional approach.
4. Programming practice for a given problem.
5. Programming practice for graphic application.
6. Practice for data exchange from draft package.
7. Drafting of design component
8. Demonstration of 3D modeling using CAD Packages.
9. Demonstration of stress analysis using FEA package.

SEMESTER VIII

HS404 MANAGEMENT PRINCIPLES AND CONCEPTS (3-0-0-6)

Introduction to management –Evolution of scientific management, modern management, Principles-Elements of management planning, organizing, staffing, directing, coordinating, reporting, budgeting. Financial management, objectives, scope, Techniques of investment analysis, Payback period, sources of financing, technology management, product design, and plant layout. Inventory management, project management, PERT, CPM- Applications. Significance of Human resources management, HR Planning, Job evaluation, recruitment and selection. Placement and induction, training, Performance appraisal, compensation, Industrial relations.

Texts:

1. **Principles and practice of Management,** Prasad, L.M., Sultan Chand & Sons, 2006.

References:

1. **Principles of Management,** Gupta, R.N., Sultan Chand & Co, 2001.

DEPARTMENTAL ELECTIVE I

ME451 INTRODUCTION TO FINITE ELEMENT METHOD (3-0-0-6)

Introduction - Illustration using spring systems and simple problems - Weighted residual methods Galerkin's method - Variational approach - Rayleigh-Ritz method. One-dimensional finite element analysis; bar element, beam element, frame element – Heat transfer problems. Two-dimensional finite element analysis; types of elements, shape functions, natural coordinate systems. Applications to structural mechanics - Numerical integration - Solution of finite element equations. Fluid flow problems - Dynamic problems.

Texts:

1. **An introduction to the Finite Element Method,** JN Reddy, McGraw-Hill, New York, 1993.
2. **Textbook of Finite Element Analysis,** Seshu, P., Prentice-Hall, India, 2003.

References:

1. **Applied Finite Element Analysis,** Segerlind, L.J., John Wiley, 1987.

ME453 ENERGY CONSERVATION (3-0-0-6)

Energy resources and use. Potential for energy conservation. Optimal utilization of fossil fuels. Total energy approach. Coupled cycles and combined plants. Cogeneration systems. Exergy analysis. Utilization of industrial waste heat. Properties of exhaust gas. Gas-to-gas, gas-to-liquid heat recovery systems. Recuperators and regenerators. Shell and tube heat exchangers. Spiral tube and plate heat exchangers. Waste heat boilers: various types and design aspects. Heat pipes: theory and applications in waste heat recovery. Prime movers: sources and uses of waste heat. Fluidized bed heat recovery systems. Utilization of waste heat in refrigeration, heating, ventilation and air conditioning systems.

Thermoelectric system to recover waste heat. Heat pump for energy recovery. Heat recovery from incineration plants. Utilization of low grade reject heat from power plants. Need for energy storage: Thermal, electrical, magnetic and chemical storage systems. Thermo-economic optimization.

Texts:

1. **Combined Heat and Power,** J. H. Harlock, Pergaman Press, 1987.
2. **Energy Efficiency,** F. Kreith and R. E. West, CRC handbook, CRC Press,1999

References:

1. **Compact Heat Exchangers,** Kays and London, 3rd Ed., McGraw-Hill, New York.

ME455 CONTROL SYSTEMS (3-0-0-6)

Linear state variable systems: Continuous time systems, Discrete time systems, minimum phase systems, Reachability, Controllability, Observability, Realization and canonical forms, State variable feedback, stabilizability, and Dectectability, Output feedback. Optimal control of mechanical systems: Continuous time linear quadratic regulator (LQR), Steady state and sub optimal control, minimum time and constrained input design, LQR with output feedback, tracking problems. State estimators: Continuous observer, Reduced order observer, Kalman filter. Linear quadratic Gaussian (LQG) design, LQG/LTR design.

Texts:

1. **Modern Control Engineering,** K. Ogata, 3rd Ed., Prentice Hall 1994.
2. **Applied Optimal control and Estimation,** F.L. Lewis, Prentice Hall, 1992.

References:

1. **Control Systems Design,** B. Friedland, McGraw Hill, 1986

ME457 WELDING ENGINEERING (3-0-0-6)

Welding Processes - 1- Gas welding, manual, submerged arc, TIG, MIG welding, plasma arc. Electroslag, electro-gas welding, pressure welding processes - cold and hot pressure welding. resistance, friction and explosive welding. Plastic and ceramic welding. Welding Processes - 2 - Radiant energy and solid phase welding processes and equipment -Beam power control. Laser beam cutting, under water welding. Diffusion welding. Allied Processes Brazing, Soldering, Cutting, Surfacing Methods - Need, Flame Spraying. Plasma Spraying. Welding metallurgy- weld thermal cycles and their effects - structural changes in different materials, effect of pre and post heat treatment. Weldability. Testing And Design of Weldment - Design and quality control of welds. Edge preparation types of joints, weld symbols. Stresses in butt and fillet welds - weld size calculations. Design for fatigue. Testing - tensile, bend hardness. Impact, notch and fatigue tests. Visual examination - liquid penetration test, magnetic particle examination. Radio graphs, ultrasonic testing. Life assessment of weldments.

Texts:

1. **Welding Methods and Metallurgy,** Jackson, M.D., Charles Griffin & Company, London, 1967.
2. **American Welding Society,** AWS, Volume I to V, Miami, 1982.

References:

1. **Metallurgy,** George E. Linnert, GML Publications, South Carolina, U.S.A., 1994.

2. **Welding and Welding Technology,** Little LR, Tata McGraw-Hill, New Delhi, 1980.

ME 469 Introduction of Two-Phase flow (3-0-0-6)

Formulation and Solution to Phase Change Problem, Two Phase Flow Fundamentals, Review of one-dimensional conservation equations in single phase flows; Governing equations for homogeneous, separated and drift-flux model; Flow pattern maps for horizontal and vertical systems; Simplified treatment of stratified, bubbly, slug and annular flows.

References:

1. J.G. Collier and J.R. Thome, Convective Boiling and Condensation, 3rd ed., Oxford University Press, 1996
2. C. Kleinstreuer, Two-Phase Flow: Theory and Applications, Taylor & Francis, 2003.
3. G.B. Wallis, One-Dimensional Two-Phase Flow, McGraw-Hill, 1969.
4. P B Whalley, Boiling, Condensation and Gas-Liquid Flow. Oxford University Press, 1987.
5. L.S. Tong and Y.S. Tang, Boiling Heat Transfer and Two-Phase Flow, 2nd ed., Taylor and Francis, 1997.
6. M. Ishii and T. Hibiki, Thermo-Fluid Dynamics of Two-Phase Flow, Springer, 2006.

ME471 Elements of Product Design (3-0-0-6)

Design Definitions and Design Spectrum; Product Attributes – Function and Emotion; Product configurations and Component relationships (component Matrix); Introduction to Design Research; Product Analysis – Diachronic, Synchronic; Understanding and Analyzing contexts, parallel situations, future situations; Understanding modularity and modular systems – 3D lattice and structures; Design of Modular System – abstract design; Process of conception and its documentation; Seminar and exercises related to above topics

Text/ References:

1. Jones, J.C : Design methods: Seeds of human futures, Wiley inter science, London, 1992.
2. Gorb, Peter, Ed. Living by Design, Lund Humphries, London 1978.
3. M.M Andereasen, Integrated Product Development, IFS Publications Ltd. / Springer Verlag, Berlin, 1987.
4. Asimow Morris; Introduction to Design, Prentice Hall, Englewood Cliffs, N.J., 1962.
5. Pulos, Arthur, The American Design Ethic, MIT, USA, 1983.
6. Roozenburg and Eekels, Product Design: Fundamentals and Methods, Publisher: John Wiley & Sons Inc; New Ed edition, 1995

7. Ulrich, Karl T., Eppinger, Steven D.; Product Design and Development, McGraw-Hill 1995, 2000, 2004

ME473 Materials handling (3-0-0-6)

Elements of Material Handling System; Selection of Material Handling Equipments; Design of Mechanical Handling Equipments; [A] Design of Hoists [B] Design of Cranes –Design of load lifting attachments: Study of systems and Equipments used for Material Storage: Material Handling / Warehouse Automation and Safety considerations: [A] Storage and warehouse planning and design; [B] Safety and design; Safety regulations and discipline.

Texts/References:

1. N. Rudenko, 'Material Handling Equipments', Peace Publishers, Moscow. 1969
2. James M. Apple, 'Material Handling System Design', John-Wiley & Sons Pub. NY. 1972
3. John R. Immer, 'Material Handling' McGrawHill Co. Ltd., New York. 1953
4. Spivakovsy, A.O. & Dyachkov, V.K., 'Conveying Machines', Vol.I, II, MIR Publi. 1985.

ME475 Elements of Plastic Technology (3-0-0-6)

Manufacturing Technologies for Thermoplastics; Unit Operations in Plastic Materials Manufacture; Manufacture of Commodity plastic Materials; Manufacture of Engineering Thermoplastic Materials: Manufacture with plant layout for Nylon-6, / 66 resins., PEEK, PPS , PC, Acetal Copolymers, PET , PTFE, etc. Applications and Advantages and Disadvantages of each resin.

Texts/References:

1. Shreve's Chemical Process Industries McGraw Hill Education; Fifth edition , 2017
2. J. A. Brydson, ButterWorth Heinemann. Plastic Materials, 7th edition, 1999
3. Handbook of Plastic Technology, Vol 1, by Allen W. S.
4. R.Sinha. Outlines of Polymer Technology.

ME 477 Production system and control (3-0-0-6)

Introduction to Production Systems; Forecasting; Aggregate Planning and Master Scheduling; Inventory Management (known demand); Inventory Management (uncertain demand); JIT and Lean

Operations; Supply Chain Management; Scheduling; Management of Waiting Lines; Job Design; Advanced Quality Control; Forecasting; Measurement Method: Traditional and Nontraditional;

Textbook/References:

1. Stevenson, W.J. Operations Management. 12th Edition. McGraw-Hill Education, ISBN-13: 978-0078024108, 2015.
2. Daniel Sipper; Robert L. Bulfin, JR., Production: Planning, Control and Integration, McGraw-Hill, 1998.
3. Stephen J. Guastello, Human Factors Engineering and Ergonomics: A Systems Approach. Lawrence Erlbaum Associates, 2006.
4. Mark S. Sanders, and Ernest J. McCormick, Human Factors in Engineering and Design, McGraw-Hill, 1993.
5. Douglas C. Montgomery, Introduction to Statistical Quality Control, 6th edition, Wiley, 2008
6. Chase, Aquilano, Jacobs, Production and Operations Management - Manufacturing and Services, 8th Edition, McGraw-Hill, 2001.
7. William J. Stevenson, Sum Chee Chuong, Operations Management, 9th Edition, McGraw-Hill/Irwin, 2010.

DEPARTMENTAL ELECTIVE II

ME459 INTRODUCTION TO POWER PLANT ENGINEERING (3-0-0-6)

Layout - various components and functions of thermal power plants. Steam Power Plants- Boilers, Nozzles, Turbines, Condensers, Cooling Towers, Water Treatment and Piping system, Cycle improvements – Superheat, Reheat, Regeneration. Diesel and Gas Turbine- I.C Engine (Otto, Diesel, Dual), Gas turbine cycles, Cycle improvements – Intercooler, Re-heaters and Re-geneartors. Advanced Power cycles- Cogeneration and combined cycles, Binary Power cycle, MHD Plants. Hydroelectric and Nuclear Power plants- Hydroelectric Power plants– classifications - essential elements – pumped storage systems – micro and mini hydel power plants General aspects of Nuclear Engineering – Components of nuclear power plants - Nuclear reactors & types – PWR, BWR, CANDU, Gas Cooled, Liquid Metal Cooled and Breeder reactor - nuclear safety – Power plant economics – Environmental issues.

Texts:

1. **Principles of Energy Conversion,** Culp Jr., A.W., McGraw-Hill, 1985.
2. **A Course in Power Plant Engineering,** Arora, S.C. and Domkundwar, S., Dhanpat Rai & Sons, 2001.

References:

1. **Power Plant Technology,** El Wakil, M.M., Tata McGraw-Hill, 1985.
2. **Power Plant Engineering,** Nag. P.K., 2nd Ed., Tata McGraw-Hill, 2002.

ME461 ADVANCED MANUFACTURING PROCESSES (3-0-0-6)

Stir casting, organic processes, Magnetic moulding, high pressure moulding, metal injection moulding, centrifugal casting, EBW, LBW, Friction welding, Friction stir processing, Analysis of composites, Hybrid welding process, Surfacing, Hydro, Magnetic and High velocity forming, design for forming, welding and injection moulding.

Texts:

1. **Friction Stir Welding and Processing,** R. S. Mishra, ASM International, 2007.

References:

1. **Principles of Metal Casting,** Heine, Loper and Rosenthal, Tata McGraw-Hill, New Delhi, 2008.

ME463 INTRODUCTION TO COMBUSTION ENGINEERING (3-0-0-6)

Combustion of fuels - Combustion equations and air-fuel ratio calculations. Thermodynamics of combustion - Thermochemistry - Kinetics of combustion. Laminar and turbulent flames - Quenching, flammability, ignition and flame stabilization. Combustion in SI and CI engines. Emission and control methods.

Texts:

1. **An Introduction to Combustion,** Turns, S.R., 2nd ed., McGraw-Hill, 2000.
2. **Combustion,**Glassman, I., 3rd Ed., Academic Press, 1996.

References:

1. **Internal Combustion Engine Fundamentals,** Heywood, J.B., McGraw-Hill, 1988.
2. **Understanding Combustion,** Mukunda, H.S., Macmillan, 1992.

ME465 OPTIMIZATION ENGINEERING (3-0-0-6)

Introduction to optimization; Formulation of optimization problems; Classical optimization techniques; Linear Programming; Non-linear Programming; single variable, multi-variable and constrained optimization; Specialised algorithms for integer programming and geometric programming; Non-traditional optimization algorithms

Texts:

1. **Optimization: Theory and Applications,**S. S. Rao, 2nd Ed., Wiley Eastern, 1984.
2. **Optimization for Engineering Design-Algorithms and Examples,** K. Deb, Prentice-Hall India, 1995.

References:

1. **Introduction to Optimum Design,** J. S. Arora, McGraw-Hill, 1989.
2. **Engineering Optimization-Methods and Applications,** G. V. Reklaitis, A. Ravindran and K. M. Ragsdell, Wiley, 1983.
3. **Optimization Methods for Engineering Design,** R. L. Fox, Addison Wesley, 1971.

ME467 NON-DESTRUCTIVE TESTING (3-0-0-6)

Introduction; Classification of techniques of material testing, Need and Significance of Non Destructive Testing methods, type of Non Destructive testing methods; Radiographic Examination: Radiant energy and radiography, practical applications, X-ray and Gamma –ray equipment, effect of variables on radiographs, requirement of a good radiograph, interpretation of radiograph, safety precautions, Xeroradiography; Magnaflux methods: Basic principles, scope and applications, magnetic analysis of steel bars and tubing magnetization methods, equipment, inspection medium, preparation of surfaces Fluorescent Penetration inspection, Demagnetization; Electrical and ultrasonic Methods: Basic principles, flaw detection in rails and tubes (Sperry Detector), Ultrasonic testing surface roughness, moisture in wood, Detection of defects in ferrous and non-ferrous metals, plastics, ceramics, measurement of thickness, hardness, stiffness, sonic material analyzer, proof tests, concrete test hammer; Photoelasticity: Concept and applications of Plane and circular polarization, Photostress, models.

Texts:

1. **The Testing of Engg. Materials,** H.E. Davies, G.E Troxell, GFW Hauck. Mc Graw Hill Publishers
2. **Mechanical Inspection**, W.H Armstrong Mc Graw Hill Publishers.

References:

1. **American Metals Society, "Non-Destructive Examination and Quality Control**", Metals Hand Book, Vol.17, 9th Ed, Metals Park, OH, 1989.

ME 481 Introduction of Turbulent Flow (3-0-0-6)

Introduction: Transition from laminar to turbulence, nature of turbulence and irregularity, types of turbulent flows, three-dimensional motions; Statistical Description of Turbulence, Kolmogorov hypothesis, turbulence spectra; Introduction to turbulence modelling and experimental method.

References:

1. Stephen B. Pope, Turbulent Flows, Cambridge University Press, 2000 J. D. Anderson, Modern Compressible Flow, Mc Graw Hill, 1989.
2. P. A. Davidson, Turbulence, Oxford University Press, 2004Shapiro, The Dynamics and Thermodynamics of Compressible Flow, The Ronald Press Co., 1954.
3. G. Biswas and V. Eswaran, Turbulent Flows: Fundamentals, Experiments and Modeling, Narosa Publishing House, 2002.
4. R. J. Garde, Turbulent Flow, New Age International Publishers, 2000.
5. Pierre Sagaut and Claude Cambon, Homogeneous Turbulence Dynamics, Cambridge University Press, 2008.
6. H. Tennekes and J. L. Lumely, A First Course in Turbulence, The MIT Press, 1972.

ME 483 Work System Design (3-0-0-6)

Work Study – Scope; Method Study; Movements of workers in shops. Construction of string diagram, Travel chart, Man & Machine chart, Multiple Activity chart; Motion Economy, use of human body, arrangement of work place, design of tools and equipments, Two handed process chart, work station design; Work Measurement; Other Methods of Work Measurement:
Synthesis, standard data, Production interruption study, analytical estimation, work sampling, statistical concepts, confidence limits, number of observations, P.M.T.S., M.T.M., W.F.S.

Texts /References:

1. Groover, M. P. (2007). Work Systems and the Methods, Measurements and Management of Work. Pearson (Education, Inc), US.
2. Kanawati, G, (Ed), (1992). Introduction to Work Study, 4th revised edition.

ME 485 RELIABILITY ENGINEERING (3-0-0-6)

The Reliability Function, Failure Rate, Hazard Rate, Bath-tub Curve, Relationship between Various Reliability Characteristics; Component Reliability, Mean-time-to-failure, Time-dependent Hazard Models –Constant-hazard, Linear-hazard, Nonlinear-hazard and Gamma Models; System Reliability, Two-state Modeling, Series Models, Parallel Models, Series-parallel and Parallel-series Models, k-out-of-m Models, Standby Models, Non-series-parallel Models, Fault-tree Approach to System Modeling; Maintained Systems, Classification of Maintenance Activities: Breakdown, Preventive and Predictive Maintenance, Condition Monitoring, Maintainability and Availability, Reliability-centered Maintenance

Text/References:

1. Antony J (2003). Design and Experiments for Engineers and Scientists, Butterworth- Heinmann.
2. Cochran W and Cox G (2000). Experimental Designs, II edition, John Wiley & Sons Inc.
3. Dean A and Voss D (2006). Design and Analysis of Experiments, Springer.
4. Jeff Wu C and Hamada M (2000). Experiments: Planning, Analysis and Parameter Design Optimization, John Wiley and Sons Inc. 29
5. Montgomery D (2001). Design and Analysis of Experiments, 5th edition, Wiley.
6. Phadke, M (1989). Quality Engineering using Robust Design, Prentice Hall.
7. Ross, P (1996). Taguchi Techniques for Quality Engineering, 2nd edition, McGraw Hill.
8. Balgurusamy E (2003). Reliability Engineering, Tata McGraw Hill.
9. Birolini A (2004). Reliability Engineering: Theory and Practice, 4th edition, Springer.

DEPARTMENTAL ELECTIVE III

ME452 CRYOGENICS ENGINEERING (3-0-0-6)

Properties of solids for cryogenic systems, refrigeration and liquefaction - simple Linde cycle, Pre-cooled Joule-Thomson cycle, dual-pressure cycle, Simon helium liquefier, classical cascade cycle, mixed-refrigerant cascade cycle, ultra-low-temperature refrigerators, equipment associated with low-temperature systems, storage and transfer systems.

Texts:

1. **Cryogenics - Low Temperature Engineering and Applied Sciences,** Traugott H.K. Frederking and S.W.K. Yuan, Yutopian Enterprises, 2005.
2. **Refrigeration and Air-conditioning,** Arora, C.P., Tata-McGraw Hill, 2008.

References:

1. **Cryogenic Technology and Applications,** R. Jha, Butterworth-Heinemann, 2005.

ME454 RENEWABLE ENERGY ENGINEEERING (3-0-0-6)

Solar energy - Solar radiation - Heat transfer equations. Solar thermal energy conversion - Efficiencies - Solar photo voltaic energy. Bio energy - Conversion - bio degradation - Biogas generation - Fuel properties – Biomass gasifier. Wind energy - Data and energy estimation, Conversion - Wind mill - Performance, applications Geothermal. Tidal energy - Magneto hydrodynamic - Thermionic - Fuel cell.

Texts:

1. **Solar Energy: Principle of Thermal Collection and Storage**, Sukhatme, S.P., , 2nd Ed., Tata McGraw Hill, 2000.
2. **Energy Technology - Nonconventional, Renewable and Conventional,** Rao, S. and Parulekar, R.BKhanna Publishers, 1995.

References:

1. **Nonconventional Energy Sources,** Rai, G.D., Khanna Publishers, 1999.
2. **Wind Power Plant - Theory and Design,** Le Gourieres, D., Pergaman Press, 1982.

ME456 TRIBOLOGY OF BEARINGS (3-0-0-6)

Introduction, Properties and Testing of Lubricants, Basic Equations, Idealized Hydrodynamic Bearings. Finite Bearings, Oil Flow and Thermal equilibrium, Bearing Design, Squeeze Film bearings, Hydrodynamic Instability. Externally pressurized Oil Bearings. Gas-lubricated Bearings. Elastohydrodynamic Lubrication, Surface Roughness Effect on Hydrodynamic Bearings and Elastohydrodynamic Line contacts. Ball Bearings, Roller Bearings. Friction of Metals. Wear of Metals.

Texts:

1. **Introduction to Tribology of Bearings,** B C Majumdar, 1999, A. H. Wheeler & Co. Ltd., New Delhi.
2. **Theory of hydrodynamic lubrication,** Pinkus, O. and Sternlicht, B., 1961, McGraw Hill Book Co. Inc., New York.

References:

1. **Basic Lubrication Theory,** A Cameron and C.M. Mc Ettles, 1987, Wiley Eastern Ltd., New Delhi.

ME458 NON-TRADITIONAL MACHINING (3-0-0-6)

General classification of unconventional machining processes; Abrasive jet machining, water jet and abrasive water jet machining, ultrasonic machining; Electric discharge machining and allied processes, laser beam machining, ion beam machining, plasma arc machining; Electro chemical machining (ECM) and allied processes, ECM tool design, chemical machining, photochemical machining; Elastic emission machining; Advanced finishing processes, abrasive flow finishing, magnetic abrasive finishing, magneto rheological finishing, chemo-mechanical polishing; Comparative evaluation of different unconventional machining processes; Analytical modeling of mechanical, thermal and electrochemical type non-traditional machining processes; Numerical modeling and simulation of unconventional machining processes; Computer aided process planning of non-traditional machining processes.

Texts:

1. **Nontraditional Manufacturing Processes,** Gary F. Benedict, Taylor & Francis, 1987.
2. **Modern Machining Processes,** P. C. Pandey and H. S. Shan, Tata McGraw-Hill Education, 1980
3. **Advanced Machining Processes,** V. K. Jain, Allied Publishers, 2009.

References:

1. **Advanced Methods of Machining,** J. A. McGeough, Springer, 1988.
2. **Non-Conventional Machining,** P K Mishra, Narosa India Publication, 1997.
3. **Advanced Machining Processes: Nontraditional and Hybrid Machining Processes,** Hassan El-Hofy, McGraw-Hill Prof Med/Tech, 2005.
4. **Modern Manufacturing Processes,** James A. Brown, Industrial Press, 1991.
5. **Introduction to Micromachining,** V. K. Jain Alpha Science International Limited, 2010.
6. **Micromachining of Engineering Materials,** J. A. McGeough, Taylor & Francis, 2001.

ME 480 Statistical Process Control (3-0-0-6)

Introduction / Introduction to Quality Control and the Total Quality Systems; Introduction to Quality Control and the Total Quality Systems; Statistical Process Control Using Control Charts; Control Charts for Variables; Control Charts for Attributes; Acceptance Sampling Plans by Attributes and Variables; Reliability

Text Books/Reference Books:

1. Amitava Mitra. Fundamentals of Quality Control and Improvement, 3rd edition, Wiley
2. Montgomery D.C. Introduction to Statistical Quality Control, 6th edition, 2009, Wiley.

DEPARTMENTAL ELECTIVE IV

ME460 INDUSTRIAL SAFETY (3-0-0-6)

Evolution of modern safety concept- safety policy - Safety Organization - Safety Committee -budgeting for safety. Safety training – creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme, safety campaign. Concept of an accident, reportable and non-reportable accidents, reporting to statutory authorities – principles of accident prevention – accident investigation and analysis – records for accidents, departmental accident reports, documentation of accidents – unsafe act and condition – domino sequence – supervisory role – cost of accident. Machine Guarding, Guarding of hazards, Machine Guarding types and its application – Safety in welding and Gas cutting – Safety in Manual and Mechanical material handling Safety in use of electricity. Toxicity- TLV- Types of Chemical Hazards-Occupational diseases caused by dust, fumes, gases, smoke and solvent hazards- control measures. Fire triangle- Types of fire - first aid firefighting equipment – flammability limit- LPG safety Overview of factories act 1948 – OHSAS-18000.

Texts:

1. **Accident Prevention Manual for Industrial Operations,** N.S.C.Chicago, 1982.
2. **Industrial Safety,** Blake R.B., Prentice Hall, Inc., New Jersey, 1973.

References:

1. **Industrial Accident Prevention,** Heinrich H.W., McGraw-Hill Company, New York, 1980.
2. **Safety Management in Industry,** Krishnan N.V., Jaico Publishing House, Bombay, 1997.
3. **Safety at Work,** John Ridley, Butterworth & Co., London, 1983.

ME462 MECHANICAL VIBRATION (3-0-0-6)

Review of single degree freedom systems, Complex frequency response, Rotating/Reciprocating unbalances, Transmissibility, Vibration measuring devices. Two degree freedom systems, Dynamic Vibration Absorbers, Multi degree freedom systems, Eigen value problems, model analysis, continuous systems: vibration strings, bars and beams.

Texts:

1. **Elements of Vibration Analysis,** Lenord Meirovitch, McGraw Hill Ltd. 2004.
2. **Mechanical Vibrations,** Rao, S.S 4th Ed., Pearson Education, 2004.

References:

1. **Theory of Vibrations with Applications,** Thomson, W.T., Prentice Hall of India, 1999.

ME464 INTRODUCTION TO COMPUTATIONAL FLUID DYNAMICS (3-0-0-6)

Classification of partial differential equations - Discretization methods; finite difference and finite volume formulations. Numerical solution of elliptical equations - Linear system of algebraic equations. Numerical solution of parabolic equations - Stability analysis. Numerical solution of hyperbolic equations - Burgers equation. Incompressible Navier-Stokes equations and algorithms - Basics of grid generation.

Texts:

1. **Computational Fluid Mechanics and Heat Transfer,** Tannehill, J.E., Anderson, D.A., and Pletcher, R.H., 2nd Ed., Taylor & Francis, 1997.
2. **Computational Fluid Dynamics for Engineers, Engineering Education Systems,** Hoffmann, K.A. and Chiang, S.T., 2000.

References:

1. **Computational Fluid Dynamics – The basics with applications,** Andeson J.D., Mc Graw Hill, 1995.
2. **An Introduction to Computational Fluid Dynamics – The finite volume method,** Versteeg, H.K. and Malalasekera, W., Longman Scientific & Technical, 1995.
3. **Numerical Heat Transfer & Fluid Flow,**Patankar, S.V., Hemisphere, 1980.

ME466 INTRODUCTION TO ADVANCED I. C. ENGINES (3-0-0-6)

Engine design parameters, properties of working fluids. Analysis of engine cycles, fuel intake systems. Spark Ignition Engine- Engine requirements, Fuel injectioin systems, Stages of combustion- Normal and Abnormal, Combustion chambers. Compression Ignition Engine- Stages of combustion, Direct and Indirect injection systems, Combustion chamber, Fuel spray and turbo charging. Pollutant formation and control- Sources and formation of various pollutants, Method of controlling emission, Catalytic convertors. Alternative fuels- Various fuels, merits and demerits, Engine modifications. Recent trends- Lean Burn Engine, Stratified charge Engines – homogeneous charge compression ignition engines – Plasma Ignition.

Texts:

1. **Internal Combustion Engine Fundamentals,** Heywood, J.B., McGraw-Hill, 1988.
2. **The Internal Combustion Engines in Theory and Practice, Vol. II,** Taylor, C.P., MIT Press, 1985.

References:

1. **Internal Combustion Engines,** Ganesan, V., 2nd Ed., Tata McGraw-Hill, 2003.

ME 468 ROBOTICS AND INDUSTRIAL AUTOMATION (3-0-0-6)

Fundamentals of Robot: Definition, Anatomy, Classification, Specifications, Parts & Functions. Robot Drive system & End effectors: Pneumatic, Hydraulic, Electrical & Mechanical drives, End effectors-gripper, Selection and design considerations. Sensors & Machine Vision: Types, Principles and Applications. Robot Kinematics & Robot programming: Forward, Reverse, DOF, Robot Programming & Commands. Implementation & Robot Economics: RGV, AGV, Application of robot in industries, Safety Considerations, Economic Analysis of robots.

Texts:

1. **Robotic Engineering- An Integrated approach,** Klafter R.D., Chmielewski T.A and Negin M. Prentice Hall, 2013.
2. **Industrial Robotics- Technology Programming and Applications,** Groover M.P. McGraw Hill, 2001.

References:

1. **Introduction to Robotics Mechanics and Control,** Craig J.J Pearson Education, 2008.
2. **Robotics Technology and Flexible Automation,** Deb S.R., Tata Mc Graw Hill Book Co., 1994.
3. **Robotics for Engineers,** Koren Y., Mc Graw Hill Book Co., 1992.
4. **Robotics Control, Sensing, Vision and Intelligence,** Fu.K.S.,Gonzalz R.C. and Lee C.S.G., McGraw Hill Book Co., 1987.
5. **Robotics and Image Processing,** Janakiraman P.A., Tata Mc Graw Hill, 1995.
6. **Robotics and Industrial Automation,** Rajput R.K., S.Chand and Company, 2008.
7. **Industrial Robots and Computer Integrated Manufacturing,** Surender Kumar, Oxford and IBH Publishing Co. Pvt. Ltd., 1991.

ME470 Industrial Quality Management (3-0-0-6)

Attributes of quality, Evolution of philosophy of Quality Management, Economics of quality and measurement of cost of quality, Data presentation techniques for quality analysis, Statistical process control, Use of control charts and process engineering techniques for implementing quality plan, Machine and process capability analysis, statistical tolerance analysis, Acceptance sampling: Single, double and multiple sampling plans, Acceptance sampling for variables Reliability analysis and predictions, Bath-Tub Curve, Exponential and Weibull distribution in modelling reliability, System reliability Experimental designs and factorial experiments: Concepts of randomization, Blocking and Confounding Single factor randomized design, ANOVA, 2 k factorial experiments Taguchi philosophy; Loss function; Signal to noise ratio, Orthogonal arrays for parameter and tolerance design. Fundamentals of TQM: Customer orientation, Continuous improvement, Total participation; Some important philosophies and their impact on quality (Deming, Juran, Crossby), QC Tools, Components of Total Quality System (TQS), Quality audit, Introduction to ISO 9000 and 14000 standards.

Texts/References:

1. Fundamental of Quality Control and Improvement, Mitra A, PHI

2. Quality Planning and Analysis, Juran J M and Gryna F M, Tata McGraw Hill
3. Total Quality Management,Dale H.Besterfield, et al., Pearson Education Asia
4. Quality Control, Dale H. Besterfield, Pearson Education, 2012
5. Total Quality Management, Subburaj Ramasamy, Tata McGraw Hill, 2008
6. Quality Control and Total Quality Management, Jain, Khanna Publications, New Delhi
7. Quality Problem Solving, Smith, Quality Press, Wisconsin Avenue, USA
8. The Management and Control of Quality, James R.Evans and William M.Lidsay, South- Western (Thomson Learning), 2002.