Detailed Syllabi of the Courses for B. Tech. Degree in

Production Engineering

(2006 Admission)

FIRST & SECOND SEMESTER: Common for all branches

THIRD SEMESTER

MAU201: Mathematics III

Prerequisite: Nil

3	0	0	3

Module I (11 Hours)

Probability distributions:- Random variables, Binomial distribution, Hyper geometric distribution, Mean and variance of a probability distribution, Chebyshev's theorem, Poisson distribution, Geometric distribution, Normal distribution, Uniform distribution, Gamma distribution, Beta distribution, Weibull distribution, Joint distribution of two random variables.

Module 2 (11 Hours)

Sampling distributions and Inference concerning means:- Population and samples, the sampling distribution of the mean (σ known and σ unknown), Sampling distribution of the variance, Point estimation and interval estimation, Tests of hypothesis, Hypothesis concerning one mean, Inference concerning two means.

Module 3 (10 Hours)

Inference concerning variances proportions:- Estimation of variances, Hypothesis concerning one variance, Hypothesis concerning two variances, Estimations of proportions, Hypothesis concerning one proportion, Hypothesis concerning several proportions, Analysis of r x c tables, Ch – square test for goodness of fit.

Module 4 (10 Hours)

Regression Analysis:- Curve fitting, Method of least squares, Curvilinear regression, Correlation.

Analysis of variance:- General principles, Completely randomised designs, Randomised block diagram, Latin square designs, Analysis of covariance.

Text Book:

1. Johnson R.A, Miller & Freund's Probability and Statistics for Engineers, 5th edn., PHI, 1995

References:

1. Levin R.I & Rubin D.S, Statistics for Management, 7th edn, PHI, 2000
2. Ross S.M, Introduction to Probability and Statistics for Engineers, John Wiley & Sons, 1987.

MEU202: Elements of Solid Mechanics

3	1	0	3

Prerequisite: ZZU101

Module 1 (11 hours)

Introduction: General concepts - definition of stress - stress tensor - stress analysis of axially loaded members - strength design of members - Axial strains and deformations in bars - stress-strain relationships - Poisson's ratio - thermal strain - Saint Venant's principle - Elastic strain energy - statically indeterminate systems.

Strain tensor - Generalised Hooke's law for isotropic materials - relationships between elastic constants - Introduction to anisotropy - orthotropy.

Module 2 (10hours)

Bending stresses in beams: Bending stresses in beams - shear flow - shearing stress formulae for beams - inelastic bending of beams – strain energy in bending.

Axial force, shear force and bending moment diagrams - shear force and bending moments by integration and by singularity functions.

Module 3 (10 hours)

Torsion: Torsion of circular elastic bars - statically indeterminate problems - torsion of inelastic circular bars – strain energy in torsion – torsion of thin walled tubes.

Deflection of beams: Direct integration method - singularity functions - superposition techniques - moment area method - conjugate beam concept - elementary treatment of statically indeterminate beams.

Module 4 (11hours)

Transformation of stresses and strains (two-dimensional case only): Equations of transformation - Principal stresses - Mohr's circles of stress and strain - strain rosettes.

Compound stresses: Superposition and its limitations - eccentrically loaded members.

Columns: Theory of columns - buckling theory - Euler's formula - effect of end conditions - eccentric loads and secant formula.

Text Books:

1. Popov, E. P., Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, Second Edn., 2000.

References:

1. Timoshenko, S.P. and Young, D.H., Elements of Strength of Materials, McGraw Hill.
2. Shames, Irving H., Introduction to Solid Mechanics, Prentice Hall of India, Second Edn.
3. Crandall, S.H., Dahl, N.C., and Lardner, T.J., Introduction to Mechanics of Solids, McGraw Hill.

MEV203: Materials Science and Metallurgy

3	0	0	3

Prerequisite: Nil

Module 1 (10 Hours)

Engineering materials; classification, requirements, properties and selection of engineering materials. Crystal structure; crystal systems, atomic packing, stacking sequence, Miller indices of crystallographic planes and directions, inter planar spacing-BCC, FCC and HCP systems, X-ray diffraction, Crystal imperfections; point defects, line defects- edge and screw dislocations, interaction between dislocations, Frank-Reed source, surface defects, volume defects. Experimental techniques for metallographic studies, optical microscopy, electron microscopy (SEM and TEM), specimen preparation, etching, common etchants, grain size, grain size measurement, ASTM grain size number

Module 2 (11 Hours)

Solidification of metals- cooling curves, nucleation-homogeneous and heterogeneous nucleation, supercooling, critical radius-grain growth, dendritic pattern, equiaxed and columnar grains, grain boundary-grain boundary effects-solidification and structure of castings-coring, homogenization. Alloys- solid solutions-interstitial, substitutional ordered and disordered solid solutions, Hume-Rothery rules, intermetallic compounds, phase diagrams; -construction from cooling curves, lever rule- equilibrium diagrams of binary alloys, isomorphous (Cu-Ni), Eutectic (Bi-Cd, Pb-Sn) detailed study of Fe-C systems.Diffusion; mechanisms of diffusion-Fick's laws of diffusion-applications

Module 3 (11 Hours)

Deformation of metals; cold working, hot working, annealing of a cold worked article-recovery, recrystallisation and grain growth, elastic and plastic deformations;mechanisms of plastic deformation, deformation by slip- slip systems- slip planes and slip directions, critical resolved shear stress-deformation by twinning. Strengthening mechanisms; work hardening, solid solution hardening, dispersion hardening, precipitation hardening, grain boundary strengthening. Heat treatment of steels; stress relieving, annealing, normalising, hardening, TTT diagram, tempering, hardenability, Jominy test. Surface hardening; flame hardening, induction hardening, Case hardening; carburising, nitriding, cyaniding, etc.. Metallic Coatings, hard facing, metal cladding, anodising, diffusion coatings

Module 4 (10 Hrs)

Ferrous alloys; steels-alloy steels, tool steels, stainless steels, effect of alloying elements on properties of steels, cast irons-classification, structure, properties, applications Non-ferrous alloys: Al and Al alloys, Cu and Cu alloys, Mg and Mg alloys, Zn and Zn alloys-major types, composition, properties and applications.Non-metallic materials; thermoplastics, thermosetting plastics, elastomers, composites, ceramics, glasses .Recent developments in materials science; smart materials, shape memory alloys, functionally graded materials, piezo-electric materials

Text Book:

1. Smith, Science of Engineering Materials, Prentice-Hall,
2. Srivastava, C.M., Srinivasan C. Science of Engineering materials, 2/E, New Age, 2002
3. Callister W.D., Materials Science and Engineering, John Wiley, 2005

References:

1. Avner S.H., Introduction to Physical Metallurgy, , 2/E, McGraw Hill, 2003
2. Van Vlack L.H., 'Elements of Material Science and Engineering', Pearson Edn., 2005
3. Shackelford J.F., Introduction to Material Science for Engineers, 6/E, Prentice Hall, 2004
4. Reed Hill, Physical Metallurgy Principles, Affiliated East West Press, 2004

EEG201: Electrical Measurements and Machines

3	0	0	3

Prerequisite: Nil

Module 1 (9 hours)

Measurement of power (using 2 Wattmeter for 3 phase system) and Energy
Electromagnetic Energy Conversion; Electromagnetic torque, Types of machines.
Basics of rotating machines- Construction, Rotating magnetic field, Principles of operation, Emf and torque equation, Losses and efficiency.

Module 2 (9 hours)

DC Machines: principle of operation – generators and motors – classification – tests and characteristics – speed control- applications.

Module 3 (9 hours)

Transformer Construction – principle of operation-equivalent circuit – regulation – efficiency – OC and SC tests – single phase transformer – introduction to three phase transformer.

Module 4 (15 hours)

Alternators: Types, Introduction to power Generation- Transmission and distribution system. Synchronous motors: Principle of operation- starting- applications.

Induction machines: Principle of operation – types – tests – Torque slip and performance characteristics – startin – speed control schemes – applications.
Single phase and special machines: FHP induction motors – universal motors - stepper motors – servo motors, tacho generators.

Text Books:

1. Hughes K, Electrical Technology, E.L.B.S., 1996
2. Nagrath I.J, Kothari D.P, Electrical Machines, Tata McGraw-Hill Publishing Company Limited-New Delhi, 1997

References:

1. Cotton H, Advanced Electrical Technology, CBS Publishers and Distributors, New Delhi, 1984
2. Vincent Del Toro, Electrical Machines & Power systems, Prentice Hall, 1998
3. Chapman S.J, Electric Machines & Power systems, McGraw Holl,1999
4. Say M.G, Alternating Current Machines, Pittman, 1983
5. Vertnott C.C, Fractional & sub-fractional Horse-power Electric Motors, McGraw Hill, New York, 1978.
6. Sawhnew A.K, Electrical & Electronic Measurements & Instrumentation, Dhanpat Rai & Sons, 1996.
7. Gupta B.R & Vandana Singhal, Fundamentals of Electric machines, D. K Publishets, New Delhi, 2000.
8. Soni, Gulpta & Bhatnagar, A course in Electric Power, Dhanpat Rai & Sons.

MEU204: Machine Drawing

Prerequisite: ZZU103

0	0	3	2

Module I (9 Hours)

Introduction to machine drawing - Principles of orthographic projections applied to machine drawing - First angle and third angle projections - Methods of dimensioning - Conversion of pictorial projections into orthographic projections.
Sectional views: Rules and conventions of sectioning - Full sectional, half sectional, partial sectional and revolved sectional views of simple machine parts.
Welded joints: types of welds - Nomenclature of welds - Welding symbols - Drawing of welded machine parts with details of welding.
Screwed fastenings: Screw thread forms - V and square threads - Nomenclature of threads - Conventional representation of threads - Hexagonal and square headed bolts and nuts - Locking arrangements of nuts - Various types of machine screws and set screws - Foundation bolts.

Module 2 (12 Hours)

Pipe joints: Coupler joint - Nipple joint - Union joint - Socket and spigot point - Integral and screwed flanged joints - Hydraulic joint and expansion joint.
Shaft joints: Cotter and pin joints - Socket and spigot joint - gib and cotter joint - Sleeve and cotter joint and knuckle joint.
Couplings and keys: Muff couplings, flanged couplings, flexible coupling, Oldham's coupling and universal coupling - parallel and tapered sunk keys - Hollow and flat saddle keys - Feather key and pin key.
Bearings: Solid journal bearings - Bush bearings -Plummer block - Foot step bearing and pedestal bearing.

Module 3 (15 hours)

Assembly drawings - Types - Accepted norms.

Engine parts: Piston - Connecting rod - Eccentric - Stuffing box and crosshead.
Parts of a lathe - Tailstock - Head stock assembly - Tool post and carriage.
Valves: Stop valves - Safety valves - Check valves - Pressure relief valves and flow and direction control valves.
Miscellaneous assemblies: Vices - Screw jack.

Module 4 (6 hours)

Surface texture: Nomenclature of surface texture - Designation of surface texture - Selection of surface characteristics.
Limits, Fits and Tolerances: Nomenclature - Classification of fits - Systems of fits and tolerances - Designation - Selection of fits and tolerances.
Working/Production drawings: Working drawings of simple machine elements.
Computer aided drafting: Elements of Computer Aided Drafting - simple exercises using graphics packages.

Text Book:

1. Bhatt N.D., and Panchal V.M., Machine Drawing, Charotar Publishing House, 2006.

Reference Books:

1. Narayana K.L., Kannaiah P., and Reddy K.V., Machine Drawing, Wiley Eastern.
2. John K.C., and Varghese P.I., Machine Drawing, VIP Publication
3. Gill P.S., A Text Book of Machine Drawing, Karlson Publication
4. Pippenger J., and Hicks T., Industrial Hydraulics, McGraw Hill
5. Sidheswar N., Kannaiah P., and Sastry V. V. S., Machine Drawing, Tata McGraw Hill

MEU205: Fluid Mechanics and Machinery

Prerequisite: Nil

3	1	0	3

Module 1 (10 hours)

Introduction – Continuum hypothesis. Properties of fluids – density, specific weight, sp. gravity, viscosity, surface tension, capillarity. Fluid statics – pressure at a point – variation of pressure in a static fluid – absolute & gauge pressures - pressure head - measurement of pressure – manometers, pressure gauges. Hydrostatic forces on plane areas – centre of pressure. Forces on curved surfaces. Floating & immersed solids in fluids – buoyant force.

Module 2 (11 hours)

Flow of fluids – classification of flows – steady flow, uniform flow, incompressible flow, ideal flow, laminar and turbulent flows. Basic physical laws applied to a fluid flow – Equation of continuity for a one dimensional steady flow – Energy and Momentum equations – Bernoulli's equation – its application to flow through pipes – head loss in pipes – Darcy Weisbach equation – pipes in series and parallel. Introduction to differential analysis – equation of continuity in differential form

Module 3 (11 hours)

Hydraulic Machines – Pumps and Turbines. Flow through turbo-machines – velocity diagrams. Pumping Machinery – classification into rotodynamic and positive displacement pumps. Centrifugal pumps – head developed and power – Specific speed of pumps - characteristics of centrifugal pumps. Reciprocating pumps – Indicator diagram – slip

Module 4 (**10 hours**)

Turbines – Impulse & reaction turbines. Pelton turbine – constructional details – Calculation of power. Reaction turbines – Principle of reaction turbines – Radial, mixed

and axial flow turbines – Draft tubes – Constructional details of Francis and Kaplan turbines – Calculation of power. Selection of turbines.

References:

1. Joseph B Franzini & E John Finnemore, *Fluid Mechanics with Engineering Applications* Mc Graw Hill International Edition , 1997
2. Victor L Streeter, *Fluid Mechanics,* Mc Graw Hill, 1983
3. Vijay Gupta & Santhosh Gupta, *Fluid Mechanics and its Applications*, New Age International Publishers, 2005

MEV291: Production Technology Lab -I

0	0	3	2

Prerequisite: Nil

Classification of Machine tools and processes, Machining on centre lathes, study of parts and function, cutting tools, types and materials, Grinding, selection of speeds, feeds and depth of cut, Cutting fluids, methods of work holding, Lathe operations like turning, taper turning and eccentric turning, thread cutting, knurling, drilling boring and profile turning, tolerance and surface finish.

References:

1. Chapman, Workshop Technology Vol II, ELBS
2. Boothroyd, Fundamentals of Metal Machining & Machine Tools McGraw Hill.
3. Axleod & Anderson, Machine Tool Operations. Vol II Tata McGraw Hill.
4. Chowdhary. H., Workshop Technology Vol II – Machine Tolls. Media Promoters and Publishing
5. HMT, Production Technology, Tata McGraw Hill

MEU292: Fluid Mechanics and Fluid Machinery Laboratory

0	0	3	2

Prerequisite: Nil

Study of plumbing tools and pipe fittings, measurement of metacentric height and radius of gyration of floating bodies, measurement of viscosity of fluids, study of viscosity measuring instruments, study and experimentation on discharge measuring instruments like venturimeter, orificemeter, notches, weirs, nozzle meters and rotameters, measurement of pressure and velocity, pipe friction, minor losses in pipes, verification of Bernoulli's theorem, demonstration of laminar and turbulent flow in pipes, critical velocity, forces on curved and plane surfaces, evaluation of the performance of turbines, main and operating characteristics, Muschel curves, performance of pumping and other machinery, centrifugal pump, reciprocating pump, gear pump, hydraulic ram and torque converter.

FOURTH SEMESTER

MAU202: Mathematics IV

Prerequisite: Nil

3	0	0	3

Module 1 (10 hours)

Series Solutions and Special Functions:- Power series solutions of differential equations, Theory of power series method, Legendre Equation, Legendre Polynomials, Frobenius Method, Bessel's Equation, Bessel functions, Bessel functions of the second kind, Strum-Liouville's Problems, Orthogonal eigen function expansions.

Module 2 (11 hours)

Partial Differential Equations:- Basic concepts, modelling: Vibrating string, Wave equation, Separation of variables, use of Fourier Series, D'Alembert's Solution of the

wave equation, Heat equation, Solution by Fourier integrals and transforms, Laplace equation, Solution of a PDE by Laplace transforms.

Module 3 (11 hours)

Complex Analysis I: - Complex functions, Derivative, Analytic functions, Cauchy – Reimann equations, Laplace's equation, Geometry of Analytic functions: Conformal mapping, Linear fractional Transformations, Schwarz- Christoffel transformation, Transformation by other functions**.**

Module 4 (10 hours)

Complex Analysis II: - Complex Integration, Line integral in the Complex plane, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of analytical functions. Power series, Functions given by power series, Taylor series and Maclaurin's series. Laurent's series, Singularities and zeros, Residue integration method, Evaluation of real integrals**.**

Text Book:

1. Kreyszig. E, Advanced Engineering Mathematics, 8th Edn., John Wiley & Sons, 2000

Reference:

1. Wylle, C.R & Barret L.C, Advanced Engineering Mathematics, 6th Edn., Mc Graw Hill, New York, 1995

MEU212: Theory of Machines - I

3	0	0	3

Prerequisite: ZZU102

Module I (14 Hours)

Introduction to Kinematics and Mechanisms: Various mechanisms, Kinematic diagrams, Degree of freedom.

Mechanisms in Machine Tools: Whitworth quick-return mechanism, Crank slotted-lever mechanism, Indexing mechanisms.

Position and displacement analysis: Graphical and Analytical methods

Velocity analysis: Relative motion, Graphical and Analytical methods, Instant center, Mechanical advantage.

Acceleration analysis: Graphical and analytical methods, Coriolis acceleration.

Computer oriented methods in kinematic analysis

Module II (6 Hours)

Cam Design: Cam and follower types, Displacement diagrams, Advanced cam profile techniques. Cam profile synthesis – Graphical and analytical methods.

Module III (12 Hours)

Gears: Involute spur gears, Involutometry, Spur gear details, Interference, Gear standardization, Backlash, Internal gear, Cycloidal gear, Non-standard gears.

Theory and details of Bevel, Helical and Worm gearing.

Gear Trains: Simple and compound gear trains, Planetary gear trains, Solution of planetary gear train problems, Applications.

Module IV (10 Hours)

Kinematic Synthesis: Tasks of kinematic synthesis, Type and dimensional synthesis, Graphical synthesis for motion, path and prescribed timing, Function generator, Overlay method.

Analytical Synthesis Techniques: Complex number modeling, Freudenstein's equation, Loop closure equation technique.

Case studies in synthesis of mechanisms

Textbooks:

1. Shigley, J.E., and Uicker, J.J. Jr., Theory of Machines and Mechanisms, McGraw Hill, Second Edition, 1995.

References:

1. Erdman, A.G., and Sandor, G.N., Mechanism Design: Analysis and Synthesis, Vol. I & II, Prentice Hall of India.
2. Mabie, H.H., and Reinholtz, C.F., Mechanisms and Dynamics of Machinery, John Wiley & sons.
3. Ghosh, A., and Mallik, A.K., Theory of Mechanisms and Machines, Affiliated East West Press.
4. Martin, George T., Kinematics and Dynamics of Machines, McGraw Hill.
5. Nikravesh, P.E., Computer Aided Analysis of Mechanical Systems, Prentice Hall.
6. Sen, G.C., and Bhattacharyya, A., Principles of Machine Tools, New Central Book Agency, Calcutta, 2002.
7. Rao. R.V., Metal Cutting and Machine Tools, S.K. Kataria & Sons, 1998.

MEU215: Thermodynamics and Heat Transfer

Prerequisite: Nil

3	0	0	3

Module 1 (10 hours)

Thermodynamic Systems, Properties, State, Processes and Cycles. Zeroth Law of Thermodynamics, First Law of Thermodynamics, Concept of Heat and Work, First Law applied to closed and open systems, Steady flow energy equation.

Module 2 (11 hours)

Second law of thermodynamics, Different Statements and their equivalence, Reversible and irreversible processes, Carnot cycle, Carnot theorem and their corollaries, Entropy, T ds Equations, Thermodynamic property relations, Maxwell's relations, Clapyron Equation, Specific heats Joule Thompson coefficient.

Module 3 (11 hours)

Basic modes of heat transfer, General heat conduction Equation in Cartesian cylindrical and spherical coordinates, Initial and boundary conditions, Steady state heat transfer in simple geometries with and without heat generation. Introduction to unsteady state heat transfer Extended surfaces. Heat exchangers, LMTD and NTU methods of calculations in heat exchanger analysis.

Module 4 (10 hours)

Convective heat transfer, Newton's law, Hydrodynamic and thermal boundary layer, External and internal flow heat transfer under fully developed laminar flow. Natural convection from vertical plates, Empirical relations in convective heat transfer, Introduction to boiling and condensation, Radiation Heat transfer, Fundamental laws of radiation, Radiation heat exchange between bodies of simple geometry. Shape factor, Electric network analogy in radiation heat transfer.

Text Books:

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1. Y.A. Cengel, M. A. Boles, Thermodynamics an Engineering Approach, Fourth Edition, Tata McGraw Hill, New Delhi, 2003.
2. J.P., Holman, Heat Transfer, Ninth Edition, Tata McGraw Hill, New Delhi, 2005.

References:

1. P.K. Nag, Engineering Thermodynamics, Third Edition, Tata McGraw Hill, New Delhi, 2005..

3. P. K. Nag, Heat Transfer, Tata McGraw Hill , New Delhi, 2003.

MEV214: Metrology and Computer Aided Inspection

3	3	1	0	3

Prerequisite: Nil

Module 1 (10 Hours)

Measurement fundamentals: Measurement system elements, Temperature, Pressure and Strain measurements, Experimental Test Plan- Random Tests, Replication & repetition, Calibration - Sensitivity, Range, Accuracy, Standards, Traceability. Regression analysis, Data outlier detection. (Ref: 1)

Module 2 (8 Hours)

Uncertainty analysis- Type A and Type B, Determining combined standard uncertainty- Uncorrelated and correlated input quantities, reporting, conformity. (Ref: 2)

Module 3 (11 Hours)

Metrology: Interferometry, Slip gauges, Comparators, Abbe's principle, Pneumatic transducer, Electronic transducers, Angle measurement- Sine bar, angle gauges Optical instruments- Profile projectors, Autocollimators. Surface finish- Parameters, Stylus instruments. (Ref:3)

Module 4 (10 Hours)

Gauge design and tolerancing, Inspection of geometric tolerances and true position tolerances. (Ref:4)

Screw thread measurements - Three wire method calculations, Gear measurements- Tooth vernier, Base tangent, measurement over pins, profile checking. (Ref:5)

Coordinate Measuring Machines- Construction, Operation & Programming, Software, Applications. (Ref:6)

Machine Vision: Sensing, Preprocessing, Segmentation, Description, Recognition and Interpretation. (Ref:7)

References:

1. Figliola, Richard S, & Beasley, Donald E, "Theory and Design for Mechanical Measurements", Third edition, John Wiley & Sons Inc,
2. ISO, "Guide to the expression of Uncertainty in Measurement", 1995.
3. Collett, CV, & Hope, AD, "Engineering Measurements", Second edition, ELBS/Longman
4. Lissaman, A. J., and Martin, S. J., "Principles of Engineering Production"
5. Chapman, W. A. J., "Workshop Technology – Part 3" Oxford & IBH Publishing Co Pvt Ltd, New Delhi.
6. Doebelin, Ernest O., "Measurement Systems", 4th edition, McGraw-Hill International.
7. S.Fu, R.C.Gonzalez, C.S.G.Lee, Robotics: Control, Sensing, Vision, and Intelligence, Chapters 7,8, pages 296-449

MEV215: Metal Casting and Joining

3	1	0	3

Prerequisite: Nil

Module 1 (10 Hours)

Introduction - solidification of metals – mechanism of solidification-solidification with predominant interface resistance- solidification with constant surface temperature- solidification with predominant resistance in mould and solidified metal- flow of molten metal in moulds - furnaces and melting practices - patterns - pattern allowance - design considerations - shrinkage and machining allowance – foundries.

Module 2 (11 Hours)

Casting processes – comparison- sand casting - shell moulding - silicate bonded sand process (CO_2 process) - expended polystyrene process - plaster mould casting - ceramic mould casting - investment casting - permanent mould casting - slush casting - pressure casting - die casting - centrifugal casting - squeeze casting – semisolid casting (rheocasting, thixoforming)- casting techniques for single crystal components-rapid solidification- residual stress- defects - inspection of castings - casting design – gating system design - risering - casting alloys - economics of casting – design rules for castings – case studies with specific examples of sand cast and permanent mould cast parts.

Module 3 (11 Hours)

Classification - filler materials - consumable electrodes - liquid state - chemical - arc - resistance – electrical characteristics of the arc- analysis of metal transfer- free light and short circuiting metal transfer- equations for heat flow in welding- equations for temperature distribution in the Heat Affected Zone- gas metal reactions- sensitivity to hydrogen porosity- weld pool solidification- contraction and residual stress crack sensitivity- dilution and uniformity of the weld deposit-

Module 4 (10 Hours)

The metallurgy of welding – metallurgy of weld metal and HAZ for carbon steels- ferritic and high alloy steels- austenitic and high alloy steels- non ferrous metals (Aluminium and its alloys, copper and its alloys, magnesium and its alloys) - weld quality - weldability - testing welded joints - welding design and process selection - brazing, soldering, adhesive bonding, and mechanical joining processes, joining plastics- surface energy and contact angle- capillary action in brazing and soldering- residual stress and stress concentration factors in adhesive bonding.

References:

1. Ghosh A., and Mallik A.K., Manufacturing Science, Affiliated East West Press,.
2. Heine R. and Rosenthal, P., Principles of Metal Casting, Tata McGraw Hill.
3. Richard A. Little, Welding and Welding Technology, Tata McGraw Hill.

MEU218: Theory of Elasticity and Plasticity

Prerequisite: MEU202

Module I (11 hours)

Analysis of stress: Basic assumptions, Stress at a point, Stress tensor; stress transformation; Mohr's circle- principal stresses; principal planes; octahedral stresses; hydrostatic and pure shear states,

Analysis of strain: Strain tensor; analogy with stress tensor.

Module 2 (10 hours)

Equation of elasticity: Equation of equilibrium, Strain-displacement equations; compatibility equations, constitutive equations; Navier equations. Use of polar coordinates.

2-D problems: Plane stress problems; plane strain problems; Axisymmetric problems; Lame's problem; rotating disks and shrink fits.

Module 3 (10 hours)

Three dimensional problems: Torsion of non circular section; St. Venant's theory; Prandtl's stress function approach; elliptical and triangular cross sections; Prandtl's membrane analogy.

Special problems in bending: Unsymmetric bending; shear centre. Bending of curved beams.

Module 4 (11 hours)

Introduction to plasticity: Ideally plastic solid - stress space and strain space - nature of yield locus - yield surfaces of Tresca and VonMises - stress strain relations- Prandtl-

Reuss equations. Analysis of elastic-plastic problems (spherical shell and cylindrical shell under internal pressure, rotating disks etc.).

References:

1. S.P. Timoshenko, and J.N. Goodier, Theory of Elasticity, McGraw Hill International Edn., Third Edn., 1970.
2. L.S. Srinath, Advanced Mechanics of Solids, Tata McGraw Hill, New Delhi, Second Edition, 2003.
3. Den Hartog, Advanced Strength of Materials, McGraw Hill, New York.
4. A.J. Durelli, E.A. Philips and C.H. Psao, Introduction to the Theoretical and Experimental Analysis of Stress and Strain, McGraw Hill, New York.
5. Fred B. Seely and Smith, Advanced Mechanics of Materials, John Wiley and sons, New York.
6. W. Johnson, and P.B. Mellor, Engineering Plasticity, Van Nostrand Reinhold, 1973.

CEG291: Strength of Materials Laboratory

0	0	3	2

Prerequisite: Nil

1. Tension test on Mild Steel Rod
2. Double Shear Test on Mild Steel Rod
3. Hardness fests
   a. Rockwell Hardness test
   b. Brinneil Hardness test
   c. Vicker's Hardness test
4. Impact test on Mild Steel Specimen
   a. Charpy test
   b. Ized test
5. Spring test
   a. Open coiled spring
   b. Close coiled spring
6. Bending test on Steel Beams
7. Torsion test on Mild Steel Rod
8. Compression test on concrete
9. Study of Extensometers and Strain Gauges
10. Fatigue test

MEV293: Metrology and Instrumentation Laboratory

Prerequisite: Nil

0	0	3	2

1. Measurement of thread parameters using UMM, three wire method
2. Measurement of tool angles of single point tool using TMM
3. Measurement of gear parameters using Profile projector
4. Evaluation of straightness error using Autocollimator
5. Calibration and determination of uncertainties of the following;
   a. Strain gauge load cells
   b. Bourdon tube pressure gauge
   c. LVDT
   d. Thermocouple
   e. Tachometers using stroboscopes, etc.
6. Study and measurement of surface finish using surface roughness tester
   Study and measurements with CMM

Experiments on limits and fits
Study and use of ultrasonic flaw detector
Preparation of psychometric chart
Exercises on measurement system analysis
Study and making measurements with thread micrometer, Disc micrometer, thread pitch gauge, height gauge, slip gauges, optical flat, three pin micrometer, pyrometer, RTD, etc.

FIFTH SEMESTER

MEV301: Principles of Management

3	0	0	3

Prerequisite: Nil

Module 1 (8 Hours)

Introduction to management theory – Management – Defined – Characteristic of Management – Management as an art-profession – System approaches to Management – Task and Responsibilities of a professional Manager – Levels of Manager and Skill required.

Module 2 (10 Hours)

Management – Process – Planning – Types – Mission – Goals – Strategy – Programmes – Procedures – Characteristics – Approaches – Organising – Principles of Organisation – Delegation – Span of Control – Organisation Structures – Directing – Leadership – Motivation – Controlling.

Module 3 (12 Hours)

Decision Making – Strategic and Tactical Decisions – Single stage decision making – Decision making under certainty – Risk – Uncertainty - Multistage Decision making – Decision Tree.

Project Management – Network construction – Arrow diagram – Redundancy – CPM and PERT Networks – Scheduling computations – PERT time estimates – Probability of completion of project – Introduction to crashing.

Module 4 (12 Hours)

Introduction to functional areas of management – Operations Management – Human resource management – Marketing management – Financial management.

Text Books:

1. Koontz & Weihrich, Management, 9th edn., McGraw Hill, 1999.
2. Ravindran, Philips and Solberg, Operations Research: Principles and Practice. Second edition, 2005, John Wiley & Sons.

References:

1. Stoner et-al, Management, 6th edn., Prentice Hall, 1999.
2. Mazda, Engineering Management, Addison Westey, 1999.
3. Certo S., Modern Management, 8th edn., Prentice Hall, 2003.
4. Wiest and Levy, A Management Guide to PERT/CPM with GERT/PDM/ DCPM and other Networks, Second edition, 1998, Prentice-Hall of India
5. Tersine, Production/Operations management, Second Edition, 1985, North-Holland

ZZU301: Environmental Studies

3	0	0	3

Prerequisite: Nil

Unit 1: The Multidisciplinary nature of environmental studies (2 lectures)

Definition, scope and importance - Need for public awareness.

Unit 2: Natural Resources: (8 lectures)

Renewable and non-renewable resources:

Natural resources and associated problems.

Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.

Water resources: Use and over-utilization of surface and ground water; floods, drought, conflicts over water, dams- benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modem agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.

Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources.

Equitable use of resources for sustainable lifestyles.

Unit 3: Ecosystems (6 lectures)

Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem: -

a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Acquatic (Ponds,streams,lakes,rivers,oceans)

Unit 4: Biodiversity and its conservation (8 lectures)

Introduction - Definition: genetic, species and ecosystem diversity - Biogeographical classification of India - Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels. . India as a mega-diversity nation. - Hot-spots of biodiversity. - Threats to biodiversity: habitat loss, poaching of wildlife, man - wildlife conflicts. - Endangered and endemic species of India. - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity

Unit 5: Environmental Pollution (8 lectures)

Definition - Causes, effects and control measures of: -

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Pollution case studies - Disaster management: floods, earthquake, cyclone and landslides.

Unit 6: Social Issues and the Environment (7 lectures)

From Unsustainable to Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, watershed management - Resettlement and rehabilitation of people; its problems and concerns - Case studies - Environmental ethics: Issues and possible solutions - Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case studies - Wasteland reclamation - Consumerism and waste products - Environment Protection Act - Air {Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation - Public awareness.

Unit 7: Human Population and the Environment (6 lectures)

Population growth, variation among nations - Population explosion - Family Welfare Programme - Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health - Case Studies.

Unit 8: Field work (Field work Equal to 5 lecture hours)

Visit to a local area to document environmental assets-river/ forest / grassland / hill / mountain - Visit to a local polluted site - Urban / Rural/Industrial/Agricultural - Study of common plants, insects, birds - Study of simple ecosystems-pond, river, hill slopes, etc.

References :

1. Agarwal, K.C.200 1 Environmental Biology, Nidi Publ. Ltd.Bikancr.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd , Ahmedabad - 380013, India, Email: m~pin(Ci).icenet.net (R)
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.480p
4. Clark.R.S., Manne Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P.Cooper, T.H.Gorhani, E & Hepworth, M: T.2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
6. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
7. Down to Earth, Centre for Science and Environment(R)
8. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev.,Environment & Security. Stockholm Env. Institute. Oxford Univ. Press. 473p
9. Hawkins R.E, Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R) 10.
10. Heywood, V.H & Watson, R.T. 1995 . Global Biodiversity Assessment. Cambridge Univ. Press 1140p
11. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya -Pub. House, Delhi 284 p.
12. Mckinney, M.L. & Schocr, R.M, 199p. Environmental.Science systems & Solut.ions, Web enhanced edition. 63.9p.
13. Mhaskar A.K, Matter Hazardous, Techno-Science Publications (TB)
14. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co.(TB)
15. Odum, E.P. 1971. Fundamentals of Ecology. W.B.Saunders Co. USA, 574p 16. Rao M N.& Datta, A.K. 1987.
16. Waste Water treatment. Oxford & IBH Publ. Co. Pvt.Ud..345p
17. Sharma B.K., 2001. Environmental Chemistry. Goel Publ. House,Meerut
18. Survey of the Environment, The Hindu (M)
19. Townsend C. , Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
20. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol I and II, Enviro Media (R)

21. Trivedi R.K. and P,K. -Goel, Introduction to air pollution, Techno-Science Publications (TB)
22. Wagner K.D.,1998. Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p
(M) Magazine (R)Reference (TB) Textbook

MEV302: CAD/CAM/CIM

3	1	0	3

Prerequisite: Nil

Module 1 (10 hours)

Introduction to computer graphics, 2D and 3D transformations, Plane and space curves, surface description and generation, CAD/CAM hardware and software, CAD/CAM data exchange and integration.

Module 2 (11 hours)

CNC machine tools, fundamentals of CNC machine tools, constructional features, drives and controls, stepper motors, servo motors, hydraulic systems, feed back devices, counting devices, interpolators linear, circular interpolation and other emerging techniques, adaptive control systems for turning and milling.

Module 3 (11 hours)

CNC manual part programming and computer assisted programming, APT language, geometry, motion and auxiliary statements, macro statements, post processors, CNC programming with interactive graphics, use of various software packages, development of CNC programmes for special problems.

Module 4 (10 hours)

Computer integrated manufacturing systems, material handling and identification technologies, computer aided inspection, group technology, flexible manufacturing systems, industrial robotics and machine vision, rapid prototyping, design for manufacturability, process planning and concurrent engineering, learn production and agile manufacturing.

References:

1. David F. Rogers & J H Adams; Mathematical Elements of Computer Graphics ; McGraw Hill International
2. David F. Rogers ; Procedural Elements for Computer Graphics; McGraw Hill International
3. Ibrahim Zeid; CAD/CAM Theory and Practice, Tata McGraw Hill publishing company.
4. Yoram Koren; Computer Control of Manufacturing Systems, Mc Graw Hill Book Company.
5. Mikell P. Groover; Automation, Production Systems, and Computer Integrated Manufacturing, Pearson Education
6. Mehta, N.K; Machine Tool Design and Numerical Control, Tata McGraw Hill
7. Bolton W, Mechatronics, Electronic Control Systems in Mechanical Engineering, Addison Wesley Longman Limited
8. HMT Limited; Mechatronics, Tata Mc Graw Hill Publishing Company Limited
9. Fu, K.S. Gonzalez, R.C. and Lee, C.S.G; Robotics, Control, Sensing, Vision and Intelligence McGraw Hill International.

MEU303: Thermal Engineering

3	0	0	3

Prerequisite: Nil

Module 1 (10 Hours)

Internal combustion engines -classification - spark ignition and compression ignition engines - 2-stroke and 4-stroke engines - valve timing diagrams - theoretical and actual cycles - deviation of an actual cycle from ideal cycle - loss due to dissociation and specific heat variation - different systems of IC engines - combustion process in CI and SI engines - excess air calculations - performance of IC engines - frictional losses - mechanical efficiency - thermal efficiency - volumetric efficiency – Morse test- heat balance sheet for IC engines - governing of IC engines.

Module 2 (11 Hours)

Nozzles - isentropic flow of fluids through variable area passage - expression for velocity and discharge - throat pressures and areas for maximum discharge - effect of friction - supersaturated flow - Wilson line - effect of variation of back pressure. Steam turbines - impulse and reaction turbines -compounding - velocity diagrams for single stage and several blade rings - work done and blade efficiency - conditions for maximum efficiency - application of energy equation to turbine blades - effect of blade friction - condition line - reheat factor

Module 3 (11 Hours)

Gas turbine cycles - Joule Brayton cycle - open and closed cycles - effect of various parameters on performance -regeneration - intercooling and reheating. Reciprocating compressors - single stage and multi stage compressors - condition for maximum efficiency - effect of cylinder clearance - volumetric efficiency. Rotary compressors: types -fans - rotary displacement blowers - turbo–blowers - turbo compressors - work done and efficiency in centrifugal compressor

Module 4 (10 Hours)

Refrigeration - working, performance and application of air refrigerator - vapour compression refrigeration– pressure–enthalpy diagram and temperature-entropy diagram, co-efficient of performance, vapour absorption refrigeration. Air conditioning - psychrometry - psychrometric processes - human comfort - effective temp. - cooling and dehumidification - heating and humidification - summer and winter air conditioning system - cooling load and simple air conditioning calculations

References:

1. M.L. Maleev, Internal Combustion Engines, 2nd Edn., McGraw Hill, New York, 1989.
2. W.J. Kearton, Steam Turbines: Theory and Practice, 7th Edn., ELBS Publishers, London, 1988.
3. E.H. Lewitt, Thermodynamics Applied to Heat Engines, 6th Edn., Sir Isaac Pitman & Sons, 1965.
4. H. Cohen, G.F.C. Rogers, Gas Turbine Theory, 4th Edn., Longman, London, 1996.
5. R.K. Rajput, Thermal Engineering, 4th Edn., Laxmi Publications, New Delhi, 2006.
6. M.L. Mathur, R.P. Sharma, Internal Combustion Engines, Dhanpath Rai and Sons, New Delhi, 2005.

MEU305: Theory of Machines - II

3	1	0	3

Prerequisite: MEU212

Module 1 (14 Hours)

Kinematics and kinetics of rigid bodies: aspects of motion of rigid body referred to local and global frames – energy and impulse – momentum methods for rigid bodies – energy methods – impulse-momentum methods – impulse – momentum equations – dynamics of general rigid body motion – Euler's equation of motion – applications – equations of motion using Euler angles – gyroscope – torque-free motion.

Module 2 (10 Hours)

Force analysis of machinery: Static and dynamic force analysis of plane motion mechanisms – graphical method – principle of superposition – matrix methods – method of virtual work – complex number method. Force analysis of spur, helical, bevel and worm gears.

Module 3 (6 Hours)

Flywheel analysis – balancing – static and dynamic balancing – balancing of masses rotating in several planes – balancing of reciprocating masses – balancing of multi cylinder engines – balancing machines.

Module 4 (12 Hours)

Introduction to vibration: Single and two degree of freedom systems – Response to harmonic, periodic and arbitrary excitations.

Random Vibration: Ergodic and stationary random processes – Autocorrelation functions – Cross correlation functions – Spectral density functions – Response of single degree of freedom system to random excitations – Complex frequency response functions.

Vibration measuring instruments.

Text Books:

1. Shames, I.H., Engineering Mechanics, Prentice Hall of India, Fourth Edn., 2001.
2. Meirovitch, L., Elements of Vibration Analysis, McGraw Hill, Second Edn., 1986.
3. Holowenko, A.R., Dynamics of Machinery, John Wiley & Sons, 1965.

References:

1. Beer, F.P., and Johnston, E.R. Jr., Vector Mechanics for Engineers – Dynamics, McGraw Hill.
2. Meirovitch, L., Methods of Analytical Dynamics, McGraw Hill.
3. Shigley, J. E., and Uicker J. J. Jr., Theory of Machines and Mechanisms, McGraw Hill, Second Edn., 1995.

0	0	3	2

MEV391: Production Technology Lab II

Prerequisite: Nil

Introduction: Limits and Fits, Horizontal and Vertical milling machine – Spindle drives and feed motion - Milling cutters – indexing head – Simple, compound and differential indexing, shaping machine - cutting motion, slotting machine, Grinding machine – Surface, cylindrical and centreless grinding – Tool and cutter grinder, unconventional machining, NC/CNC machine.

Exercises:

Shaping and slotting Exercises - Flat and bevel surfaces, grooves, Slots, guide ways, key ways etc. Exercises in horizontal and Vertical milling machine - Surface, slot, key way and gear milling. Turning Exercises - Limits and Fits. Grinding Exercises. Non–traditional Machining. NC / CNC Machining.

References:

1. HMT, Production Technology, Tata McGraw Hill.
2. ASTME, Tool Engineer's Gandbook.
3. Chapman W. A. J., workshop technology part 2 & 3, ELBS.
4. Rao P. N., Manufacturing Technology, Tata McGraw Hill.
5. Groover & Zimmer, CAD/CAM, Prentice Hall.
6. Metha N. K., Machine Tool Design – Tata McGraw Gill.

MEU392: Thermal Engineering Laboratory

0	0	3	2

Prerequisite: Nil

Study of system and components of petrol and diesel engines, Study of automotive parts, Study of air compressors, blower and fan, Determination of viscosity, flash and fire points and calorific value of oils, Tests on internal combustion engines: determination of valve timing diagrams of engines. Determination of various efficiencies like brake thermal efficiency, indicated thermal efficiency, mechanical efficiency and volumetric efficiency. Determination of friction power – retardation test and Morse test

Study of effect of cooling water and speed on engine performance. Heat balance test

Analysis of exhaust gas internal combustion engines. Performance tests on air compressor and blower, Performance test on refrigeration plant.

SIXTH SEMESTER

MEV311: Machine Tools

3	0	0	3

Prerequisite: Nil

Module 1 (10 Hours)

Machine tool systems, kinematics of machine tools: - job -tool relative motions, types of drives, kinematics of gear boxes, realisation of various machine tools like lathe, milling machines, grinding machines, drilling machines, shaping machines, planning machines, boring machines. Mechanical controls.

Module 2 (10 Hours)

Design of machine tool structures- spindles and guide-ways. dynamics of machine tools. Hydraulic and pneumatic circuits: components- valves, motors, accumulators, etc.- characteristics. Features of typical machine tools, control circuits and their characteristics.

Module 3 (11 Hours)

Machining operations: thread cutting, turning, facing, taper turning, form cutting with form tools, gear forming, gear shaping, gear hobbing, kinematics of gear shapers and gear hobbers, boring, boring tools, boring bars. Drilling, fluted drills, deep hole drilling. Grinding machines, types, construction features, wheel mounting, etc. Special purpose machine tools: Automated machines, jig boring machine, superfinishing, honing machines etc.

Module 4 (11 Hours)

Design of modern CNC machines, positioning accuracy and repeatability of CNC Machine tools. Machining centers, 3,4,5 axis machining, design of CNC machine tools. Mechatronic elements, sensors and transducers, tool changers. Testing of machine tools, positioning accuracy and repeatability. Machine tool error analysis, sources of error, error compensation strategies, real time error compensation techniques, CNC programming, industrial design, aesthetics and ergonomics. Acceptance testing of machine tools. Machine tools for micro machining. Modern trends in machine tools.

References:

1. Acherkan - Principle of Machine tools. Vol. 1,2,3 and 4. Mir publishers
2. Chapman. - Workshop Technology. Vol. 1, Vol. 2, Vol.3.
3. Khaimovitch. - Hydraulic control of Machine tools - Pergamon Press
4. A. Bhattacharyya, Principles of Machine Tools, New Central Agency
5. A. Bhattacharyya, Metal Cutting: Theory & Practice, Central book publishers.
6. HMT, Production Technology – Tata Mc Graw Hill.
7. N. K. Mehta, Machine Tool Design & Numerical Control, Tata McGraw Hill.
8. Ernst - Oil Hydraulics power – Industrial applications - McGraw Hill Book Company.
9. M. C. Shaw, Metal Cutting Principles, CBS Publishers.
10. HMT Limited; Mechatronics: Tata McGraw Hill Publishing Company Limited, 1998.
11. Geoffrey Boothroyd & W. A. Knight, Fundamentals of Machining & Machine Tools, Marcel Dekkel.

12. Donaldson, Lecain & Goold; Tool design, Tata McGraw Hill.

MEV312: Production Management

4	0	0	4

Prerequisite: MAU101 and MAU201

Module 1 (10 Hours)

Characteristics of production systems – Modern production management systems – Operation strategy and competitiveness – Competitive dimensions of operations – Product design and process selection – Quality function deployment – Value analysis – Break even analysis – Strategic capacity planning – Procurement of capital equipment – Alternative evaluation method

Module 2 (12 Hours)

Forecasting – Time series analysis – Components of time series – Moving average – Simple exponential smoothing – Simple regression – Error measurement – Tracking signal – Point estimates and interval estimates

Production Planning and Control – Framework – Material requirement planning (MRP) – Technical Issues – System Dynamics – Production activity control – Production activity control techniques – Finite loading – Gantt Chart – Priority sequencing

Module 3 (12 Hours)

Inventory Control – Functions of inventory-Inventory problem classification—Relevant cost-Selective Inventory control-Independent demand systems: Deterministic models-Sensitivity analysis-Quantity discount-Batch production - Introduction to independent demand systems: probabilistic models – Basic concepts of supply chain management – Logistics management

Module 4 (12 Hours)

Facilities Planning – Objectives of facility planning-Facilities planning strategies-Product design-Process design- assembly chart-Operation process chart-Scrap and Equipment Estimation-Facility Design-Management and planning tools-Flow, space and activity relationship-Flow patterns –Layout planning - Systematic layout planning – Types of layout – Process layout – Product layout – Group Technology layout – Retail service layout.

Module 5 (10 Hours)

Quality Management – Quality costs – Analytical tools for quality control- Introduction to TQM – Introduction to Six sigma – Statistical process control – Control charts for variables – X-bar and R chart – Control charts for attributes – P and C chart – Introduction acceptance sampling.

Text Books:

1. Chase, Acquilano and Jacobs, Operations Management for Competitive Advantage, Tenth Edition, 2003, Tata McGraw-Hill Edition
2. Tersine, R. J., Principles of Inventory and Materials Management, Fourth Edition, Prentice-Hall Inc., New Jersey, 1994.
3. Vollmann, Berry, Whybark, and Jacobs, Manufacturing Planning and Control for Supply Chain Management, 2005, Fifth Edition, Tata McGraw-Hill.
4. Francis, *et al.*, Facility Layout and Location, Second Edition, 1999, Prentice Hall of India.

References:

1. Tomkins, White, Bozer, Frazelle, Tanchoco and Trevino, Facility Planning, Second Edition, John Wiley & Sons

MEV313: Quantitative Techniques for Executive Decisions

3	0	0	3

Prerequisite: MAU101, MAU102 and MAU201

Module 1(11 Hours)

Methodology of operations research- Linear programming: Mathematical formulation of linear programming problems - Graphical solution - Theory of simplex method - Two-phase method -Charne's M method - Special cases in simplex method application: Degeneracy, alternative optima, unbounded solutions and infeasible solutions – Revised simplex - Sensitivity analysis.

Module 2 (10 Hours)

Duality in Linear Programming - Primal-dual relationships. Transportation Problems: Formulation and solution. Assignment Problems: Formulation and solution.

Module 3 (9 Hours)

Games Theory: Rectangular games - Saddle points - Pure and mixed strategies - Solving zero-sum games using linear programming formulations - Dominance - Graphical solution.

Module 4 (12 Hours)

Dynamic Programming: Characteristics of dynamic programming problems - Bellman's principle of optimality – Deterministic dynamic programming problems with a finite number of consecutive decisions.

Queueing Theory: Basic structure of queueing models – The role of exponential distribution - Steady state solution of single server model (Poisson input and exponential service times) - Finite queue model.

Text Books:

1. Hadley, G., Linear Programming, Addison Wesley/Narosa, Narosa Publishing House, 1994.
2. Taha, H.A., Operations Research: An introduction, Seventh Edition, Prentice Hall of India Private Limited, New Delhi, 2003.

References:

1. Hillier, F.S., and Liberman, G.J., Introduction to Operations Research: Concepts and Cases, Eighth Edition, McGraw-Hill International Edition, 2005.
2. Ravindran A., Philips, D. and Solberg, J.J., Operations Research: Principles and Practice, Second Edition, John Wiley & Sons Inc., 2005.
3. Murthy, K.G., Linear and Combinatorial Programming, John Wiley & Sons, 1976.

MEU315: Design of Machine Elements

4	0	0	4

Prerequisites: MEU202 and MEU212

Module 1 (13 Hours)

Introduction to Design: Steps in design process; design factors; tolerances & fits; principles of standardization; selection of materials; strength of mechanical elements; stress concentration; theories of failure; impact load; fatigue loading; consideration of creep and thermal stresses in design.

Threaded fasteners: Thread standards; stresses in screw threads; preloading of bolts; bolted joints; eccentric loading; gasketed joints.

Module 2 (15 Hours)

Welded joints: Types of welded joints; stresses in butt and fillet welds; torsion and bending in welded joints; welds subjected to fluctuating loads; design of welded machine parts and structural joints.

Springs: Stresses in helical springs; deflection of helical springs; extension, compression and torsion springs; design of helical springs for static and fatigue loading; critical frequency of helical springs; stress analysis and design of leaf springs.

Module 3 (16 Hours)

Power shafting: Stresses in shafts; design for static loads; reversed bending and steady torsion; design for strength and deflection; design for fatigue loading; critical speed of shafts; stresses in keys; design of keys

Design of gears: Spur, helical, bevel and worm gears; tooth loads; gear materials; design stresses; basic tooth stresses; stress concentration; service factor; velocity factor; bending strength of gear teeth; Buckingham's equation for dynamic load; surface strength and durability; heat dissipation; design for strength and wear.

Module 4 (12 Hours)

Lubrication & Journal Bearing Design: Types of lubrication and lubricants; viscosity; journal bearing with perfect lubrication; hydrodynamic theory; design considerations; heat balance; journal bearing design.

Rolling Contact Bearings: Bearing types; Bearing life; static and dynamic capacity; selection of bearings with axial and radial loads; lubrication; seals, shaft, housing and mounting details.

References:

1. J.E. Shigley, Mechanical Engineering Design, McGraw Hill, First Metric Edn., 1986.
2. J.E. Shigley, and C.R. Mischke, Mechanical Engineering Design, Tata McGraw Hill, Sixth Edn., 2003.
3. M.J. Siegel, V.L. Maleev and J.B. Hartman, Mechanical Design of Machines, International Textbook Company
4. R.M. Phelan, Fundamentals of Mechanical Design, Tata McGraw Hill
5. V.L. Doughtie and A.V. Vallance, Design of Machine elements, McGraw Hill.
6. R.C. Juvinall and K.M. Marshek, Fundamentals of Machine Component design, John Wiley & Sons
7. R.L. Norton, Machine Design, Pearson Education

Data Handbooks (allowed for reference during examinations also):

1. Prof. B.R. Narayana Iyengar and Dr. K. Lingaigh, Machine Design Data Handbook, Vol. I & II
2. P.S.G. Tech., Machine Design Data Hand Book.

MEV392: CAD/CAM/CIM Laboratory

0	0	3	2

Prerequisite: Nil

1. Exercises on Solid Modeling [12 Hours]

Introduction to Computer Graphics – Viewing transformations, Curves and Surfaces generation, Curve fitting and Curve fairing techniques. 2D, wire frame, 3D shading – Familiarity with Boolean operations – Sweep, Revolve, Loft, Extrude, Filleting, Chamfer, Splines etc. Windowing, View Point, Clipping, Scaling and Rotation Transformations using commercial solid modeling packages like IDEAS, Pro-E, CATIA, etc..

2. Exercise on Finite Element Analysis [12Hours]

Introduction to FEM – 1D, 2D and 3D elements – shape functions

Preprocessing – Boundary Conditions, Structured and Free Mesh Generation

Analysis – Linear and Non Linear analysis – Static and Dynamic analysis

Post Processing – Display, Animation, Extraction of Nodal data

Exercises on Heat Conduction, fluid flow and Elasticity may be given using commercial FEM packages like ANSYS, ABAQUS, etc.

3. Assemblies and Mechanism Design [6 Hours]

Assembling of various parts and Tolerance analysis

Synthesis and Design of Mechanisms – Animations

Exercises on various mechanisms like four bar linkages and its variations, cam and follower, Two and Four Stroke engines.
Design for manufacturability – use of commercial software packages.

4. Computer Aided Manufacturing [6 Hours]

Process Control using PLC – PID control strategy
Part Programming fundamentals – Manual part Programming and Computer Aided Part Programming.
Hands on training in computer controlled turning and milling operations – Familiarity with Windows based software packages – Tool path generation and simulation.
Exercises on CNC Lathe and Machining Center/Milling Machines, Rapid prototyping.

5. Programming of Industrial Robots [6 Hours]

Introduction to Robotics – Structure, Workspace analysis and various components-actuators, sensors, encoders, end effectors-applications, Hands on training on industrial robots – manual and programmed path planning.

6. Computer Aided inspection and Quality Control [3 Hours]

Introduction to CMM –Classification-structure-components – familiarity with measurement software packages and its Modules. Demonstration of the capability of Coordinate Measuring Machine using a sample component e.g.: Engines Block – Concepts of Reverse Engineering and Rapid Prototyping Technology.

References:

1. Rogers, D.F., and Adams J.A., "Mathematical Elements for Computer Graphics", McGraw Hill.
2. Rogers David F., "Procedural Elements for computer Graphics", McGraw Hill.
3. Cook, Robert Davis et al., "Concepts and Applications of Finite Element Analysis", John Wiley and Sons.
4. Koren, Yoram "Computer Control of manufacturing System", McGraw Hill.
5. Kundra, Rao and Tewari, "Numerical Control and Computer aided Manufacturing", Tata McGraw Hill.
6. Ramamurthy, V., "Computer Aided Mechanical Design", Tata McGraw Hill.
7. Fu, K.S., Gonzalez R.C., and Lee C.S.G., "Robotics: Control, Sensing, vision and Intelligence", McGraw Hill.
8. Koren, Yoram, "Robotics for Engineers", McGraw Hill.
9. John A Bosch, "Coordinae measuring Machines and Systems", Marcel Decker Inc., New York.

MEV398: Mini Project/ Industrial Training

0	0	3	1

Prerequisite: Nil

Students may undertake short research projects under the direction of members of the faculty, normally 3 hrs/week. A written, detailed report describing the project and results is required. Students are expected to undertake fabrication work of new experimental set up/devices or develop software packages for the various laboratories in the department.
Students may opt to undertake with help from the Department of Training and Placement, Internship in the field of Mechanical Engineering by undergoing in-plant training of at least one-month duration in reputed industries/research centers in the country. The industrial training is expected to be undertaken during the semester recess. The student writes a final report on this training and makes an oral presentation before an evaluation committee.

SEVENTH SEMESTER

MEV402: Theory of Metal Cutting

4	0	0	4

Prerequisite: Nil

Module 1 (14 Hours)

Tool nomenclatures, mechanics of chip formation, orthogonal and oblique cutting, shear angle, velocity relationship. Merchant's analysis of cutting forces, other theories of cutting, tool geometries, cutting variables and power estimation in various machining processes.

Module 2 (14 Hours)

Inserts- chip groove geometries; nomenclature, selection and applications in turning, milling, drilling, effect of cutting variables. Carbide grade design, carbide coatings, Advances in cutting tool materials. Theories of tool wear, measurement of tool wear, tool failure analysis. Tool life and economics of machining.

Module 3 (14 Hours)

Tool Dynamometers: Turning, Milling, Drilling and Grinding Dynamometers, features and measuring strategy. Thermal aspects of machining: Cutting fluids and its selection. Optimal machining conditions and productivity, Machinability: criteria and factors affecting machinability. Abrasive machining processes, mechanics of grinding, power requirements, mechanics of wheel wear, creep feed grinding, thermal aspects of grinding process. Surface integrity, methods of improving surface integrity.

Module 4 (14 Hours)

Modern machining processes- principles, process characteristics and application of ECM, EDM, USM, AJM, EBM, LBM, PAM, etc., capability analysis. Micro/nano machining.

References:

1. Amitabh Ghosh and Asok Kumar Mallik, “Manufacturing Science”, Affiliated East West Press Pvt. Ltd.
2. B. L. Juneja and G.S. Sekhon, “Fundamentals of Metal Cutting and Machine Tools”, New Age, International (P) Ltd.
3. Amitabha Battacharyya, “Metal Cutting, Theory and Practice”, New Central Book Agency.
4. Serope Kalpakjian and Steven R. Schmid, “Manufacturing Engineering and Technology, Pearson Education.
5. M. C. Shaw, “Metal Cutting Principles”, CBs Publishers.
6. V. C. Vekatesh and H. Chandrasekharan, “Experimental Techniques in Metal cutting”, Practice Hall of India Pvt. Ltd.
7. E.M. Trent, “Metal Cutting”, Butterworth Heinemann.
8. Geoffrey Boothroyd and W. A. Knight, “Fundamentals of Machining and Machine Tools”, Marcel Dekkel Inc.
9. Pandey & Shaw - Modern Machining Processes - Tata Mc Graw Hill.

MEV403: Introduction to Mechatronics

3	1	0	3

Prerequisite: ZZU191 and ECU101

Module 1 (10 Hours)

Introduction To Mechatronics System: Key elements-Mechatronics Design Process-Types of Design-Traditional and Mechatronics Designs-Advanced Approaches in Mechatronics-Real Time Interfacing –Elements of Data Acquisition System.

Module 2 (11 Hours)

Actuators, Sensors&Transducers: Fluid Power and Electrical Actuators-Piezoelectric Actuator; Sensors for position, motion, force and temperature-Flow sensors-Range sensors-Ultrasonic sensors-Fibre Optic Sensors-Magnetostrictive transducer-Selection of Sensors.

Module 3 (11 Hours)

Signals, System & Controllers: Introduction to Signals, system and Controls-System representation-Linearisation-Time Delays-Measures of System performance; Closed loop Controllers-PID Controller, Digital Controllers-Controller tuning, adaptive Control-Introduction to Microprocessors, Micro-controllers and Programmable Logic Controllers-Components-PLC programming.

Module 4 (10 hours)

Advanced Applications In Mechatronics: Sensors for Condition Monitoring-Mechatronics Control in Automated Manufacturing-Artificial Intelligence in Mechatronics-Fuzzy Logic Application in Mechatronics-Microsensors in Mechatronics-Case Studies of Mechatronics Systems.

Text Books:

1. Bolton, W, Mechatronics, Pearson education Asia 2004.
2. Devadas Shetty, Richard A Kolk, Mechatronics System Design, Thomson Learning, 2001

References:

1. Dan Necsulescu Mechatronics, Parson education Asia 2002.
2. HMT Ltd, Mechatronics, TMH 1998.
3. B.P.Singh, Microprocessors and Microcontrollers, Galgotia Pub First Edn, 1997.
4. Frank D.Petruzella, Programmable Logic Controllers, TMH, 1989.
5. Krishna Kant, Computer Based Industrial Control, PHI, 1999.

MEV491: Management Science Laboratory

0	0	3	2

Prerequisites: MEV312 and MEV313

Statistical Process Control, Construction of Process Flow Charts, Learning Curve, Determination of Standard Time, Performance Rating Analysis, Study of effect of method and workplace layout on performance, Visual Acuity test, Coordination test, Determination of Production System Parameter Through Simulation, Simulation of Single Server Queuing System, Simulation of Inventory system, Monte Carlo Simulation, Design of manufacturing cell, Mathematical Model formulation and solution of decision problems in operations management using LINGO

MEV492: Metal Cutting Laboratory

0	0	3	2

Prerequisite: Nil

NC and CNC machines, Measurement of cutting force in various machine tools; study of the variation of cutting force with parameters like cutting velocity, feed, depth & tool geometry, study of influence of cutting fluids on machining, study of tool and cutter grinder, surface integrity studies on parts machined in traditional machine tools

MEV498: Project

0	0	3	3

Prerequisite: Nil

Students are required to enroll in this course to complete the degree requirements. The project work commenced in VII Semester shall be continued in VIII Semester, normally 3 hours/week. At the end of seventh semester, a mid term evaluation will be conducted by a project evaluation committee.

EIGHTH SEMESTER

MEV411: Industrial Engineering

3	1	0	3

Prerequisite: MAU201

Module 1 (8 Hours)

Productivity – Productivity measurement approaches at the enterprise level – Techniques for productivity improvement – Work study – Working conditions – Introduction to ergonomics.

Module 2 (10 Hours)

Method study – Techniques – Various types of charts and diagrams – Flow and handling of materials – Tools for recording the movement of workers – Principles of motion economy – Micromotion study – SIMO chart

Module 3 (12 Hours)

Work measurement – Basic procedure – Techniques – Work sampling – Time study – allowances – standard time – Introduction predetermined time standards – Job analysis – Job evaluation – Merit rating – Wages and incentives.

Module 4 (12 Hours)

Statements of financial Information – Balance sheet – Profit and Loss Account – Cost concept – Income measurement – Profit planning – Control – Decision making – Job/Order costing – Batch costing – Depreciation methods - Introduction Activity based costing.

Text Books:

1. I. L. O., Introduction to Work Study: Indian Adaptation, Third (Revised Edition), 1997, Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.
2. Barnes, R. M.: Motion and Time Study: Design and Measurement of Work, 7e, 1980, John Wiley & Sons, NY.
3. Khan M.Y. and P.K. Jain, Management Accounting, 3rd edition, 2002, Tata McGraw Hill.

MEV412: Tool Engineering and Design

3	1	0	3

Prerequisite: Nil

Module 1 (12 Hours)

Design of Chips Forming Tools,single point tools, tool geometry, tool materials- milling cutters, drills & reamers, grinding wheels, tipped tools and inserts. Design of tool holders & boring bars, vibration damping of boring bars, form tools. Influence of cutting parameters on cutting force and power, cutting power estimation in Turning, Milling & Drilling.

Module 2 (10 Hours)

Press Working Tools, power presses, die cutting operations, centre of pressure, punch & die size and press tonnage calculations, scrap -strip layout . Compound and progressive dies, die design, drawing dies , blank development, press tonnage estimation, blank holding pressure, multiple draws, design of drawing dies.

Module 3 (10 Hours)

Design of fixture,elements of fixture, standard work holding devices, principles of location & clamping, plain & concentric location, clamping elements, quick acting clamps, design of fixtures.

Module 4 (10 Hours)

Design of Jigs, Jigs for drilling & reaming, types of jigs, guide bushings, indexing jigs, design of jigs.

References:

1. Acherkan - Principle of Machine tools. Vol. 1,2,3 and 4. Mir publishers
2. A Bhattacharyya , "Metal Cutting Theory & Practice"; Central Book Publishers, Calcultta .
3. ASTME ," Fundamentals of Tools Design"; Prentice Hall.
4. F.W. Wilson , "Hand Book of Fixture Design"; Mc Graw Hill.
5. Donaldson. Lecain, Goold ," Tool Design", Tata Mc Graw Hill.
6. Rodin. P ," Design & Production of Metal Cutting Tools", MIR Publishers.
7. HMT ," Production Technology", Tata Mc Graw Hill.
8. P. H. Joshi, “Jigs and Fixtures”, Tata McGraw Hill.

SHU417: Industrial Economics

3	0	0	3

Prerequisite: Nil

Module 1 (11 hours)

The scope of Industrial Economics and its History. Industrial efficiency: Concepts and Measmement. Meaning of the concept. The Detenninants of efficiency levels. Some efficiency conditions in the theory of production, Efficiency and decision making process. The organisational fOlDl and Alternative motives of the fimt. Types of organisational fOlDl. Business Motives.

Module 2 (10 hours)

Demand Analysis - Theory of Demand. The elasticity concept. Demand for the Products of Individual firms in an Industry. Demand forecasting. The cost theory and optimum size of the firm. The theory of cost and production. The efficiency and size of the firm.

Module 3 (11 hours)

Elements of Market Structure - Some concepts - standard forms of Market structure - The concept of workable competiton. The conceptual frame work of the study of Industrial Economics. Market stroctw"e and Innovation. The process of innovation, concepts and Relationships, Measuremerit of innovation activities - The Theory of technological innovation. Diffusion of New Technology.

Module 4 (10 hours)

Industrial Finance and Accounting - The need for finance - types of Finance - sources of finance - contribution of various sources finance in Indian situation. Choice of Funding: Internal VB External somces. An evaluation of Indian Industrial policy. The ways and means of Government regulation of Industry. Labour productivity – concept of labour productivity and its measurement - the determinants of labour productivity.

References:

1. R.R. Barthwal - Industrial Economics, John Wiley.
2. W. Stewart, Industrial Economics: An applied approach (Macmillan)
3. Rogar Clark - Industrial Economics Blackwall- Oxford.
4. Bhagawati and P. Desai, India: planning for Industrialisation.
5. Sharad S. Martha, Regulation and development: India's experience.
6. A Bagchi and n. Banetjee, changing structure of industrial fInance in India (K.P. Bahi and Co.)
7. P.J. Devons etal. An introduction to Industrial Economics.(Allen and Wlwin.)

MEV493: Seminar

0	0	3	1

Prerequisite: Nil

Each student shall prepare a technical paper and make a 20 – 30 minute oral presentation on a current research topic relevant to mechanical engineering to the rest of the class, after scrutiny and approval of the faculty- in charge of seminar. The oral presentation and a final technical report (in the format of an ASME journal paper of not less than 12 pages) are evaluated by faculty members in charge of seminar. Appropriate weights may be given for communications skills (both verbal and written) as well as for capacity to impress the audience and ability to handle question & answer (Q&A) sessions.

MEV499: Project

0	0	6	5

Prerequisite: MEV498

Students are required to enroll in this course to complete the degree requirements. The project work commenced in VII Semester shall be continued in VIII Semester, normally 3 hours/week. At the end of the semester, a thesis written in an acceptable style describing an original research project, and a successful oral defense of the thesis topic before a project evaluation committee are required.

Electives:

MEU321: Unconventional Energy Systems

3	0	0	3

Prerequisite: Nil

Module 1 (12 Hours)

Introduction: Energy problem – Finite fossil reserves – Energy & Environment – Need for renewables and energy efficiency. Solar Thermal: Analysis of flat plate collectors – Measurement and Testing procedures – Solar pond – Parabolic collectors – Paraboloid dish - Central receiver – Energy storage systems – Residential water heating, industrial heating & power generation.

Module 2 (10 Hours)

Biomass Systems: Biomass conversion routes – Combustion, gasification, aerobic digestion, pyrolysis & co-generation – Performance analysis & testing – Thermal applications & power generation.

Module 3 (10 Hours)

Wind Energy & Small Hydro: Wind distribution – Types & Operation of wind turbines and their characteristics – Generators & control strategies – classification of hydro turbines – performance analysis – Selection & sizing - Power generation using OTEC – Wave & tidal energy.

Module 4 (10 Hours)

Scope and Economics: Calculation of energy cost from renewables – Comparison with conventional fuel driven systems – Calculation of CO_2 reduction – Incremental costs for renewable options – Introduction to integrated energy systems.

References:

1. S. P. Sukhatne: Solar Energy – Principles of Thermal Collection & Storage, 2e, Tata McGraw Hill, 1996.
2. H. P. Garg: Advances in Solar Energy Technology, D. Reid Publishing House, 1997.
3. G. N. Tiwari & S. Suneja: Solar Thermal Energy Systems, Narora Publishing House, 1997.
4. A.N. Mathur and N. S. Rathore: Biogas Production, Management and Utilization, Himansu Publications, 1992.

5. K. C. Khandelwal & S. S. Mandi: Practical Hand Book of Biogas Technology, 1990.
6. L. L. Freris: Wind Energy Conversion Systems, Prentice Hall, 1990.

MEV323: Introduction to Marketing

Prerequisite: Nil

3	0	0	3

Module 1 (10 Hours)

Defining marketing, scope and concepts – building customer satisfaction and value – Analysing marketing opportunities and planning.

Module 2 (11 Hours)

Consumer markets and buyer behaviour – business markets dealing with competition – market segmentation – product life cycle – strategies.

Module 3 (11 Hours)

Marketing Channels – advertising, sales promotion, direct marketing, managing sales force.

Module 4 (10 Hours)

Special topics in marketing – marketing communication-global market offering – changing marketing practices.

Text Book:

1. Kotler. P, "Marketing Management", 10th edition, Prentice Hall India Ltd, New Delhi (2000).

References:

1. Ramaswamy V.S and Namkumari S., "Marketing Management", Macmillan India Ltd, New Delhi (1997).
2. Keegan, "Global Marketing Management", Pearson Education India, New Delhi (2002).
3. Saxena, "Marketing Management", 2nd edition, Tata McGraw Hill (2002).

MEV324: Design and Analysis of Information Systems

Prerequisite: Nil

3	0	0	3

Module 1 (11 Hours)

Concepts of data and information – Producing information from data – economies of information – analysis of system – management and formal information system concepts.
Building blocks in information systems – system design forces – information development life cycle – information systems for strategic planning.

Module 2 (10 Hours)

General steps in Information system design – systems investigation and requirements engineering – System analysis and general system design – charting tools for system analysis and design.

Module 3 (11 Hours)

Introduction to database management – classification of data items – Coding considerations – types of code structures – Forms design.
General File storage consideration – composition and classification of data files – selection consideration for file media and file organization methods, concepts of data structures – data association – sorting and searching techniques.

Module 4 (10 Hours)

System implementation – Verification and Validation of Software system – Software metric and models, introduction to capability maturity model – software testing

approaches – training and post implementation audit – Recent developments in information systems, Security features in global information systems.

References:

1. Burch and Grudnitski, Information Systems – Theory and Practice, Fifth edition, John Wiley & Sons, New York, 1989.
2. Hawryszkiewycz, I. T., "Introduction to Systems Analysis and Design", Prentice Hall of India, 1989.
3. Ian Sommerville, Software Engineering, 6th Edition, Pearson Education Asia, 2001.
4. Lucas, Henry C., Analysis, Design, and Implementation of Information Systems, 4th edition, McGraw Hill, New York, 1992.
5. O' Brien J. A., Management Information Systems, 4/e, Tata McGraw Hill, 1999.

MEV330: Design for Manufacturability

Prerequisite: Nil

3	0	0	3

Module 1 (10 Hours)

Introduction - Design philosophy, implementing DFM, Benefits of DFM Concurrent Engineering - Design for Quality, Design for Life Cycle, Design for Cost, Enabling Technology, Concurrent Engineering and the Organization, Improving the Development Process Management Frameworks - Architecture, Management's concerns with Manufacturability, Team Building and Training Justification of DFM, Viewpoints for DFM

Module 2 (11 Hours)

Quality Tools in DFM - Problem Solving Tools, Quality Function Deployment, Benchmarking, Supplier Involvement, Taguchi approach. Computer Aided Technology - CAD/CAM/CAE, Rapid Prototyping, Group Technology, CIM Creative Thinking in DFM, Tools General Product Design - Impact of Design concept and early project decisions, Evaluating manufacturability of conceptual designs, Producibility, Geometric Tolerancing

Module 3 (11 Hours)

Design for Assembly - Principles, improving serviceability, recyclability Design for Machining - Principles, Non-Traditional Machining Design for forming - Principles, fine blanking, roll forming, precision forming, metal spinning, tube fabrication

Module 4 (10 Hours)

Design for Forging, Casting. Design for Coating - Painting, powder coating, metal spraying Design for Heat Treatment Design for Fastening & Joining - Design guidelines for fasteners, adhesive assembly, welded assemblies Design for Materials: Plastics, Composites, Ceramics, Powder Metallurgy

Text Book:

1. Chitale, AK and Gupta, RC, 1997, "Product Design and Manufacturing", Prentice Hall of India Pvt Ltd.

References:

1. Dieter, George Elwood, "Engineering Design - A Materials and Processing approach", Mc Graw Hill International.
2. Bakerjian, Ramon, Ed., "Design for Manufacturability, Tool and Manufacturing Engineers Handbook", Society of Manufacturing Engineers, Michigan.

MEU331: Computational Methods in Engineering

3	0	0	3

Prerequisite: Nil

Module I (9 Hours)

Introduction to computational methods; Computational procedure-method of selection, programming languages, development of computer code; Numerical errors and accuracy - round-off error, truncation error, accuracy of numerical results, numerical stability; Iterative convergence – condition of convergence, rate of convergence, termination of iteration; Numerical parameters – step size, convergence criterion, other arbitrarily chosen variables

Module II (10Hours)

Roots of equations- search method for real roots, bisection method, regula falsi method, and secant method, Newton-Raphson method, modified Newton's method; Method of least squares for a best fit – basic considerations, linear regression, best fit with a polynomial, nonpolynomial forms; Lagrange interpolation, Newton's divided – difference interpolating polynomial, numerical interpolation with splines.

Module III (9 Hours)

Numerical differentiation: direct approximation of derivatives; Taylor series approach and accuracy- finite difference approximation of the derivatives; polynomial fitting approach; Numerical Integration – the trapezoidal rule, truncation error; Simpson's rules for numerical integration, truncation errors; higher - accuracy methods- Newton – Cotes formulae; Gauss quadrature.

Module IV (14 Hours)

Numerical solution of simultaneous linear algebraic equations: Gaussian elimination, tridiagonal matrix algorithm, LU decomposition; Iterative methods - Jacobi method, Gauss - Seidel method; Solution of simultaneous non-linear equations- Newton- Raphson method, modified Jacobi and Gauss Seidel methods;

Numerical solution of ordinary differential equations: Eulers method, Runga- Kutta methods, predictor- corrector methods; Numerical solution of boundary value problems - shooting methods, finite difference methods.

References:

1. Chapra, S. C. and Canale, R. P., Numerical Methods for Engineers, Fourth Edition, Tata McGraw-Hill, 2002.
2. Jaluria, Y., Computer Methods for Engineering, Allyn and Bacon, Inc., 1988.
3. James, M. L., Applied Numerical Methods for Digital Computations, Third Edition, Harper and Row, 1985.
4. Griffiths, D.V and Smith I. M., Numerical Methods for Engineers: A Programming Approach, CRC Press, 1991.

MEU322: Introduction to Finite Element Methods

3	0	0	3

Prerequisites: MAU101 and MAU102

Module 1 (11 Hours)

Linear vector spaces – linear transformations and functionals – linear, bilinear and quadratic forms – theory of normed spaces – theory of inner product spaces – concepts from variational calculus – variational methods of approximation – Ritz method – weighted residual method – Galerkin method – subdomain method – collocation method.

Module 2 (10 Hours)

Finite element analysis of one dimensional problems – procedure – one dimensional elements and interpolation functions – analysis of one dimensional second and fourth order equations – approximation errors in the finite element method – computer implementation.

Module 3 (12 Hours)

Finite element analysis of two dimensional problems – two dimensional elements and interpolation functions – second order equations involving a scalar valued function – comments on mesh generation and composition of boundary conditions – analysis of plane elasticity and incompressible fluid flow problems – time dependent problems (transient heat transfer) – isoparametric elements and numerical integration.

Module 4 (9 Hours)

Alternative formulations – the least square formulation – the mixed formulation – Eigen value problems – non linear problems – three dimensional elements and interpolation functions – formulation of three dimensional problems (two and three dimensional Navier Stoke's equations – three dimensional heat transfer equations).

Text Books:

1. Reddy, J.N., An Introduction to the Finite Element Method, Tata McGraw Hill Third Edn., 2005.
2. Reddy, J.N., Applied Functional Analysis and Variational Methods in Engineering, McGraw Hill International Edition, 1987.

References:

1. Huebner, K.H., The Finite Element Method for Engineers, John Wiley
2. Zenkiewicz, O.C., The Finite Element Method, Tata McGraw Gill Edition.
3. Zienkiewicz, O.C., and Morgan, K., Finite Elements and Approximation, John Wiley & Sons, 1983.
4. Cook, R.D., Malkus, D.S., Plesha, M.E., and Witt, R.J., Concepts and Applications of Finite Element Analysis, John Wiley & Sons, Fourth Edn., 2004.

MEU325: Experimental Stress Analysis

3	0	0	3

Prerequisites: MEU202 or Equivalent (Consent of teacher)

Module 1 (9 Hours)

Stress at a point, strain at a point, stress-strain relations, principal stresses and principal strains, compatibility conditions. Basic equations in elasticity theory:- Formulation of the problem, field equations, plane stress and plane strain problems. Airy's stress function:- Solution by polynomials, Example problem-bending of a cantilever with a point load at the free end.

Module 2 (12 Hours)

Strain measurements: Strain and its relation to experimental determinations- types of strain gauges: –mechanical strain gauges –optical strain gauges- inductance strain gauges. Electrical resistance strain gauges:- strain sensitivity in metallic alloys-Gauge construction-Strain gauge adhesives and mounting methods - gauge sensitivities and gauge factor – performance characteristics of foil strain gauges - temperature compensation - strain gauge circuits - potentiometer - Wheastone bridge circuits.

Strain rosette: The three element rectangular rosette and delta rosette.

Module 3 (12 Hours)

Photo elasticity: Basic optics – temporary double refraction - stress optic law - stress and bire fringence .Two dimensional photoelasticity:- plane polariscope- circular polariscope - isoclinics - isochromatics - effects of stressed model in a plane and circular polariscope -dark field and light field arrangements - compensation techniques - photo elastic materials – calibration methods-separation methods-scaling model to prototype stresses.

Module 4 (9 Hours)

Theory of brittle coating method - coating stresses, failure theories - brittle coating patterns - crack detection - ceramic based brittle coatings, Resin based brittle coatings - Test procedures for brittle coating analyses - analysis of brittle coating data.

Text Book:

1. James W. Dally, and William E. Riley, Experimental Stress Analysis, McGraw Hill, Third Edn., 1991.

References:

1. R.G. Budynas, Advanced Strength and Applied Stress Analysis, McGraw Hill, Second Edn., 1999.
2. L. S. Sreenath, M. R. Raghavan, K. Lingaiah, G. Garghesha, B. Pant, and K. Ramachandra, Experimental Stress Analysis, Tata McGraw Hill
3. S.P. Timoshenko and J.N. Goodier, Theory of Elasticity, McGraw Hill, New York, Third Edn., 1970.

MEU326: Fluid Power Control

3	0	0	3

Prerequisite: MEU205

Module 1(10 Hours)

Introduction to oil hydraulics and pneumatics, their advantages and limitations. ISO symbols and standards in Oil Hydraulics and pneumatics. Recent developments, applications, Basic types and constructions of Hydraulic pumps and motors. Ideal pump and motor analysis. Practical pump and motor analysis. Performance curves and parameters.

Module 2 (11 Hours)

Hydraulic control elements – direction, pressure and flow control valves. Valve configurations, General valve analysis, valve lap, flow forces and lateral forces on spool valves. Series and parallel pressure compensation flow control valves. Flapper valve Analysis and Design. Analysis of valve controlled and pump controlled motor. Electro-hydraulic servo valves-specifications, selection and use of servo valves.

Module 3 (11 Hours)

Electro hydraulic servomechanisms – Electro hydraulic position control servos and velocity control servos. Nonlinearities in control systems (backlash, hysteresis, dead band and friction nonlinearities). Basic configurations of hydraulic power supplies – Bypass Regulated and Stroke Regulated Hydraulic Power Supplies. Heat generation and dissipation in hydraulic systems. Design and analysis of typical hydraulic circuits. Use of Displacement – Time and Travels-Step diagrams; Synchronization circuits and accumulator sizing. Meter-in, Meter-out and Bleed-off circuits; Fail Safe and Counter balancing circuits.

Module 4 (10 Hours)

Components of pneumatic systems; Direction, flow and pressure control valves in pneumatic systems. Development of single and multiple actuator circuits. Valves for logic functions; Time delay valve; Exhaust and supply air throttling; Examples of typical circuits using Displacement – Time and Travel-Step diagrams. Will-dependent control, Travel-dependent control and Time-dependent control, Combined control, Program Control, Electro-pneumatic control and air-hydraulic control. Applications in Assembly, Feeding, Metalworking, materials handling and plastics working.

References:

1. Blackburn, J. F., G. Reethof, and J. L. Shearer, Fluid Power Control, New York: Technology Press of M. I. T. and Wiley.
2. Anthony Esposito, "Fluid Power with applications", Pearson Education.
3. Ernst, W., Oil Hydraulic Power and its Industrial Applications, New York: McGraw Hill.
4. Lewis, E. E., and H. Stern, Design of Hydraulic Control Systems, New York: McGraw Hill.
5. Morse, A. C., Electro hydraulic Servomechanism, New York: McGraw Hill.
6. Pippenger, J.J., and R.M. Koff, Fluid Power Control systems, New York: McGraw Hill.
7. Fitch, Jr., E.C., Fluid Power Control Systems, New York: McGraw Hill.
8. Khaimovitch, "Hydraulic and Pneumatic Control of Machine Tools".
9. John Watton, "Fluid Power Systems: modeling, simulation and microcomputer control", Prentice Hall International.
10. Herbert E. Merritt: Hydraulic control systems, John Wilely and Sons Inc.
11. Thoma, Jean U., Hydrostatic Power Transmission, Trade and Technical Press, Surrey, England.
12. Ian Mencal, Hydraulic operation and control of Machine tools – Ronald Press
13. Harry L Sterwart, Hydraulic and Pneumatic power for production-Industrial Press.
14. Hasebrink J.P., and Kobler R., "Fundamentals of Pnuematics/electropeumatics", FESTO Didactic publication No. 7301, Esslingen Germany.
15. Werner deppert and Kurt Stoll, "Pneumatic Control-An introduction to the principles", Vogel-Verlag.
16. Blaine W. Andersen, "The analysis and Design of Pneumatic Systems", John Wiley and Sons, Inc.

MEV327: Human Factors in Engineering and Design

3	0	0	3

Prerequisite: Nil

Module 1 (10 Hours)

Human factors and Systems - Nature of man-machine systems and characteristics; Information input and processing – Information Theory – Displaying Information – Coding of Information – Mode of information processing – Perception – Attention – Mental Workload – Human Factors in information revolution

Module 2 (10 Hours)

Test, Graphics, Symbols and Codes – Visual capabilities – Visual display terminal screens and text – Graphic representations – Symbolic designs – Quantitative visual displays – Signals and warning lights – Representational displays – Auditory, Tactual and Olfactory Displays – Cutaneous senses – Speech communication.

Module 3 (12 Hours)

Human motor activity – Muscle physiology – Measure of physiological strain – Physical workload – Strength and Endurance – Manual material handling – Recommended limits – Motor skills – Human control of systems.

Module 4 (10 Hours)

Anthropometry and work-space design – Use of anthropometric data – Design of work surfaces – Science of seating – General location of control and displays within work space - Interpersonal aspects of workplace design.

Text Book:

1. Sanders, M.S., and McCormick, E.J., Human Factors in Engineering and design, McGraw-Hill International editions, Seventh Edition, 1993.

References:

1. Murrell K.F.H. and Schnauber, H.:Ergonomics. Econ, Munich, 1986.
2. Gavriel Salvendy: Handbook of Human Factors & Ergonomics, Inter-science, 1997.

MEV328: Technology Management

3	0	0	3

Prerequisite: Nil

Module 1 (9 Hours)

Technology – Concepts – definition – Technological change – scope – implication

Module 2 (11 Hours)

Approach to technology management – technology cycle – technology flow process – basic tenets of management of technology.

Module 3 (11 Hours)

Technology acquisition-forecasting generation – development-technology transfer.

Module 4 (11 Hours)

Technology absorption – diffusion – evaluation and assessment – intellectual property rights.

Text Book:

1. Hawthorn E.P, "The Management of Technology", McGraw Hill (2000)

References:

1. Babcock D.L., "Managing Engineering Technology", Printice Hall (1998).
2. Burgelman *et al*., "Strategic Management of Technology and Innovation", Tata McGraw Hill (2001).
3. Cleland and Bursic, "Strategic Technology Management", A Macom Publishers, Newyork (1999).
4. Betz. F., "Managing Technology – Competing through new ventures, innovation and corporate research", Prentice Hall(1998).

MEU329: Theory of Metal Forming

3	0	0	3

Prerequisite: MEU214 or MEU218

Module I (10hrs)

Review of the theory of stress and strain, transformation laws, principal stresses and strains, Mohrs circle, stress strain relations, Material properties.

Introduction to the theory of plasticity: behavior of metals under uni-axial tension and compression, true stress-true strain plots, work hardening, bollarding and barreling, empirical stress strain relations for work hardening materials.

Module 2 (10hrs)

Yield criterion, stress space representation of yield criterion, Tresca, von Mises and other criterion, yield surface for work hardening materials, Stress strain relations in the plastic range, Prandtl-Reuss, Levy-Mises and St.Venant's stress strain relations, Plastic potential, principle of maximum work dissipation.

Module 3 (12 Hrs)

Analysis of problems in the elastic and plastic range, elastic plastic bending and torsion, problems with spherical symmetry and cylindrical symmetry, Plane strain problems, slip line field theory, simple slip line fields, bound theorems and their application.

Module 4 (10 hrs)

Mechanics of metal forming operations, plasticity analysis of extrusion and drawing of wires and plane strips, analysis of tube drawing with and without mandrels, analysis of rolling and forging operations.

References:

1. Chakrabarty, J., Theory of Plasticity, McGraw Hill, Second Edn., 1998.
2. Johnson, W., and Mellor, P.B., Engineering Plasticity, van Nostrand Reinhold Co., London, 1973.
3. Hoffman, O., and Sachs, G., Introduction to the Theory of Plasticity for Engineers, McGraw Hill Book Co. New York, 1953.

MEU337: Nonlinear Dynamics and Chaos

3	0	0	3

Prerequisites: MAU101, MAU102, ZZU102 and Consent of Teacher

Module I (10 Hours)

Introduction to dynamical systems: Discrete and continuous time systems, autonomous and non-autonomous systems

Discrete time systems: one-dimensional map, Fixed points of maps and their stability, Bifurcation of maps

Continuous time systems: Phase space and flows, Attracting sets, Concepts of stability

Module 2 (12 Hours)

Equilibrium solutions: Fixed points and stability of continuous time systems, Classification and stability of equilibrium solutions

Periodic solutions: Periodic solutions of continuos time dynamical systems, Autonomous and nonautonomous systems, Limit cycle, Poincare' maps.

Bifurcation: Local and global bifurcation of continuous systems, Static and dynamic bifurcations Symmetry breaking, Cyclic fold, Period doubling, Transcritical and Hopf bifurcations.

Quasiperiodic solutions: Poincare' maps, Circle map, Construction of quasiperiodic solutions.

Module 3 (10 Hours)

Chaotic solutions of maps: Dynamics of logistic equation, Bifurcation diagram of one-dimensional maps, Henon map.

Chaotic solutions of continuous systems: Duffing's equation, Rossler equations- period doubling and Intermittency mechanisms.

Tools to identify and analyze motions: Time history, State-space and pseudo state space-Attractor reconstruction-embedding dimension and time delay, Fourier spectra, Poincare' sections and maps, Lyapunov exponents.

Module 4 (10 Hours)

Fractals and dynamical systems: Examples of fractals: Koch curve, Cantor set etc, Fractal dimension, Measures of fractal dimension

Computational methods: Numerical schemes such as shooting method, harmonic balance method Determination of Lyapunov exponents, Fractal dimensions

References:

1. S.H. Strogatz, *Nonlinear Dynamics and Chaos*, Westview Press, 1994.
2. A.H. Nayfeh and B. Balachandran, *Applied Nonlinear Dynamics*, John Wiley & Sons, 1995
3. J.M.T. Thomson and H.B. Stewart, *Nonlinear Dynamics and Chaos*, John Wiley & Sons, 1986.
4. F.C. Moon, *Chaotic and Fractal Dynamics*, John Wiley & Sons, 1987.

5. G.L. Baker and J.P. Gollub, *Chaotic Dynamics*, Cambridge University Press, Second Edn., 1996.
6. Peitgens, Jurgens, and Saupe, *Chaos and Fractals*, Springer Verlag, 1992.
7. E.R. Scheinerman, *Invitation to Dynamical Systems*, Prentice hall, New Jersey, 1996.
8. P.G. Drazin, *Nonlinear Systems*, Cambridge University Press, 1992.
9. R.L. Devaney, *An Introduction to Chaotic Dynamical Systems*, Addison-Wesley, Second Edn., 1989.

MEV421: Mechanical Behavior and Testing of Materials

3	0	0	3

Prerequisite: MEV203

Module 1 (8 Hours)

Concepts of crystals, Plastic deformation by slip and twinning, Slip systems in FCC, BCC and HCP lattices, Critical resolved shear for slip, Theoretical shear strength of solids, Stacking faults and deformation bands.

Module 2 (14 Hours)

Observation of dislocations, Geometric properties of dislocations, Edge and screw dislocations, Climb and cross slip, Dislocations in FCC and HCP lattice, Partial dislocations, Stress fields and energies of dislocations, Forces between dislocations. Applications of dislocation theory, Strengthening from grain boundaries, Grain size measurements, Yield point phenomenon, Strain aging, solid solution strengthening, Strengthening from fine particles, Fiber strengthening, Cold working and strain hardening, Annealing of cold worked metal.

Module 3 (12 Hours)

Fracture in metals, Griffith theory of brittle fracture, Metallographic aspects of fracture, Fractography, Dislocation theories of brittle fracture, Ductile fracture, Notch effects, Fatigue of metals, The S-N curve, Low cycle fatigue, Fatigue crack propagation, Effects of metallurgical variables and fatigue, Corrosion fatigue, Effect of temperature on fatigue. Creep and stress rupture, Creep curve, mechanism of creep formation, Stress rupture test, Activation energy for steady state creep, Fracture at elevated temperature, Creep resistant alloys.

Module 4 (8 Hours)

Tension test, Stress-strain curves, Instability in tension, Ductility measurement, Effect of strain rate, temperature and testing machine on flow properties, Stress relaxation testing. Hardness test, Brinnel, Rockwell and Vickers hardness, flow of metal under the identer, relationship between hardness and flow curve, micro hardness testing. Torsion test, Mechanical properties in torsion, Torsion stresses for large plastic strains, Types of torsion failures, and torsion testing.

Text Book:

1. Dieter M. George, Mechanical Metallurgy, McGraw – Hill Inc., 2001.

References:

1. Deformation and fracture mechanics, Richard W Hertzberg John Wiley & Sons
2. Mechanical behaviour of Materials, Frank A McCLINOCK and ALI S ARGON
3. Physical Metallurgy Principles, Reed Hill and Robert E, East West Press.
4. Structure and properties of Mateials, Hyden W. M. Vol. 3, McGraw Hill.

5. Plastic deformation of Metals, Honeycombe, Arnold Press.

MEU423: Automobile Engineering

3	0	0	3

Prerequisite: Nil

Module 1 (9 Hours)

Constructional details of engines – engine parts – piston –different types-piston rings cylinder block, cylinder head-gudgeon pin-connecting rod-bearing bushes-different type of bearings-crank Cooling – purpose cooling-types of cooling systems-air cooling-water cooling-steam cooling-radiator-types of radiators-constructional details-thermostat-temperature indicators.

Module 2 (10 Hours)

Lubrication- purpose of lubricating systems- grading of oils- service ratings of oils- oil pumps- oil filters- oil pressure indicators. Fuel systems-fuel system components-fuel tank-fuel filters and screens-fuel gauges-fuel pumps-carburetors-idle and low speed circuits-high speed part load circuit-compensating system-full power circuit-choke – petrol injection system-diesel pump-injectors ignition system- battery and coil ignition-magneto ignition.

Module 3 (13 Hours)

Transmission – clutch-types of clutches-single and multi plate clutches-centrifugal clutch-fluid coupling-torque converter-gear box-sliding mesh-constant mesh-synchro mesh-propeller shaft-universal coupling-differential-axle-semi floating, three-fourth floating, fully floating. Brakes- mechanical and hydraulic brakes- vacuum, servo and air brakes –different components of braking systems and their functions-constructional details. Steering mechanism – steering geometry-steering gears-worm and wheel gears-power assisted steering-wheel alignment-caster, camber, toe in, toe out; king pin inclination.

Module 4 (10 Hour)

Chassis and suspension – chassis lay out-road springs-shock absorbers-independent suspension – torsion bars – air suspension systems – independent rear suspension-wheel balancing-tyres and tubes. Starting mechanism – starter drives-bendix drive-over running clutch. Electrical equipments – battery-battery charging-charging circuit-regulating generator output-wiring circuit. Engine troubles – detection and rectification – maintenance-periodic and preventive maintenance-top overhauling-major overhauls-checking valve timing. Modern trends in automobile engines – steam cars, electric cars and gas turbine cars – air pollution and control – pollution rating.

References:

1. Joseph Heitner – Automotive mechanics
2. Newton and Seeds – Automotive mechanics
3. William Crouse – Automotive engines
4. Judge – Motor manual (four volumes)
5. William Crouse – Automotive fuel, lubricating and cooling systems
6. William Crouse – Automotive chassis and body
7. William Crouse – Automotive electrical equipments
8. Crouse and Anglin – Automotive mechanics.

MEU424: Industrial Tribology

3	0	0	3

Prerequisite 1: MEU201 or MEU205

Prerequisite 2: MEU214 or MEU218

Module 1 (11 Hours)

Introduction: Basic equations; Navier Stoke's equations; Derivation of Reynolds equation from Navier-Stoke's equation; Energy equation; Idealized hydrodynamic beatings; Mechanism of pressure development; Plane slider bearings; Idealized journal bearings; Infinitely long and short bearings.

Module 2 (11 Hours)

Finite bearings; Performance characteristics; Numerical solution; Hydrodynamic instability; Bearing design; Analysis of Externally pressurized and gas lubricated bearings.

Module 3 (10 Hours)

Costs of wear; Surface topography; Toughness measurements; Hertzian contact; Real area of contact; Theories of friction; Friction of metals; Friction of non-metals; Temperature of sliding surface; Stick-slip; Rolling friction.

Module 4 (10 Hours)

Wear of metal: Adhesive wear; Abrasive wear; Corrosion and corrosion wear; Erosion; Fatigue and impact wear; Wear of elastomers; Wear of ceramics and composite materials; Measurement of friction and wear.

References:

1. B.C. Majumdar, Introduction to Tribology, A.H. Wheeler, Bangalore.
2. Pinkus and Sternlincht, Theory of hydrodynamic lubrication, John Wiley & Sons, New York.
3. D. F. Moore, Principle and Application of Tribology, Pergamon Press, New York.
4. E. Rabinnowicz, Friction and Wear of Metals, John Wiley & Sons, New York.
5. K. L. Johnson, Contact Mechanics, Cambridge University Press.
6. T. R. Thomas, Rough Surfaces, Longman Inc.

MEV425: Supply Chain Management

3	0	0	3

Prerequisite: MAU101 and MAU201

Module 1(10 Hours)

Supply chain definition - flows in supply chains - Evolution of Supply Chain Management (SCM) from logistics management - Decision phases in a supply chain - Performance measures for SCM - Competitive and supply chain strategies - Achieving strategic fit - Supply chain drivers and obstacles - Information technology and SCM - Enterprise resource planning and SCM.

Module 2 (10 Hours)

Purchasing: Role of purchasing in SCM - Objectives - Basic operating policies - General procurement procedures - Purchasing records - Computer based systems/Electronic Data Interchange (EDI) - Sources of supply - Outsourcing and Make or Buy decisions - Handling rush orders - Handling small orders - Evolving ordering arrangements.

Module 3 (11 Hours)

Managing Inventories in a Supply Chain: Inventory models with constraints - Working capital, space constraints - Exchange curve - Role of safety inventory in a supply chain - Measuring demand uncertainty - Measuring product availability - Replenishment policies - Evaluating cycle service level and fill rate given a replenishment policy - Impact of supply uncertainty on safety inventory - Impact of replenishment policies on safety inventory.

Module 4 (11 Hours)

Transportation in a supply chain: Factors affecting transportation decisions - Modes of transportation and their performance characteristics - Design options for a transportation network - Routing and scheduling in transportation.
Facility Decisions: Factors influencing network design decisions - Models for facility location and capacity allocation.

Text Books:

1. Chopra, S. and Meindl, P., Supply Chain Management: Strategy, Planning and Operation, Pearson Education, Inc., Singapore, Second Edition, 2004.
2. Dobler, D. W. and Burt, D. N., Purchasing and Supply Management: Text and Cases, Sixth Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 1996.
3. Tersine, R. J., Principles of Inventory and Materials Management, Fourth Edition, Prentice-Hall Inc., New Jersey, 1994.

References:

1. Christopher, M., Logistics and Supply Chain Management, Second Edition, Financial Times Professional Limited, 1998.
2. Narasimhan, S. L., McLeavy, D. W. and Billington, P. J., Production Planning and Inventory Control, Second Edition, Prentice Hall of India Private Limited, 1995.
3. Raghuram, G. and Rangaraj, N., Logistics and Supply Chain Management: Cases and Concepts, Macmillan India Limited, New Delhi, 2000.
4. Arnold, J. R. T. and Chapman, S. N., Introduction to Materials Management, Fourth Edition, Prentice-Hall Inc., 1998.
5. Burt, Dobler and Starling, World Class Supply Management: Key to Supply Chain Management, Tata McGraw-Hill, 7th Edition, 2003

MEV426: Cost Analysis and Control

3	0	0	3

Prerequisite: Nil

Module 1 (11 Hours)

Meaning – nature and managerial need of cost analysis – cost concepts –classification– income determination – profit planning – control – decision making – elements of cost.

Module 2 (11 Hours)

Allocation of costs – absorption of overheads – depreciation methods of competition– cost volume profit relationships – analysis.

Module 3 (10 Hours)

Cost accounting system – process costing job costing – unit costing.

Module 4 (10 Hours)

Absorption costing and variable costing – standard costing and variance analysis.

Text Book:

1. Khan M.Y. and P.K. Jain, "Management Accounting", 3rd edition, Tata McGraw Hill (2002).

References:

1. Duccan Williamson, "Cost and Management accounting", Prentice Hall of India, (1999).
2. Hilton *et al*.., "Cost Management", 2nd edition Tata McGraw Hill (2002).
3. Khan M.Y. and Jain P.K., "Cost Management", TMH outline series, 2nd edition (2000).

MEU427: Aerodynamics

3	0	0	3

Prerequisite: Nil

Module 1 (11 Hours)

Equations for incompressible inviscid flows, Fluid circulation and rotation, Vorticity, Kelvin's theorem, Velocity potential, Stream function, Equation of a stream line, Complex potential, Blasius theorem for force and moment on bodies, Elementary flow patterns and their superposition.

Module 2 (11 Hours)

Flow past a cylinder, Magnus effect, Kutta condition, Vortex theory of lift, Conformal transformation, The Jowkowski transformation, Lift on arbitrary cylinder, Aerodynamic center, Pitching moment.

Module 3 (10 Hours)

Aerofoils, Low speed flows over aerofoils-the vortex sheet, Thin aerofoil theory, Symmetric aerofoil, Tear drop theory, Camber line at zero angle of attack, Characteristics of thin aero foils, Motion in three dimensions, Flow past slender bodies.

Module 4 (10 Hours)

Finite wings, Downwash and induced drag, Prandtl-Lachester theory, Biot- Savarat law, General series solution, Glauret method, Multhop's method, Horseshoe effects, Ground effects, Lineraised compressible flows in two dimensions, Flow past a wavy wall, Similarity rules, Aerofoil in compressible flows.

Reference Books:

1. Kuethe and Chow, Foundations of aerodynamics- Wiley 1976
2. Katz and Plotkin, Low speed aerodynamics-McGraw Hill 1990
3. Milne Thomson. L. M., Theoretical hydrodynamics, Mc Millen, 1958
4. John D. Anderson Jr., Fundamentals of Aerodynamics, McGraw Hill
5. E.L.Houghton and A.E.Brock, Aerodynamics for Engineering Students, Edward Arnold (Publishers) Ltd.

MEV428: Introduction to Computer Graphics

3	0	0	3

Prerequisite: CSU101

Module 1 (11 Hours)

Introduction to computer graphics-Overview of computer graphics, Representing and interfacing with pictures, Description of graphic devices, Raster Scan Graphics, Line drawing algorithm, Circle generation, Fundamentals of initializing.

Module 2 (11 Hours)

Two-dimensional Transformations, Three-dimensional transformations – scaling, shearing, rotation, reflection, translation. Affine and perspective geometry - Orthographic, axonometric and oblique projections; perspective transformations.

Module 3 (10 Hours)

Plane curves, non-parametric and parametric curves; Space curves – Representation of space curves, cubic spline, Bezier curves, B-spline curves, NURBS.

Module 4 (10 Hours)

Surface description and generation- Surface of revolution, Sweep Surfaces, Linear coon surfaces, Bezier surfaces, B-Spline surface, B-Spline surface filling, Introduction to solid modeling, Hidden lines and Hidden Surfaces.

Computer program oriented term projects and term papers are essential for this course.

Text Books:

1. David F. Rogers & J H Adams, Mathematical Elements of Computer Graphics, McGraw Hill International Editions.
2. David F Rogers, Procedural Elements for Computer Graphics, McGraw Hill International Editions.

References:

1. Donald Hearn & M Pauline Baker, Computer Graphics; Second edition, Prentice Hall of India Private Limited.
2. Foley, Van Dam Feiner & Hughes, Computer Graphics Principles and Practice, Second Edition, Addison-wesley Publishing Company.
3. Michael E Mortenson, Geometric Modeling, John Wiley & sons.

MEV429: Human Behaviour in Organization

3	0	0	3

Prerequisite: Nil

Module 1 (11 hours)

Introduction to Organizational (OB): - Development and challenges, assumptions of contemporary OB. Foundations of individual behavior values – attitudes – personality – emotions – perception – abilities – motivation in organizations – work related attitudes.

Module 2 (11 hours)

Group Process: - Foundations of group behavior, understanding team, communication leadership, power, conflict and negotiation.

Module 3 (10 hours)

Organizational Process: - Work design and technology, organizations structure and design – organizational culture.

Module 4 (10 hours)

Special topics: - Organizational change, stress management, decision making in Organization.

Text Book:

1. Robbins, “Organizational Behavior”, 9/e, Pearson Education, (2002).

References:

1. Greenberg and Baron, “Behavior in Organizations”, 7/e, Pearson Education, (2002).
2. Machane and Vonglinow, “Organizational Behavior”, 2/e, TMH, (2003).
3. Hersey, Balaschard and Johnson, “Management of organizational Behavior”, 8/e, Pearson Education, (2002).

MEV433: Quality Planning and Analysis

3	0	0	3

Prerequisite: MAU201

Module 1 (10 hrs)

Quality and quality assessment - concept of Total Quality Management - Total Quality pioneers - Deming's philosophy - Juran's contributions - Crossby's contributions Quality and competitiveness - Total Quality tools - Quality cost - Quality management Quality systems - ISO 9000 certification.

Module 2 (12 hrs)

Quality Function Deployment - House of Quality -Bench marking - approaches to benchmarking - Product design - System reliability -Design for manufacturability Error proofing - Failure mode and effect analysis - Quality circles - Taguchi's quality engineering - concept of loss function - robust design - Concept of Total Productive Maintenance.

Module 3 (10 hrs)

Six Sigma Basics - Overview & Implementation - Different Phases - Process Flow Charting/Process Mapping - Basic Tools - Statistical Process Control - Six Sigma Measurements - Process Capability and Process Performance Metrics.

Module 4 (10 hrs)

Sampling plans and quality assurance - Acceptance sampling - Operating characteristic curve - Types of sampling plans - Acceptance quality level - Dodge-Romig sampling tables - A TI and API - Acceptance sampling by variables - selection of proper sampling procedures.

References:

1. D. H. Besterfield et al: Total Quality Management, Pearson Education Asia, 2001
2. J. M. Juran and F. M. Gryna: Quality Planning and Analysis, Tata McGraw Hill (3rd Edition), 1995
3. B. L. Geoetsch and S. B. Davis: Introduction to Total Quality : Quality Management for Production, Processing and Services, (2nd Edition) Prentice Hall, 1997
4. Bharat Wakhlu: Total Quality, Wheeler Publishing, 1998
5. Taguchi G, Elsayed E. A, and Hsiang T. C: Quality Engineering in Production Systems, McGraw-Hill Book Company, International Edition, 1989.
6. E. L. Grant and R. S. Leavenworth: Statistical Quality Control, (7th Edition), 2002, Tata McGraw-Hill.
7. Breyfogle, Forrest, Implementing: Six Sigma : Smarter Solutions Using Statistical Methods, New York – John Wiley & Sons, 1999
8. Harry, Mikel and Rich Schroeder, Six Sigma: The Breakthrough Management Stategy Revolutionizing the World's Top Corporations, New York – Doubleday, 2000.

MEV437: Manufacturing Planning and Control

3	0	0	3

Prerequisite: MEV312

Module 1 (12 Hours)

Evolution of manufacturing planning and control system – Continuous improvement – Process reengineering- Just-in-time principles- Various kind and sources of waste in manufacturing operations. Forecasting: Forecasting for established and new product – Time series analysis – Error measurement.

Module 2 (10 Hours)

Aggregate planning and master Production Scheduling: Nature of aggregate planning – Strategic variables – Relevant cost – Quantitative methods. Master production scheduling (MPS) environment – MPS technique – Final assembly schedule – freezing and time fencing.

Module 3 (10 Hours)

Material requirement planning (MRP): Advanced concepts in MRP – Lot sizing- Buffering concept – Nervousness. Just-in-time (JIT): Advanced concepts in JIT-Pull production systems – Mixed model production schedule.

Module 4 (10 Hours)

Shop-floor control and Capacity analysis; Hierarchy of capacity planning Decisions – Capacity planning and control techniques – Input/output control – Frame work of shop-floor control – Shop-floor control techniques-Advanced concepts in scheduling.

Text Books:

1. Vollmann, Berry, Whybark, and Jacobs, Manufacturing Planning and Control for Supply Chain Management, 2005, Fifth Edition, Tata McGraw-Hill
2. John M. Nicholas, Competitive Manufacturing Management: Continuous Improvement, Lean production and Customer – Focussed Quality, 2001, Tata McGraw Hill publishing Company Limited.

References:

1. Narasimhan, S. l., McLeavy, D. W., and Billington, P. J., Production planning and Inventory Control, Second Edition, 2000, Prentice-Hall of India.
2. Tersine, R. J., Principles of Inventory and Materials Management, Fourth Edition, Prentice-Hall Inc., New Jersey, 1994.
3. Monks, J. G., Operations Management: Theory and Problems, Third Edition, 1987, McGraw Hill, International Edition.
4. Panneerselvam, R., Production and Operations Management, 2001, Prentice-Hall of India, New Delhi.

MEV430: Consumer Psychology in Marketing

3	0	0	3

Prerequisite: Nil

Module 1 (10 Hours)

Introduction: Diversity in the market place, market segmentation, CB as discipline and Science, Ethics in marketing.

Module 2 (11 Hours)

Consumers as individuals: - Consumer motivation, consumer perception, consumer learning, personality and life styles, attitudes, attitude change, communications and CB.

Module 3 (11 Hours)

Consumers as decision –makers: - Consumer influence and diffusion of innovations, individual decision making, group influence and opinion leadership.

Module 4 (10 Hours)

Consumers in their social and cultural settings: - Social class and CB, influence of culture, subculture and CB, income, Age, Ethnic, racial and religion subcultures.

Text Book:

1. Schiffman & Kanuk, “Consumer Behavior”, 7/e, Pearson Education, (2000).

References:

1. Solomon, “Consumer Behavior”, 5/e, Pearson Education, (2001).
2. Peter & Olson, “Consumer Behavior and Marketing Strategy”, 6/e, TMH, (2001).
3. Arnould, Linda and Zinkhan, “Consumers”, TMH, (2001).

MEV439: Powder Metallurgy

3	0	0	3

Prerequisite: Nil

Module I (10 hours)

Versatility and benefits of Powder Metallurgy, PM Process, Powder production techniques-mechanical, atomisation, chemical-reduction and carbonyl and electro-chemical processes; Ceramic powder production, Powder properties and their characteristics, Sieve analysis, Microscopy, Sedimentation analysis; Specific surface and other technological properties; Powder conditioning

Module II (11 hours)

Compaction and shaping-cold and iso-static compaction, Die compaction ,Pressing equipments and tooling; Powder Injection Moulding, Slip casting Extrusion and rolling. Hot compaction-axial and isostatic, Hot Iso-static Pressing (HIP) process variants, equipments, tooling and applications; Explosive compaction.

Module III (10 hours)

Sintering-stages, single component, material transport mechanisms; Model studies; Powder shrinkage experiments; Sintering diagrams and sintering anomalies. Multi-component sintering-solid phase and liquid phase, infiltration and reaction sintering; Sintering atmospheres and equipments

Module IV (11 hours)

Production routes in practice; Products of PM- Bearing materials, Friction materials, Tool materials, Cermets, Electric and magnetic parts and ceramic components.

Text Book:

An introduction to Powder Metallurgy by F Thummler and R Oberacker, The Institute of Materials, The University Press, Cambridge Great Britain. ISBN 0-901716-26-X

References:

1. ASM Handbook: Powder Metal Technologies and Applications (ASM Handbook, Vol 7).

2. Fundamentals of Powder Metallurgy by Leander F and William G West, 2002 Metal Powder Industries Federation, USA ISBN: 1878954865

3. Powder Metallurgy Technology by G S Upadhyaya, Cambridge International Science Publishing Co, 1993.

4. Powder Metallurgy by Anil Kumar Sinha, Dhanpat Rai Publications, 2003

MEV441: Accounting and Finance for Engineers

3	0	0	3

Prerequisite: Nil

Module 1 (10 Hours)

Finance and related discipline – scope – function – time value of money – sources of corporate finance – capital market.

Module 2 (11 Hours)

Financial Accounting – need – accounting concepts – journal – ledger – trial balance – profit and loss account – balance sheet – accounting softwares.

Module 3 (11 Hours)

Financial statement analysis – ratio analysis – statement of changes in financial position-working capital basis.

Module 4 (10 Hours)

Financial planning – budgeting - working capital computation - capital budgeting – traditional and discounted cash flow techniques (simple treatment).

Text Book:

1. Khan M.Y. and Jain P.K., "Financial Management", 3rd edition, Tata McGraw Hill (2003)
2. Jawahar lal, "Financial Accounting", 2nd edition, Wheeler publishing (2000).

References:

1. I.M. Pandey, "Financial Management", 8th edition, Vikas publishing house (2003).
2. Prasanna Chandra, "Financial Management", 4th edition, Tata McGraw Hill (2003).

MEV442: Introduction to Robotics

3	0	0	3

Prerequisite: ZZU101

Module 1 (11 Hours)

Manipulator Kinematics: Introduction to robotics, classification of robots, workspace analysis, Convention for affixing frames to links – DH Representation, Derivation of

Direct kinematic equations for various types of robots. Inverse Manipulator Kinematics: Solvability, algebraic vs. geometric, Pipers solution when three axes intersect, Examples of inverse manipulator kinematics, repeatability and accuracy.

Module 2 (11 Hours)

Jacobians: Velocities and static forces: Linear and rotational velocity of rigid bodies, velocity propagation from link to link, jacobians, singularities, static forces in manipulators, jacobians in force domain, Cartesian transformation of velocities and static forces.

Module 3 (10 Hours)

Trajectory Generation: General consideration in path description and generation, joint space schemes, collision free path planning, Robot programming.

Module 4 (10 Hours)

Sensing and vision – range sensors, proximity sensors, touch sensors, force and torque sensors – Low level and high-level vision, Robot intelligence and task planning.

References:

1. K S Fu R C Gonzales, C S G Lee: Robotics Control, Sensing, Vision and intelligence, McGraw Hill.
2. John J Craig, Introduction to Robotics, Mechanics and control, Addison – Wesley.
3. Mark W Spong & M Vidyasagar, Robot Dynamics and Control, John Wiley & Sons.
4. R P Paul: Robot Manipulators Mathematics Programming, Control, The computer control of robotic manipulators, The MIT Press.
5. Robert J Schilling: Fundamentals of Robotics, Analysis and Control. Prentice Hall of India.
6. Gonzalez/Woods, Digital Image Processing, Addison Wesley.

MEV443: Discrete Event System Simulation

3	0	0	3

Prerequisite: MAU201 and CSU101

Module 1 (10 Hours)

System concepts - Components of a system - Discrete and continuous systems - System modeling - Types of models - System simulation - Steps in a simulation study - Monte Carlo simulation - Examples of simulation of single server, single queue systems and simple inventory systems - Concepts in discrete event system simulation - Event scheduling/time advance algorithm.

Module 2 (11 Hours)

Random number generation: Techniques for generating random numbers - Linear congruential method - Tests for random numbers: Frequency tests.

Random variate generation: Inverse transformation method - Exponential, uniform, empirical discrete and empirical continuous distributions.

Input modeling for simulation: Data collection - Identifying the distribution using histograms - Parameter estimation - Goodness of fit test.

Module 3 (12 Hours)

Verification and validation of simulation models: Verification - Validation: Face validity, validation of model assumptions and validating input-output transformations.

Output analysis for a single model: Types of simulations with respect to output analysis - Measures of performance and their estimation - Output analysis for terminating simulations - Confidence interval estimation for a fixed number of replication - confidence intervals with specified precision - Output analysis for steady state

simulations - Initialization bias - Replication method - Sample size determination for a specified precision - Batch means method.

Module 4 (9 Hours)

Simulation modeling and analysis of manufacturing systems: Objectives and performance measures - Issues in simulation of manufacturing systems - Modelling downtimes and failures. Introduction to simulation software for manufacturing applications: Salient features of ARENA.

Text Book:

1. Banks, J., Carson, J.S., and Nelson, B.L., Discrete-Event System Simulation, Second Edition, Prentice Hall of India Private Limited, 1996.

References:

1. Deo, N., System Simulation with Digital Computer, Prentice Hall of India Private Limited, 1996.
2. Gordon, G., System Simulation, Prentice Hall of India Private Limited, 1996.
3. Kelton, W.D., Sadowski, R.P and Sturrock, D.A., Simulation with ARENA, McGraw-Hill Higher Education, Fourth edition, 2007.
4. Law, A.W., and Kelton, W.D., Simulation Modeling and Analysis, Third Edition, McGraw-Hill International Edition, 2000.

MEV444: Management of Human Resources

3	0	0	3

Prerequisite: Nil

Module 1 (11 Hours)

Personnel Management: Personnel Functions – Personnel Management Environment in India – Manpower Planning - Recruitment – selection and Induction of Employees – Staff Training and Development – Career Planning – Job Analysis and Design – Compensation Planning – Salary Administration – Job Evaluation – Merit Rating – Incentive Schemes.

Module 2 (11 Hours)

Behavioural Science and Industrial Psychology: Organisational Behaviour – Human Relations Movement – Hathorne Studies – Introduction to Psychology – Dimensions of Human Behaviour – Measurement – PsychologIical Tests – Individual Behaviour – Concept of Personality – Determinants – Perception – Motivation – Theories of Motivation – Learning Theories – Modification of Organizational Behaviour – Group Behaviour – Formal and informal – Communication in Business – Leadership Process and Styles.

Module 3 (10 Hours)

Industrial Relations: Managing Industrial Relations – Labour Laws – Trade Union – Employee Discipline – Grievance handling mechanisms – Suspension, Dismissal and Retrenchment – Industrial Conflict Resolution – Collective Bargaining – Productivity Bargaining – Workers, Participation in Management – Gold Collar Employee Management – Recent issues in Industrial Relations – Turnover.

Module 4 (10 Hours)

Organizational Development: Organizational Design – Dimensions – Restructuring Strategies – Work Organization – Organizational Development – Change Agents – Process of organizational change – Managing Resistance to Change – Modules in OD – Role of Counseling.

References:

1. Fred Luthans, “Organizational Behaviour”, McGraw Hill, 10th Edition, 2005.
2. Dwivedi, R.S., “Manpower Management – An Integrated Approach to Personnel Management and Labour Relations”, PHI, 1984.

3. Yoder D., and Staodohar P. D., “Personnel Management and Industrial Relations”, PHI 1986.
4. Monappa A., and Saiyadain M. S., “Personnel Management”, TMH, 1988.
5. Kapoor N. D., “Introduction to Commercial and Industrial Law”, Sultan Chand & Sons, New Delhi, 1986.
6. Monappa A., “Managing Human resource”, Macmillan, Second Edition, 1998.