**ANNA UNIVERSITY :: CHENNAI 600 025**

**UNIVERSITY DEPARTMENTS**

# CURRICULUM - R 2008

## B.E. INDUSTRIAL ENGINEERING

## CURRICULUM FROM III TO VIII SEMESTERS FOR B.E. INDUSTRIAL ENGINEERING

### III SEMESTER

| CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|
| **THEORY** | | | | | |
| IE9201 | Work System Design | 3 | 0 | 0 | 3 |
| MA9211 | Mathematics – III | 3 | 1 | 0 | 4 |
| ME9201 | Manufacturing Technology -I | 3 | 0 | 0 | 3 |
| ME9211 | Mechanics of Machines | 3 | 1 | 0 | 4 |
| CE9213 | Strength of Materials | 3 | 0 | 0 | 3 |
| IE9202 | Operations Research - I | 3 | 1 | 0 | 4 |
| **PRACTICAL** | | | | | |
| ME9204 | Manufacturing Technology Laboratory I | 0 | 0 | 3 | 2 |
| IE9203 | Work System Design Laboratory | 0 | 0 | 2 | 1 |
| CE9214 | Strength of Materials laboratory | 0 | 0 | 3 | 2 |
| | **TOTAL** | **18** | **3** | **8** | **26** |

### IV SEMESTER

| CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|
| **THEORY** | | | | | |
| MA9261 | Probability and Statistics | 3 | 1 | 0 | 4 |
| CE9211 | Fluid Mechanics and Machinery | 3 | 1 | 0 | 4 |
| ME9305 | Design of Machine Elements | 3 | 1 | 0 | 4 |
| ME9251 | Manufacturing Technology -II | 3 | 0 | 0 | 3 |
| ME9215 | Thermodynamics | 4 | 0 | 0 | 4 |
| IE9251 | Engineering Economy, Costing and Accounting | 3 | 1 | 0 | 4 |
| **PRACTICAL** | | | | | |
| CE9212 | Fluid Mechanics and Machinery Laboratory | 0 | 0 | 3 | 2 |
| ME9256 | Manufacturing Technology Laboratory II | 0 | 0 | 3 | 2 |
| | **TOTAL** | **19** | **4** | **6** | **27** |

## V SEMESTER

| CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|
| **THEORY** | | | | | |
| IE9301 | Principles of Management | 3 | 0 | 0 | 3 |
| IE9302 | Operations Research - II | 3 | 1 | 0 | 4 |
| IE9303 | Statistical Quality Control | 4 | 0 | 0 | 4 |
| IE9304 | Applied Ergonomics | 3 | 0 | 0 | 3 |
| IE9305 | Manufacturing Automation | 3 | 0 | 0 | 3 |
| | Elective I | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | |
| IE9306 | Automation Laboratory | 0 | 0 | 3 | 2 |
| IE9307 | Ergonomics Lab | 0 | 0 | 2 | 1 |
| IE9308 | Technical Seminar I | 0 | 0 | 2 | 1 |
| | **TOTAL** | **19** | **1** | **7** | **24** |

## VI SEMESTER

| CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|
| **THEORY** | | | | | |
| IE9351 | Multi-Variate Statistical Analysis | 3 | 0 | 0 | 3 |
| IE9352 | Principles of Computer Integrated Manufacturing Systems | 3 | 0 | 0 | 3 |
| IE9353 | Reliability Engineering | 3 | 0 | 0 | 3 |
| IE9354 | Facility layout and Materials handling | 3 | 0 | 0 | 3 |
| IE9355 | Production Planning and Control | 3 | 0 | 0 | 3 |
| | Elective - II | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | |
| IE9356 | Production System Design Project | 0 | 0 | 6 | 3 |
| IE9357 | Statistical Applications and Optimization lab | 0 | 0 | 3 | 2 |
| GE9371 | Communication skills and Soft Skills lab | 0 | 0 | 2 | 1 |
| | **TOTAL** | **18** | **0** | **11** | **24** |

## VII SEMESTER

| CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|
| **THEORY** | | | | | |
| IE9401 | Design of Experiments | 3 | 1 | 0 | 4 |
| GE9022 | Total Quality Management | 3 | 0 | 0 | 3 |
| IE9402 | Simulation Modeling and Analysis | 3 | 0 | 0 | 3 |
| IE9403 | Operations Scheduling | 3 | 0 | 0 | 3 |
| | Elective –III | 3 | 0 | 0 | 3 |
| | Elective – IV | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | |
| IE9404 | Discrete Simulation Laboratory | 0 | 0 | 3 | 2 |
| IE9405 | Comprehension | 0 | 0 | 2 | 1 |
| | **TOTAL** | **18** | **1** | **5** | **22** |

## VIII SEMESTER

| CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|
| **THEORY** | | | | | |
| | Elective - V | 3 | 0 | 0 | 3 |
| | Elective - VI | 3 | 0 | 0 | 3 |
| **PRACTICAL** | | | | | |
| IE9451 | Project work | 0 | 0 | 12 | 6 |
| | **TOTAL** | **6** | **0** | **12** | **12** |

**TOTAL CREDITS TO BE EARNED FOR THE AWARD OF THE DEGREE = 190**

## LIST OF ELECTIVES FOR B.E. INDUSTRIAL ENGINEERING

| CODE | COURSE TITLE | L | T | P | C |
|---|---|---|---|---|---|
| ME9021 | Energy Conservation & Management | 3 | 0 | 0 | 3 |
| IE9021 | Productivity Management and Re-engineering | 3 | 0 | 0 | 3 |
| IE9022 | Safety Engineering and Management | 3 | 0 | 0 | 3 |
| IE9023 | Human Resources Management | 3 | 0 | 0 | 3 |
| IE9024 | Information Systems Analysis and Design | 3 | 0 | 0 | 3 |
| IE9025 | Advanced Optimization Techniques | 3 | 0 | 0 | 3 |
| IE9026 | Value Engineering and Project Management | 3 | 0 | 0 | 3 |
| IE9027 | Technology Management | 3 | 0 | 0 | 3 |
| IE9028 | Modeling of Manufacturing Systems | 3 | 0 | 0 | 3 |
| IE9029 | Computational Methods and Algorithms | 3 | 0 | 0 | 3 |
| IE9030 | Decision Support and Intelligent Systems | 3 | 0 | 0 | 3 |
| IE9031 | Evolutionary Optimization | 3 | 0 | 0 | 3 |
| IE9032 | Systems Engineering | 3 | 0 | 0 | 3 |
| IE9033 | Supply Chain Management | 3 | 0 | 0 | 3 |
| IE9034 | Maintenance Engineering & Management | 3 | 0 | 0 | 3 |
| ME9029 | Automobile Engineering | 3 | 0 | 0 | 3 |
| ME9301 | Design of Jigs, Fixtures and Press tools | 3 | 0 | 0 | 3 |
| ME9351 | Finite Element Analysis | 3 | 0 | 0 | 3 |
| MF9021 | Product Design and development | 3 | 0 | 0 | 3 |
| MF9031 | Robotics | 3 | 0 | 0 | 3 |
| MF9353 | Electronics Manufacturing Technology | 3 | 0 | 0 | 3 |
| MF9402 | Flexible Manufacturing Systems | 3 | 0 | 0 | 3 |
| MG9071 | Marketing Management | 3 | 0 | 0 | 3 |
| MG9072 | Entrepreneurship Development | 3 | 0 | 0 | 3 |
| MA9262 | Numerical Methods | 3 | 1 | 0 | 4 |
| PT9071 | Packaging Materials and Technology | 3 | 0 | 0 | 3 |
| GE9021 | Professional Ethics in Engineering | 3 | 0 | 0 | 3 |
| GE9023 | Fundamentals of Nano Science | 3 | 0 | 0 | 3 |

**IE9201 WORK SYSTEM DESIGN L T P C**
**3 0 0 3**

**OBJECTIVE**

- To impart knowledge in the area of Method study and Time study so that students can implement these principles and techniques to improve productivity in manufacturing and Service sectors.

**UNIT I PRODUCTIVITY 9**

Total time for a job or operation, total work content and ineffective time, – Production and Productivity - Productivity and standard of living, Factors affecting Productivity, Productivity measurement Models.

**UNIT II METHODS ENGINEERING 9**

Methods Engineering-Steps -Tools and techniques, Motion study.

**UNIT III WORK MEASUREMENT 9**

Stop watch time study, performance rating, allowances, Development of Standard data, learning effect. Work measurement in Automated Processes. Computerised Labour standards.

**UNIT IV APPLIED WORK MEASUREMENT 9**

Work sampling, Group Timing Technique (GTT), predetermined time systems, types, Methods Time Measurement (MTM), Wage incentive plans.

**UNIT V WORK DESIGN FOR OFFICE WORK 9**

Organization and methods (O & M), Work measurement of office work, Work Analysis techniques applied to support staff, Form design and control.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Barnes, R.M. Motion and Time Study, Design and measurement of work, John Wiley sons(Asia), Seventh edition,2002.

**REFERENCES:**

1. Benjamin W.Niebel, Andris Freivalds, Methods, standards & Work Design, McGraw hill, Eleventh edition, 2002.
2. ILO, Introduction to Work Study, Oxford and IBH publishing , 2001
3. Maynard H.B, Industrial Engineering Hand book,McGraw-Hill,2001

**MA9211 MATHEMATICS III L T P C**
**( Common to all branches of BE / B.Tech Programmes) 3 1 0 4**

**AIM:**

- To facilitate the understanding of the principles and to cultivate the art of formulating physical problems in the language of mathematics.

**OBJECTIVES*:***

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems
- To acquaint the student with Fourier transform techniques used in wide variety of situations in which the functions used are not periodic
- To introduce the effective mathematical tools for the solutions of partial differential equations that model physical processes
- To develop Z- transform techniques which will perform the same task for discrete time systems as Laplace Transform, a valuable aid in analysis of continuous time systems

**UNIT I FOURIER SERIES 9+3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier Series – Parseval's identity – Harmonic Analysis.

**UNIT II FOURIER TRANSFORM 9+3**

Fourier integral theorem – Fourier transform pair-Sine and Cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

**UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9+3**

Formation – Solutions of first order equations – Standard types and Equations reducibleto standard types – Singular solutions – Lagrange's Linear equation – Integral surfacepassing through a given curve – Solution of linear equations of higher order with constant coefficients.

**UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3**

Method of separation of Variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

**UNIT V Z – TRANSFORM AND DIFFERENCE EQUATIONS 9+3**

Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and Final value theorems – Formation of difference equation – Solution of difference equation using Z-transform.

**L: 45, T: 15, TOTAL: 60 PERIODS**

**TEXT BOOK:**

1. Grewal, B.S. "Higher Engineering Mathematics", Khanna Publications (2007)

**REFERENCES:**

1. Glyn James, "Advanced Modern Engineering Mathematics, Pearson Education (2007)
2. Ramana, B.V. "Higher Engineering Mathematics" Tata McGraw Hill (2007).
3. Bali, N.P. and Manish Goyal, "A Text Book of Engineering 7th Edition (2007) Lakshmi Publications (P) Limited, New Delhi.

**ME9201 MANUFACTURING TECHNOLOGY – I L T P C**
**3 0 0 3**

**AIM:**

- To gain comprehensive knowledge about different manufacturing processes

**OBJECTIVES:**

- To introduce the students on the concepts of basic manufacturing processes and fabrication techniques, such as metal casting, metal joining, metal forming and plastics component manufacture.

**UNIT I METAL CASTING PROCESSES 9**

Sand casting – Sand moulds - Type of patterns – Pattern materials – Pattern allowances – Types of Moulding sand – Properties – Core making – Methods of Sand testing – Moulding machines – Types of moulding machines - Melting furnaces – Working principle of Special casting processes – Shell, investment casting – Ceramic mould – Lost Wax process – Pressure die casting – Centrifugal casting – $CO_2$ process – Defects in Casting – Inspection methods

**UNIT II JOINING PROCESSES 9**

Fusion welding processes – Types of Gas welding – Equipments used – Flame characteristics – Filler and Flux materials - Arc welding equipments - Electrodes – Coating and specifications – Principles of Resistance welding – Spot/butt, seam welding – Percusion welding - Gas metal arc welding – Flux cored – Submerged arc welding – Electro slag welding – TIG welding – Principle and application of special welding processes - Plasma arc welding – Thermit welding – Electron beam welding – Friction welding – Diffusion welding – Weld defects – Brazing and soldering process – Methods and process capabilities – Filler materials and fluxes – Types of Adhesive bonding.

**UNIT III BULK DEFORMATION PROCESSES 9**

Hot working and cold working of metals – Forging processes – Open, impression and closed die forging – Characteristics of the process – Types of Forging Machines – Typical forging operations – Rolling of metals – Types of Rolling mills - Flat strip rolling – Shape rolling operations – Defects in rolled parts - Principle of rod and wire drawing - Tube drawing –– Principles of Extrusion – Types of Extrusion – Hot and Cold extrusion –– Equipments used.

**UNIT IV SHEET METAL PROCESSES 9**

Sheet metal characteristics - Typical shearing operations, bending and drawing operations – Stretch forming operations –– Formability of sheet metal – Test methods – Working principle and application of special forming processes - Hydro forming – Rubber pad forming – Metal spinning – Introduction to Explosive forming, Magnetic pulse forming, Peen forming, Super plastic forming.

**UNIT V MANUFACTURING OF PLASTIC COMPONENTS 9**

Types and characteristics of plastics -– Moulding of Thermoplastics – Working principles and typical applications of - Injection moulding – Plunger and screw machines – Compression moulding, Transfer moulding - Typical industrial applications – Introduction to Blow moulding – Rotational moulding – Film blowing – Extrusion - Thermoforming - Bonding of Thermoplastics.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**


1. Kalpakjian, S., “Manufacturing Engineering and Technology”, Pearson Education India Edition, 2006.
2. S. Gowri, P. Hariharan, A. Suresh Babu, Manufacturing Technology I, Pearson Education, 2008


**REFERENCES:**


1. Roy. A. Lindberg, Processes and Materials of Manufacture, PHI / Pearson Education, 2006
2. Hajra Choudhury S.K and Hajra Choudhury. A.K., Elements of Workshop Technology, Volume I and II, Media Promoters and Publishers Private Limited, Mumbai, 1997.
3. Paul Degarma E, Black J.T. and Ronald A. Kosher, Elighth Edition, Materials and Processes, in Manufacturing Prentice – Hall of India, 1997.
4. Sharma, P.C., A Text book of Production Technology, S. Chand and Co. Ltd., 2004.
5. P.N. Rao, Manufacturing Technology Foundry, Forming and Welding, TMH-2003; 2nd Edition, 2003

**ME9211 MECHANICS OF MACHINES L T P C**
**3 1 0 4**

**OBJECTIVES:**

- To understand the principles in the formation of mechanisms and their kinematics.
- To understand the effect of friction in different machine elements.
- To analyse the forces and toques acting on simple mechanical systems
- To understand the importance of balancing and vibration.

**UNIT I KINEMATIC OF MECHANICS 10**

Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

**UNIT II GEARS and GEAR TRAINS 9**

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

**UNIT III FRICTION 8**

Sliding and Rolling Friction angle – friction in threads – Friction Drives – Friction clutches – Belt and rope drives – brakes – Tractive resistance.

**UNIT IV FORCE ANALYSIS 9**

Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members.

**UNIT V BALANCING AND VIBRATION 9**

Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration solation.

**T:45 +15, TOTAL: 60 PERIODS**

**TEXT BOOKS:**


1. Ambekar A.G., "Mechanism and Machine Theory" Prentice Hall of India, New Delhi, 2007
2. Shigley J.E., Pennock G.R and Uicker J.J., "Theory of Machines and Mechanisms", Oxford University Press, 2003


**REFERENCES:**


1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh.A, and A.K.Mallick, "Theory and Machine", Affiliated East-West Pvt. Ltd., New Delhi, 1988.
3. Rao.J.S. and Dukkipatti R.V. "Mechanisms and Machines", Wiley-Eastern Ltd., New Delhi, 1992.
4. V.Ramamurthi, Mechanisms of Machine, Narosa Publishing House, 2002.
5. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.

**STANDARDS:**

IS 2458:2001, Vocabulary of Gear Terms – Definitions related to Geometry.
IS 3756 : 2002, Method of Gear Correction – Addendum modification for External cylindrical gears with parallel axes.
IS 5267 : 2002 Vocabulary of Gear Terms – Definitions Related to Worm Gear Geometry.
IS 12328 : Part 1 : 1988 Bevel Gear Systems Part -1 Straight Bevel Gears.
IS12328 : 1988 Bevel Systems Part – 2 Spiral Bevel Gears.

**CE9213 STRENGTH OF MATERIALS L T P C**
**3 0 0 3**

**AIM:**
To understand the stresses and strains for different types of loads for various applications.

**OBJECTIVES:**
- To understand the stresses developed in beams under transverse load
- To understand the shear stress developed due to tensional load
- To understand the stresses induced in cylinders and spheres due to internal pressure.

**UNIT I STRESS, STRAIN AND DEFORMATION OF SOLIDS 8**
Rigid and deformable bodies –- Axial and Shear Stresses – Deformation of simple and compound bars – Thermal stresses – Elastic Constants - Volumetric strains- Stresses and deformation of thin cylinders and thin shells – Stresses on inclined planes – Principal stresses and principal planes – Mohr's circle of stress.

**UNIT II TRANSEVERSE LOADING ON BEAMS AND STRESSES IN BEAMS 10**
Beams – types Transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over hanging beams. Theory of simple bending – bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

**UNIT III TORSION 8**
Torsion formulation Stresses and deformation in circular and hollows shafts – Stepped shafts – deflection in Shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs.

**UNIT IV DEFLECTION OF BEAMS 10**
Double Integration method – Macaulay's method – Area moment theorems for computation of slopes and deflections in beams – Conjugate beam and strain energy method – Maxwell's reciprocal theorems.

**UNIT V THIN CYLINDERS, SPHERES AND THICK CYLINDERS 9**
Stresses in thin cylindrical shell due to internal pressure circumferential and longitudinal stresses – deformation in thin cylinders –spherical shells subjected to internal pressure
deformations in spherical shells - Lame's theory – application of theories of failure.

**TOTAL : 45 PERIODS**

**TEXTBOOKS:**

1. Rajput.R.K. “Strength of Materials” S.Chand & co Ltd. New Delhi 1996
2. Jindal U.C. “Strength of Materials” Asian Books Pvt Ltd, New Delhi 2007

**REFERENCES:**

1. Egor.P.Popov “Engineering Mechanics of Solids” Prentice Hall of India, New Delhi 1997
2. Subramanian R. “Strength of Materials” Oxford University Press, Oxford Higher Education series ,2007
3. Hibbeler , R.C, Mechanics of materials”, Pearson Education, Low price Edition,2007
4. Bansal, R.K, Strength of Materials , Lakshmi Publication (P) Ltd, New Delhi.
5. Ferdinand P Been, Russell Johnson,j.r. & John J Dewole mechanics of materials, Tata Mcgraw Hill publishing Co Ltd, NewDelhi,2006

**IE9202 OPERATIONS RESEARCH – I L T P C**
**3 1 0 4**

**OBJECTIVE:**

To learn the basics of deterministic optimization tools

**UNIT I LINEAR PROGRAMMING 10**

Introduction - Formulation of linear programming models – Assumptions-Graphical solution procedure – solving LPP using simplex algorithm – Degeneracy, Alternative Optima, Unbounded identification- LP Applications- Data Envelopment Analysis-Revised Simplex Method

**UNIT II ADVANCES IN LPP - I 10**

Duality theory - Interpretation of dual variables- Primal Dual Relationships – Role of duality in sensitivity analysis - Dual simplex method – Graphical based and Simplex based Sensitivity analysis –- Transportation problems, transportation simplex method– Assignment problems, Hungarian method- LP formulation of transportation and Assignment networks- Traveling sales man problem

**UNIT III ADVANCES IN LPP - II 6**

Integer Linear programming formulations, graphical solution of the LP relaxation, Graphical solution to all integer problem, applications involving 0-1 variables, introduction to cutting plane and branch & bound methods – Multi objective optimization - Goal programming problem formulation.

**UNIT IV NETWORK MODELS 12**

Maximal flow problem – Shortest route problem – Minimal spanning tree problem - Project networks, CPM, PERT, Crashing of networks, L P model for crashing – project costing and control.

**UNIT V DYNAMIC PROGRAMMING 7**

Elements of dynamic programming – stage and state, characteristics of DP problems, recursive relationship, Bellman’s principle of optimality – computational procedure for shortest route problem, knapsack problem, production and inventory control problem.

**L: 45, T: 15, TOTAL : 60PERIODS**

**TEXT BOOKS**

1. Hillier and Lieberman Introduction to Operations Research, TMH, 2000
2. R.Panneerselvam, Operations Research,PHI,2006

**REFERENCES**


1. Philips, Ravindran and Solberg, Operations Research, John Wiley,2002
2. Hamdy A Taha, Operations Research – An Introduction, Prentice Hall India,2003
3. Ronald L Rardin, Optimisation in Operations Research, Pearson, 2003
4. David R. Anderson, et al , An Introduction to Management Science – Quantitative approaches to Decision Making, Thomson,2003


**ME9204 MANUFACTURING TECHNOLOGY LAB-1 L T P C**
**0 0 3 2**

**AIM:**

To have knowledge on common basic machining operations

**OBJECTIVES:**

To study and practice the various operations that can be performed in lathe, shaping, drilling, milling etc. and equip with the practical knowledge required in the core industries.

**LIST OF EXPERIMENTS**

Measurement of the Machined Components and Machining time estimation of:

1. Taper Turning
2. External thread cutting
3. Internal thread cutting
4. Eccentric Turning
5. Knurling
6. Square Head Shaping
7. Hexagonal Head Shaping
8. Drilling and Tapping
9. Determination of Cutting forces in Turning and Milling Operations.

**TOTAL: 45 PERIODS**

**IE9203 WORK SYSTEM DESIGN LAB L T P C**
**0 0 2 1**

**OBJECTIVE:**

To understand the theory better and apply in practice, practical training is given in the following areas

1. Graphic tools for method study
2. Peg board experiment
3. Stop watch time study
4. Performance rating exercise
5. Work sampling
6. MTM practice

**TOTAL: 30 PERIODS**

**CE9214 STRENGTH OF MATERIALS LABORATORY L T P C**
**0 0 3 2**

**AIM:**
To perform various types test like tension, compression impact tests in Laboratory.

**OBJECTIVES:**
- To understand the various mechanical properties by conducting tensile test.

1. To understand the hardness value of different materials
2. Tension test on mild steel / tor steel rod
3. Double shear test on metal
4. Torsion test on mild steel rod
5. Impact test on metal specimen
6. Hardness test on metals
7. Compression test on helical spring
8. Deflection test on carriage spring

**TOTAL : 45 PERIODS**

**MA9261 PROBABILITY AND STATISTICS L T P C**
**3 1 0 4**

**AIM:**
This course aims at providing the required skill to apply the statistical tools in engineering problems.

**OBJECTIVES:**

- The students will have a fundamental knowledge of the concepts of probability.
- Have knowledge of standard distributions which can describe real life phenomenon.
- Have the notion of sampling distributions and statistical techniques used in management problems.

**UNIT I RANDOM VARIABLES 9 + 3**
Discrete and Continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions - Functions of random variable.

**UNIT II TWO-DIMENSIONAL RANDOM VARIABLES 9 + 3**
Joint distributions – Marginal and Conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables-Linberg Levy central limit theorem

**UNIT III TESTING OF HYPOTHESIS 9 + 3**
Sampling distributions - Tests for single mean, proportion, Difference of means (large and small samples) – Tests for single variance and equality of variances – $\chi^2$-test for goodness of fit – Independence of attributes – Non-parametric tests: Test for Randomness and Rank-sum test (Wilcoxon test).

**UNIT IV DESIGN OF EXPERIMENTS 9 + 3**
Completely randomized design – Randomized block design – Latin square design - $2^2$ - factorial design.

**UNIT V STATISTICAL QUALITY CONTROL 9 + 3**

Control charts for measurements ( $\bar{X}$ and R charts) – Control charts for attributes ( p, c and np charts) – Tolerance limits - Acceptance sampling.

**L: 45, T: 15, TOTAL : 60 PERIODS**

**TEXT BOOKS:**


1. Milton, J. S. and Arnold, J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th edition, (2007).
2. Johnson, R.A. and Gupta, C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th edition, (2007).


**REFERENCES:**


1. Devore, J.L., "Probability and Statistics for Engineering and the Sciences", Thomson Brooks/Cole, International Student Edition, 7th edition, (2008).
2. Walpole, R.E., Myers, R.H., Myers, S.L. and Ye, K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th edition, (2007).
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists, 3rd edition, Elsevier, (2004).
4. Spiegel, M.R., Schiller, J. and Srinivasan, R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill edition, (2004


**CE9211 FLUID MECHANICS AND MACHINERY L T P C**
**3 1 0 4**

**AIM:**

The student is introduced to the mechanics of fluids through a thorough understanding of the properties of the fluids. The dynamics of fluids is introduced through the control volume approach which gives an integrated under standing of the transport of mass, momentum and energy.

**OBJECTIVES:**

- The applications of the conservation laws to flow though pipes and hydraulics machines are studied
- To understand the importance of dimensional analysis.
- To understand the importance of various types of flow in pumps and turbines.

**UNIT I INTRODUCTION 12**

Units & Dimensions. Properties of fluids – Specific gravity, specific weight, viscosity, compressibility, vapour pressure and gas laws – capillarity and surface tension. Flow characteristics: concepts of system and control volume. Application of control volume to continuity equiation, energy equation, momentum equation and moment of momentum equation.

**UNIT II FLOW THROUG CIRCULAR CONDUITS 12**

Laminar flow though circular conduits and circular annuli. Boundary layer concepts. Boundary layer thickness. Hydraulic and energy gradient. Darcy – Weisbach equaition. Friction factor and Moody diagram. Commercial pipes. Minor losses. Flow though pipes in series and in parallel.

**UNIT III DIMENSIONAL ANALYSIS 9**

Dimension and units: Buckingham's Π theorem. Discussion on dimensionless parameters. Models and similitude. Applications of dimensionless parameters.

**UNITIV ROTO DYNAMIC MACHINES 16**

Homologus units. Specific speed. Elementary cascade theory. Theory of turbo machines. Euler's equation. Hydraulic efficiency. Velocity components at the entry and exit of the rotor. Velocity triangle for single stage radial flow and axial flow machines. Centrifugal pumps, turbines, performance curves for pumps and turbines.

**UNITV POSITIVE DISPLACEMENT MACHINES 11**

Recriprocating pumps, Indicator diagrams, Work saved by air vessels. Rotory pumps. Classification. Working and performance curves.

**T: 45 + 15 ,TOTAL: 60 PERIODS**

**TEXT BOOKS:**


1. Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 1983.
2. Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 1988.


**REFERENCES:**


1. Kumar. K.L., Engineering Fluid Mechanics (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 1995.
2. Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi.


**ME9305 DESIGN OF MACHINE ELEMENTS L T P C**
**3 0 0 3**

**AIM:**

To impart knowledge on design principles of various components in mechanical engineering application.

**OBJECTIVES:**

- To familiarize the various steps involved in the Design Process
- To understand the principles involved in evaluating the shape and dimensions
- of a component to satisfy functional and strength requirements.
- To learn to use standard practices and standard data
- To learn to use catalogues and standard machine components

**UNIT I STEADY STRESSES AND VARIABLE STRESSES IN MACHINE MEMBERS 9**

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties -- Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – Impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and 'C' frame - Factor of safety - theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations

**UNIT II DESIGN OF SHAFTS AND COUPLINGS 9**

Design of solid and hollow shafts based on strength, rigidity and critical speed – Design of keys, key ways and splines - Design of crankshafts -- Design of rigid and flexible couplings.

**UNIT III DESIGN OF TEMPORARY AND PERMANENT JOINTS 9**

Threaded fastners - Design of bolted joints including eccentric loading, Knuckle joints, Cotter joints – Design of welded joints, riveted joints for structures - theory of bonded joints.

**UNIT IV DESIGN OF ENERGY STORING ELEMENTS 9**

Design of various types of springs, optimization of helical springs -- rubber springs -- Design of flywheels considering stresses in rims and arms for engines and punching machines.

**UNIT V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 9**

Sliding contact and rolling contact bearings -- Design of hydrodynamic journal bearings, McKee's Eqn., Sommerfield Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings -- Design of Seals and Gaskets - Design of Connecting Rod.

**TOTAL : 45 PERIODS**

**Note:** (Use of P S G Design Data Book is permitted in the University examination)

**TEXT BOOKS:**


1. Shigley J.E and Mischke C. R., “Mechanical Engineering Design”, Sixth Edition, Tata McGraw-Hill , 2003.
2. Bhandari V.B, “Design of Machine Elements”, Second Edition, Tata McGraw-Hill Book Co, 2007.


**REFERENCES:**


1. Sundararajamoorthy T. V, Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
2. Orthwein W, “Machine Component Design”, Jaico Publishing Co, 2003.
3. Ugural A.C, “Mechanical Design – An Integral Approach, McGraw-Hill Book Co, 2004.
4. Spotts M.F., Shoup T.E “Design and Machine Elements” Pearson Education, 2004.


**STANDARDS:**

1. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 1 : Construction.
2. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 2 : Friction and Wear.
3. IS 10260 : Part 1 : 1982 Terms, definitions and classification of Plain bearings Part 3 : Lubrication.

**ME9251 MANUFACTURING TECHNOLOGY – II L T P C**
**3 0 0 3**

**AIM:**

To provide the concepts and working principal of special machineries and recent trends in manufacturing.

**OBJECTIVE**

To understand the concept and basic mechanics of metal cutting, working of standard machine tools such as lathe, shaping and allied machines, milling, drilling and allied machines, grinding and allied machines and broaching. To understand the basic concepts of (CNC) Computer Numerical Control of Machine tools and CNC Programming.

**UNIT I THEORY OF METAL CUTTING 8**

Mechanics of chip formation, single point cutting tool, forces in machining, thermal aspects of chip formation. orthogonal metal cutting, cutting tool materials, tool wear, tool life, surface finish, cutting fluids and Machinability.

**UNIT II CENTRE LATHE AND SPECIAL PURPOSE LATHES 10**

Centre lathe, constructional features, specification, cutting tools, nomenclature various operations – taper turning methods, thread cutting methods, special attachments, machining time and power estimation. capstan and turret lathes – tool layout, - automatic lathes: semi automatics – single spindle: swiss type, automatic screw type- multi spindle:

**UNIT III RECIPROCATING MACHINES, MILLING MACHINES AND GEAR CUTTING 12**

Reciprocating machine tools: shaper, planer, slotter: milling: types, milling cutter attachments, change gear calculations, machining time calculation, operations. hole making: drilling, reaming, boring, tapping, machining time calculations. gear cutting: forming, generations, shaping, planning and hobbing-tool and cutter grinders.

**UNIT IV ABRASIVE PROCESS, BROACHING 8**

Abrasive processes: grinding wheel – specifications and selection, types of grinding process – cylindrical grinding , surface grinding, centreless grinding, internal grinding-honing, lapping, super finishing, polishing and buffing, abrasive jet grindling.broaching machines: broach construction – push, pull, surface and continuous broaching machines.

**UNIT V CNC MACHINE TOOLS AND PART PROGRAMMING 7**

Numerical control (NC) machine tools – CNC types, constructional details, special features. machining centre, training centre.part programming fundamentals – manual programming.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**


1. Roy. A. Lindberg, “Process and Materials of Manufacture”, PHI / Pearson Education Fourth Edition 2006.
2. Rao. P.N “ Manufacturing Technology”, Metal Cutting and Machine Tools, Tata Mc Graw–Hill, New Delhi, 2003.


**REFERENCES:**


1. Richerd R Kibbe, John E. Neely, Roland O. Merges and Warren J. White. “Machine Tool Practices”, Prentice Hall of India, 1998
2. HMT – Production Technology, Tata Mc Graw Hill, 1998.
3. Hajra Choudhury. Elements of Workshop Technology – Vol.II. Media Promoters.
4. Geofrey Boothroyd, Fundamentals of Metal Machining and Machine Tools, Mc Graw Hill, 1984.


**ME9215 THERMODYNAMICS L T P C**
**4 0 0 4**

**AIM:**

- To impart the importance of thermal science aspects in the field of manufacturingengineering.

**OBJECTIVES:**

- To understand the basic laws of thermodynamics and heat transfer.
- To understand the principle of operation of thermal equipments like IC engine, boilers, turbine and refrigerator etc.

**UNIT I BASIC CONCEPTS OF THERMODYNAMICS 9**

Thermodynamics and Energy – Systems – Types and properties - State and Equilibrium - Processes and Cycles – Forms of Energy – Temperature and Zeroth law of Thermodynamics – Pure substances – Phase change processes of pure substances – Property diagrams – Internal energy – Enthalpy – Energy transfer by Heat, Work and Mass – Applications.

**UNIT II FIRST AND SECOND LAW OF THERMODYNAMICS 9**

First law of thermodynamics – Energy balance for closed systems and steady flow systems – Applications of First law of Thermodynamics – Energy balance for Unsteady flow processes – Second law of Thermodynamics – Entropy – Carnot principles – Change in Entropy – Entropy and irreversibility – Third law of Thermodynamics - Applications.

**UNIT III HEAT ENGINES 15**

Internal Combustion Engines – C.I and S.I Engines – Four Stroke and Two Stroke Engines – Gas Turbines. Boilers – Fire Tube Boiler & Water Tube Boilers – Boiler Accessories and Components. Turbines – Impulse Turbine and Reaction Turbine – Turbine Components. Refrigeration Cycle – Vapour Compression & Vapour Absorption System – Gas Refrigeration System – Environmental friendly Refrigerants – Air Conditioning.

**UNIT IV GASES AND VAPOUR MIXTURES 9**

Ideal and Real gases – Vander waals equations – Reduced property – Compressibility chart -Properties of mixture of gases – Dalton's law and Gibbs – Dalton law – Internal energy, Enthalpy and specific heats of gas mixtures.

**UNIT V HEAT RANSFER 9**

Conduction – Plane Wall, Cylinder system, Composite Walls – Critical insulation thickness – Simple, fins convection – Free convection and forced convection – Flow over Flat plates and Flow through Pipes – Radiation – Black Body, Grey Body Radiation.

**TOTAL: 60 PERIODS**

**TEXT BOOKS:**


1. "Thermodynamics an Engineering Approach" Yunus A. Cenegal and Michael A.Boles, Tata McGraw hill, Fourth edition.
2. "Fundamentals of Engineering Thermodynamics" Michael J.Moran, Howard N.Shapiro, John wiley &Sons, Fourth editon,2000.


**REFERENCES:**


1. "A Text book of engineering Thermodynamics" R.K.Rajput ,Laxmi puplication(P) Ltd. ,third Edition
2. "Engineering Thermodynamics" P.K.Nag, Tata McGraw hill, Third edition
3. "A course in Thermal engineering" S.Domkundwar, C.P.Kothandaraman , Dhanpat rai & co (p) Ltd, fifth edition 2000.


**IE9251 ENGINEERING ECONOMY, COSTING AND ACCOUNTING L T P C**
**3 1 0 4**

**OBJECTIVES:**

- To impart knowledge in the areas of cost estimation, pricing of products, cost control methods and principles of accounting.
- After undergoing the course, the students will be able to estimate cost
- of products, analyze product cost and suggest cost reduction measure.

**UNIT I INTRODUCTION 6**

Objectives of Managerial Economics, Firm, Cost Estimation, Costing, Cost Accounting, Factors Influencing Managerial Decisions & Theoretical Concepts, Classification and Elements of cost.

**UNIT II PRODUCTION ANALYSIS AND PRICING 9**

Production Function-Least Cost Combination of Inputs-Factor Productivities & Return to Scale-Determinants of Price-Pricing under different objectives and Market Structures-Price Discrimination & Pricing methods in practice.

**UNIT III ESTIMATION 10**

Estimation of Material, Labor and Overhead Cost, Allocation of Overheads. Estimation for different types of jobs.

**UNIT IV COSTING 10**

Job Costing-Operating Costing-Process Costing- Standard Costing (Variance Analysis)

**UNIT V ACCOUNTING 10**

Balance Sheet-Profit & Loss Statement-Evaluation of Investment decisions- Average Rate of Return-Payback Period-Net Present Value & IRR.

**L: 45 T: 15 TOTAL: 60 PERIODS**

**TEXT BOOKS:**


1. Jawaharlal, Cost Accounting, TMH, 1996
2. A. Ramachandran Aryasry & VV.Ramana Murthy, Engg Economics & Financial Accounting, TMH, NewDelhi, 2004.


**REFERENCES:**


1. James.C.Van Home, “Fundamentals of fincancial Management”, PHI, NewDelhi, 2004.
2. V.L.Mote, Samuel Paul & G.S.Gupta, Managerial Economics-Concepts & Cases, TMH, Co, NewDelhi, 1989
3. T.P.Banga & S.C.Sharma, Mechancial Estimating and Costing, Khanna Publishers, 1984.


**CE9212 FLUIDS MECHANICS AND MACHINERY LABORATORY L T P C**
**0 0 3 2**

**AIM:**

To perform experiments an various types of pumps and turbines to understand their characteristics.

**OBJECTIVES:**

- To understand the concepts flow through different cross sections.
- To understand and draw characteristics of various pumps.
- To understand and draw performance characteristics of different turbines

**UNIT I FLOW MEASUREMENT**

Calibration of Flow Measuring instruments – venturimeter, orificemeter, rotometer, Calibration of flows in open channels – weirs and notches. Estimation of friction factor in flow through pipes.

**UNIT II PUMPS**

Determination of performance characteristics of pumps – centrifugal pumps, submersible pumps, turbine pumps and positive displacement pumps – reciprocating and gear pumps.

**UNIT III TURBINES**

Determination of performance characteristics of turbines – reaction turbines and impulse turbines.

**TOTAL : 45 PERIODS**

**REFERENCE:**

1. CWR, Hydraulics Laboratory Manual,2004

**ME9256 MANUFACTURING TECHNOLOGY LAB – II L T P C**
**0 0 3 2**

**AIM:**

To acquire skills on common basic machining operations and press working

**OBJECTIVES:**

To study and practice the basic machining operations in the special purpose machines and acquire its applicability in the real time components manufacturing industries.

**LIST OF EXPERIMENTS**

1. Contour Milling using vertical milling machine
2. Gear Cutting using milling machine
3. Gear Hobbing
4. Gear Shaping
5. Hexagonal Machining using Horizontal Milling Machine
6. Gear Cutting – Gear Shaping
7. Spline Broaching
8. Exercise in Surface Grinding
9. Exercise in Cylindrical Grinding
10. Exercise in Tool and Cutter Grinder
11. Spur and helical gear cutting in Milling Machine
12. Determination of cutting forces in Milling Machine
13. Study of Turret and Capstan lathe
14. Forming of Simple Components in Press Working and simple Calculations of sheet metal work

**TOTAL : 45 PERIODS**

**IE9301 PRINCIPLES OF MANAGEMENT L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To explain the basic principles of management, namely, Planning, Organizing ,Staffing, Leading and Controlling and application of these principles in any given organization.

**UNIT I PLANNING 9**

Nature and Purpose of Planning – Objectives –Strategies, Pricing & Planning Process and Decision Making.

**UNIT II ORGANIZING 9**

Nature and Purpose of Organizing –Basic Departmentation – Line/Staff Authority and Decentralization –Effective Organization and Organizational Culture.

**UNIT III STAFFING 9**

HRM and Selection - Performance Appraisal & Wages Strategy –Manager and Organizationl Development..

**UNIT IV LEADING 9**

Managing and the human factor –Motivation –Leadership –Communication
The System & Process of Controlling –Controlling Techniques & IT Productivity and Operations Management– Overall Preventive Control –Towards a unified, Global Management Theory.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

Herold Koontz and Heinz Weibrich, “Essentials of Management”, TMH, 2001.

**REFERENCES:**

1. James.A.F., Stones and R.Edward Freeman, “Management”, PHI, 1992.
2. Josesph.L.Massic, “Essentials of Management”, PHI, 1985.

**IE9302 OPERATIONS RESEARCH – II L T P C**
**3 1 0 4**

**OBJECTIVE:**

To impart knowledge on some probabilistic optimization techniques

**UNIT I DETERMINISTIC INVENTORY MODELS 9**

Purchase model with no shortages – manufacturing model with no shortage – Purchase model with shortage – Manufacturing model with shortages –model with price breaks

**UNIT II PROBABILISTIC INVENTORY MODELS 9**

Probabilistic inventory model – Reorder point model – multi product-Selective Inventory control.

**UNIT III QUEUING THEORY 9**

Queuing theory terminology – Single server, multi server, Limited queue capacity – applications – Markov chains

**UNIT IV DECISION THEORY 12**

Decision making under certainty – Decision making under risk – Decision making under uncertainty – Decision tree analysis – MCDM – AHP. Game Theory - Two person zero sum games, pure and mixed strategies – graphical solution – solving by LP.

**UNIT V REPLACEMENT MODELS 6**

Replacement models – Money value, present worth factor and discount rate.

**TOTAL: 60 PERIODS**

**TEXT BOOK**

1. Philips, Ravindran and Solberg, Operations Research, John Wiley,2002

**REFERENCES**

1. Hamdy A Taha, Operations Research – An Introduction, Prentice Hall ndia,2003
2. Ronald L Rardin, Optimisation in Operations Research, Pearson, 2003
3. David R. Anderson, et al , An Introduction to Management Science – Quantitative approaches to Decision Making, Thomson,2003

**IE9303 STATISTICAL QUALITY CONTROL L T P C**
**3 1 0 4**

**OBJECTIVE**

- This course is concerned with the applications of statistical tools in measuring and controlling the quality of products/processes

**UNIT I QUALITY FUNDAMENTALS 5**

Importance of quality, meaning of quality, quality dimensions, quality planning, quality control, SQC, Quality assurance, quality costs, economics of quality, quality and productivity, quality and reliability, quality loss function.

**UNIT II CONTROL CHARTS FOR VARIABLES 10**

Process variation,– Statistical basis, 3 – sigma control limits, Rational sub-grouping, $\overline{X}$ ,R and S charts, Interpretation of charts, warning and modified control limits, operating characteristic curve for $\overline{X}$ – chart, SPC -process capability analysis – $C_p$, $C_{PK}$, $C_{pm}$, Machine capability, Gauge capability.

**UNIT III CONTROL CHARTS FOR ATTRIBUTES 10**

P, np, C, U and ku charts, demerits control chart, Multi – variable chart, individual measurement charts – moving average and moving range charts, quality control in service sector.

**UNIT IV ACCEPTANCE SAMPLING 10**

Need for Acceptance sampling, economics of sampling, sample selection, single and Double sampling – O.C. curves, Average outgoing quality (AOQ), Average sample number (ASN), Average total inspection (ATI), Multiple and sequential sampling, sampling plans – military standards, Dodge – Roming, IS 2500.

**UNIT V METROLOGY & INSPECTION 10**

Fundamental methods of measurement, precision & accuracy, measurement devices - Linear and Angular - Coordinate Measuring Machine, Destructive and Non-Destructive Testing methods.

**L : 45 T:15 TOTAL: 60 PERIODS**

**TEXT BOOK :**

1. Douglus C.Montgomery, Introduction to Statistical Quality Control, John Wiley & Sons, 2004.

**REFERENCES :**


1. Statistical Quality Control, Eugene L.Grant and Richard S.Leaven Worth, TMH, Seventh Edition, 2000.
2. Quality Control. Dale H.Besterfield, Pearson Education Asia, Seventh Edition,2004.


**IE9304 APPLIED ERGONOMICS L T P C**
**3 0 0 3**

**OBJECTIVE**

To explain the general principles that govern the interaction of humans and their working environment for improving worker performance and safety.

**UNIT I INTRODUCTION 3**

Brief history of human factors engineering/Ergonomics – Interdisciplinary nature.

**UNIT II HUMAN PERFORMANCE: 10**

Factors influencing performance – Information receiving and processing – Information theory and its application - Human response and errors – Signal detection theory – Biostatic and Biodynamic Mechanics.

**UNIT III PHYSIOLOGICAL ASPECTS OF HUMAN AT WORK 12**

Metabolism – Physiological factors involved in muscular activity – Measurement of energy expenditure – Quantitative work load analysis - Physical work capacity and its evaluation – Physiological fatigue – Work and rest schedules – Physical fitness tests.

**UNIT IV WORK PLACE DESIGN: 12**

Problems of body size, Anthropometry measures, Work posture - Work space layout and work station design – Design of displays, controls and VDT work stations - Hand tool design. illumination.

**UNIT V OCCUPATIONAL HEALTH AND SAFETY 8**

Industrial accidents, Personal Protective devices, Safety Management practices – Effect of Environment – heat, cold & noise – NIOHS regulations and Factories Act

**TOTAL : 45 PERIODS**

**TEXT BOOK**


Bridger, R.S., Introduction to Ergonomics, McGraw Hill, 1995.


**REFERENCES**


1. Martin Helander, A guide to Ergonomics of Manufacturing, TMH, 2006.
2. Mecormik, T.J., Human Factors Engineering, TMH, 1990.
3. John Grimaldi, Safety Management, A.I.B.S., 5th Edition, Hazard Control Technology 2003
4. Philips, Chandler A, Human Factors Engineering, John Wiley and Sons, Inc. 2000


**IE9305 MANUFACTURING AUTOMATION L T P C**
**3 0 0 3**

**OBJECTIVE**

To give a brief exposure to automation principles and applications to production systems covering few types of automation**.**

**UNIT I MANUFACTURING OPERATIONS 9**

Automation in production systems, principles and strategies, Product/production relationships, Production concepts and mathematical models, Costs of manufacturing operations.

**UNIT II CONTROL TECHNOLOGIES 9**

Automated systems – elements, functions, levels, Continuous Vs discrete control, Computer process control, Sensors, Actuators, ADC, DAC, Programmable logic controllers – ladder logic diagrams.

**UNIT III NUMERICAL CONTROL AND ROBOTICS 9**

NC - CNC – Part programming – DNC – Adaptive control – Robot anatomy – Specifications – End effectors – Industrial applications

**UNIT IV AUTOMATED HANDLING AND STORAGE 9**

Automated guided vehicle systems – AS/RS – carousel storage, Automatic data capture- Bar coding technology.

**UNIT V COMPUTER-AIDED DESIGN 9**

Fundamentals of CAD – design process, manufacturing database – Computer graphics – functions, constructing the geometry, transformation, wire frame Vs solid modelling.

**TOTAL : 45 PERIODS**

**REFERENCES**


1. Mikell P.Groover, Automation, “Production Systems and Computer Integrated Manufacturing” PHI, 2003.
2. Mikell P.Groover, Emory W. Zimmers, Jr., “CAD/CAM: Computer - Aided Design and Manufacturing”, PHI, 2007.


**IE9306 AUTOMATION LABORATORY L T P C**
**0 0 3 2**

1. Part programming for CNC lathe
2. Simulation and machining practice in CNC lathe
3. Part programming for CNC Milling machine
4. Practice in CNC milling machine
5. Programming exercise for robot
6. Programming of PLC using ladder logic diagram
7. Experiments using PLC.

**TOTAL : 45 PERIODS**

**IE9307 ERGONOMICS LAB L T P C**
**0 0 2 1**

**OBJECTIVE:**

To provide hands on experience in some areas of Ergonomics

1. Effect of speed of walking on treadmill using heart rate and energy expenditure
2. Effect of workload on heart rate using Ergo cycle.
3. Evaluation of physical fitness using step test
4. Effect of work-rest schedule on physical performance (Ergo cycle / tread mill)

5. Development of anthropometric data for male and female.
6. Application of anthropometric data for the design of desk for students
7. Evaluation of physical facilities (chairs, tables etc.) through comfort rating.
8. Evaluation of cognitive performance of individuals
9. Analysis of noise level in different environments
10. Study of Illumination at work places.

**TOTAL : 30 PERIODS**

**IE9308 TECHNICAL SEMINAR I L T PC**
**0 0 2 1**

To enrich the communication skills of the student and presentations of technical topics of interest, this course is introduced. In this course, a student has to present three Technical papers or recent advances in engineering/technology that will be evaluated by a Committee constituted by the Head of the Department.

**TOTAL : 30 PERIODS**

**IE 9351 MULTI VARIATE STATISTICAL ANALYSIS L T P C**
**3 0 0 3**

**OBJECTIVE:**
To impart knowledge on applications of Multi Variate Statistical analysis.

**UNIT I REGRESSION AND CORRELATION 9**
Simple Regression, and Correlation – estimation using the regression line, correlation analysis, Multiple Regression and Canonical Correlation analysis – finding the multiple regression equation, modeling techniques, Making inferences about population parameters

**UNIT II MULTIVARIATE NORMAL 9**
An overview of multivariate methods, Multivariate normal distribution, Eigen values and Eigen vectors

**UNIT III FACTOR ANALYSIS 9**
Principal components analysis – objectives, estimation of principal components, testing for independence of variables, Factor analysis model – factor analysis equations and solution

**UNIT IV DISCRIMINANT ANALYSIS 9**
Discriminant analysis – discrimination for two multi variate normal populations- Discriminant rules –Discriminant Functions.

**UNIT V CLUSTER ANALYSIS 9**
Cluster analysis – clustering methods, Multivariate analysis of variance

**TOTAL : 45 PERIODS**

**TEXT BOOK:**
1. Dallas E Johnson, Applied multi variate methods for data analysis, Duxbury Press (1998)

**REFERENCE:**
1. Richard I Levin, Statistics for Management, PHI (2000)

**IE9352 PRINCIPLES OF COMPUTER INTEGRATED MANUFACTURING** **L T P C 3 0 0 3**

**OBJECTIVE:**

To provide some aspects of Fixed, Flexible and integrated automation along with their applications

**UNIT I GT AND FMS** **9**

Part families, production flow analysis, cellular manufacturing, ROC, Flexible manufacturing systems- components, FMS applications, FMS analysis – bottleneck model.

**UNIT II TRANSFER LINES** **9**

Automated production lines – applications, Analysis – with and without buffers automated assembly systems, line unbalancing concept.

**UNIT III MANUFACTURING SUPPORT SYSTEMS** **9**

Product design and CAD, CAD/CAM and CIM, Computer aided process planning-variant and generative approaches, Concurrent engineering and design for manufacture, Lean production, Agile manufacturing.

**UNIT IV FUNDAMENTALS OF COMMUNICATIONS** **9**

Information, Communications matrix, Computer communications, Network architecture, Tools and techniques.

**UNIT V DATABASE AND CIM MANAGEMENT** **9**

Manufacturing data, database technology, Database management, Management OF CIM – role, cost justification, expert systems

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Mickel P Groover, Automation production systems and computer integrated manufacturing, PHI, second edition, 2003.
2. S.Kant Vajpayee, Principles of Computer-Integrated Manufacturing, PHI, 2005


**IE9353 RELIABILITY ENGINEERING** **L T P C 3 0 0 3**

**OBJECTIVE:**

To cover the basic concepts of reliability, reliability estimation, and reliability management

**UNIT I RELIABILITY CONCEPTS** **6**

Reliability definition – Reliability function – Graphical representation – a priori, a posteriori probabilities of survival. Component mortality – Mortality curve – Useful life – Reliability mathematics.

**UNIT II FAILURE DATA MODELING:** **13**

Failure data requirements – Measures of reliability: Failure rate, MTBF, MTTF – Median time to failure – Comparison of measures of central tendency – Design life – Performance parameters using histogram – Survival curves – Failure time distributions Variable failure rates – Ranking of data – Probability plotting: Binomial, Exponential, Weibull hazard plotting – Goodness of fit: Chi square test – Kolmogorov Smirnov test – Confidence intervals.

**UNIT III RELIABILITY PREDICTION AND MODELING: 13**

Series – parallel configurations – Redundant systems – Standby systems – K out of n redundancy – Reliability of complex systems: RBD approach – Baye's decomposition method – Cut and tie sets – Fault tree analysis – Markov model – Software reliability prediction and measurement.

**UNIT IV RELIABILITY MANAGEMENT: 8**

Reliability in design – limitations – Reliability life testing – Reliability growth monitoring – Reliability allocation – Reliability Centered Maintenance (RCM) – Replacement models: Items that deteriorate with time – Items which fail completely – Economic life of asset – Spares planning – System availability – Restorability demonstration.

**UNIT V RISK ASSESSMENT: 5**

Perception of risk and ALARP – Measurement of risk – Hazard identification: HAZOP, HAZID – FMEA – Probabilistic Risk Assessment. (PRA).

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. An introduction to, "Reliability and Maintainability Engineering"- Charles E.Ebeling, TMH, 2000.
2. Practical Reliability Engineering – Patrick D.T.O'Corner John Wiley & Sons Ltd.,2003.
3. "Reliability for Technology, Engineering and Management", Paul Kales, Prentice Hall, New Jersey, 1998.


**IE9354 FACILITY LAYOUT AND MATERIAL HANDLING L T P C**
**3 0 0 3**

**OBJECTIVE**

To explain the basic principles in facilities planning, location, layout designs and material handling systems

**UNIT I FACILITY LOCATION 12**

Introduction , Factors affecting location decisions , Location theory , Qualitative models , Semi-Quantitative models -Composite measure , Brown & Gibbs model , Break-Even analysis model, Single facility location problems – Median model, Gravity location model, Mini-Max model, Multi-facility location problems, Network and warehouse location problems.

**UNIT II FACILITY LAYOUT DESIGN 9**

Need for Layout study , Factors influencing plant layout ,Objectives of a good facility layout, Classification of layout , Layout procedure – Nadler's ideal system approach, Immer's basic steps, Apple's layout procedure, Reed's layout procedure –Layout planning – Systematic Layout Planning – Information gathering, flow analysis and activity analysis, relationship diagram, space requirements and availability, designing the layout. Utilities planning

**UNIT III COMPUTERISED LAYOUT PLANNING 9**

Concepts, Designing process layout – CRAFT, ALDEP, CORELAP – Trends in computerized layout, Algorithms and models for Group Technology - ROC and Bond Energy Algorithms.

**UNIT IV DESIGNING PRODUCT LAYOUT 6**

Line balancing - Objectives, Line balancing techniques – Largest Candidate rule-Kilbridge and Wester method- RPW method- COMSOAL.

**UNITV MATERIAL HANDLING AND PACKAGING 9**

Objectives and benefits of Material handling, Relationship between layout and Material handling, Principles of material handling, Unit load concept, Classification of material handling equipments, Equipment selection, Packaging.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Francis, R.L., and White, J.A.Facilities layout and Location, Prentice Hall of India, 2002.

**REFERENCES:**

1. Tompkins, White et al., Facilities planning, John Wiley & Sons, inc. 2003.
2. James, Apple, Material Handling System design, Ronald Press, 1980.
3. Krajewski, J. and Ritzman, Operations Management – Strategy and Analysis, Addison – Wesley publishing company inc. 5th Edition, 1999.
4. Pannerselvam,R.Production & operations Management, PHI, 2nd Edition, 2005

**IE9355 PRODUCTION PLANNING AND CONTROL L T P C**
**3 0 0 3**

**OBJECTIVE:**

To give an overview of techniques applicable to production planning, scheduling and control

**UNITI INTRODUCTION 5**

Introduction to Production Systems, Objectives and Scope of Operation Management, Operations Management Frame work, Relationship of operations with other Functional areas, Manufacturing Vs Service sector, Operations Decision making, Production Design Process and Process choices

**UNIT II FORECASTING 10**

Need for Forecasting, Factors affecting Demand, Demand Patterns, Qualitative Forecasting Methods-Delphi techniques, Market Research, Nominal Group Technique etc, Quantitative Forecasting methods–Moving Average Methods, Exponential Smoothing Methods, Regression methods, Monitoring and Control of Forecasts, Selection of forecasting methods, Forecasting Process.

**UNIT III AGGREGATE PLANNING 10**

Role of Aggregate Planning, Inputs to Aggregate planning, Pure and Mixed strategies, Mathematical Models for Aggregate planning – Transportation Method, Linear programming Formulation, Linear Decision Rules, Master Production Schedule(MPS), Procedure for developing MPS, MRP terminology, process of MRP, Lot sizing in MRP

**UNIT IV CAPACITY MANAGEMENT 10**

Types of Capacity, Measures of capacity, Factors affecting capacity, Capacity planning, Systematic approach to capacity planning, Long-term and short-term capacity decisions, Tools for capacity planning, Theory of Constraints,MRP–II, Capacity Requirement planning ,Basics of ERP.

**UNIT V PRODUCTION ACTIVITY CONTROL 10**

Objectives and Activities of Production Activity Control, Flow-shop and Job shop production activity control.

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Lee J.Krajewski, Larry P.Ritzman, Operations Management Strategy and Analysis, PHI, 6th Edition, 2003.
2. Norman Gaither, Greg Frazier, Operations Management, Thomson Learning, 9th Edition, 2002.
3. Pannerselvam,R.Production & operations Management, PHI, 2nd Edition,2005
4. Seetharama .L.Narasimhan,Dennis W.McLeavey,Peter J.Billington, Production Planning and Inventory Control,PHI,second edition,2003.
5. B.Mahadevan, Operations Management:Theory and Practice,Pearson Education, 2006.


## IE9356 PRODUCTION SYSTEM DESIGN PROJECT

**L T P C**
**0 0 6 3**

**OBJECTIVE:**

- To apply the concepts of various techniques covered in the areas of Industrial Engineering in a given practical situation.

Projects shall be assigned in the following areas:

- Forecasting and Aggregate Planning
- Materials Requirement Planning and Capacity Planning
- Transportation and Distribution of goods
- Group technology and Cellular manufacturing
- Production and Project Scheduling
- Quality Control
- Plant Layout Design
- Methods improvement in manufacturing and service organisation

**TOTAL: 90 PERIODS**

## IE9357 STATISTICAL APPLICATIONS AND OPTIMIZATION LAB

**LT P C**
**0 0 3 2**

**OBJECTIVE:**

- To give adequate exposure to applications of software packages in the areas of Applied Statistics, Operations Research and Reliability

**UNIT-I** Basic Statistics
1. Mean, Median, Mode, measures of dispersion

**UNIT- II** Use of Spreadsheet
2. Look up tables, Statistics

**UNIT- III** Use of RELIASOFT
3. Data analysis

**UNIT- IV** Simple Operation Research Programs
4. Initial Solution of TP, Inventory Price Break Models

**UNIT- V** Optimization Package (TORA /LINDO)
5. LP Models
6. Transportation
7. Assignment
8. Maximal flow
9. Minimal spanning tree
10. Shortest route
11. Network scheduling

**TOTAL: 45 PERIODS**

**GE9371 COMMUNICATION SKILLS AND SOFT SKILLS LAB LT P C**
**0 0 2 1**

**AIM:**

To enhance the overall capability of students and to equip them with the necessary Communication Skills and Soft Skills that would help them excel in their profession.

**OBJECTIVES:**

- To equip students of engineering and technology with effective speaking and listening skills in English.
- To help them develop their soft skills and interpersonal skills, which will make the transition from college to workplace smoother and help them excel in their job.
- To enhance the performance of students at Placement Interviews, Group Discussions and other recruitment exercises.

**1. PC based session**

**A. Career Lab (15 periods) Viewing and discussing audio-visual materials**

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1. **Resume / Report Preparation / Letter Writing:** (3)
   Letter writing – Job application with Resume - Project report - Email etiquette.
2. **Presentation skills:** (3)
   Elements of effective presentation – Structure of presentation - Presentation tools – Body language.
3. **Soft Skills:** (3)
   Time management – Stress management – Assertiveness – Negotiation strategies, Psychometrics - Analytical and logical reasoning.
4. **Group Discussion:** (3)
   Group discussion as part of selection process, Structure of group discussion – Strategies in group discussion – Mock group discussions.
5. **Interview Skills:** **(3**)
   Kinds of interviews – Interview techniques – Corporate culture – Mock interviews.

**II. Class Room Session**

1. **Resume / Report Preparation / Letter writing**: Students prepare their (9)
   own resume and report.
2. **Presentation Skills:** Students make presentations on given topics. (12)
3. **Group Discussion**: Students participate in group discussions. (12)
4. **Interview Skills**: Students participate in Mock Interviews (12)

**Note:** Classroom sessions are practice sessions.

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Prakash P, **Verbal and Non-Verbal Reasoning**, Macmillan India Ltd., 2nd Edition, New Delhi, 2004.
2. John Seely, **The Oxford Guide to Writing and Speaking**, Oxford University Press, New Delhi 2004.
3. Paul V Anderson, **Technical Communication**, Thomson Wadsworth , 6th Edition, New Delhi, 2007.
4. Edgar Thorpe and Showick Thorpe, **Objective English**, Pearson Education, 2nd Edition, New Delhi 2007.
5. David Evans, **Decision maker**, CUP, 1997

**Lab Requirement:**

1. Teacher console and systems for students.
2. English Language Lab Software
3. Tape recorders

**IE9401 DESIGN OF EXPERIMENTS L T P C**
**3 1 0 4**

**OBJECTIVE:**

To impart knowledge on statistical tools for industrial experimentation related to selection of product and process parameters in various environments.

**UNIT I CONCEPTS AND TERMINOLOGY 5**

Review of hypothesis testing – P Value, "t" Vs paired "t" test, simple comparative experiment, planning of experiment – steps. Terminology - factors, levels, variables, Design principles – replication, randomization, blocking, confounding, Analysis of variance, sum of squares, degrees of freedom.

**UNIT II SINGLE FACTOR EXPERIMENTS 10**

Completely randomized design, Randomized block design, effect of coding the observations, Latin Square design, orthogonal contrasts, comparison of treatment means – Duncan's multiple range test, Newman- Keuel's test, Fisher's LSD test, Tukey's test.

**UNIT III FACTORIAL EXPERIMENTS 10**

Main and interaction effects, Rules for sum of squares and expected mean square, two and three factor full factorial design, $2^k$ designs with two and three factors, Yate's algorithm, practical applications.

**UNIT IV SPECIAL EXPERIMENTAL DESIGNS 10**

Blocking and confounding in $2^k$ design, nested design, split – plot design, two level fractional factorial design, fitting regression models, introduction to response surface methods- Central composite design.

**UNIT V TAGUCHI TECHNIQUES 10**

Introduction, Orthogonal designs, data analysis using ANOVA and response graph, parameter design – noise factors, objective functions (S/N ratios), multi-level factor OA designs, applications.

**TOTAL : 45 +15 = 60 PERIODS**

**TEXT BOOK :**

1. Douglus C.Montgomery, Design and Analysis of Experiments, John Wiley & Sons,2005

**REFERENCES :**

1. Angela M.Dean and Daniel Voss, Design and Analysis of Experiments, Springer texts in Statistics, 2000.
2. Philip J.Ross, Taguchi Techniques for Quality Engineering, Prentice Hall, 1989.

**GE9022 TOTAL QUALITY MANAGEMENT L T P C**
**3 0 0 3**

**AIM**

To provide comprehensive knowledge about the principles, practices, tools and techniques of Total quality management.

**OBJECTIVES**

- To understand the various principles, practices of TQM to achieve quality.
- To learn the various statistical approaches for Quality control.
- To understand the TQM tools for continuous process improvement.
- To learn the importance of ISO and Quality systems

**UNIT I INTRODUCTION 9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

**UNIT II TQM PRINCIPLES 9**

Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

**UNIT III TQM TOOLS & TECHNIQUES I 9**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

**UNIT IV TQM TOOLS & TECHNIQUES II 9**

Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

**UNIT V QUALITY SYSTEMS 9**

Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

**TOTAL : 45 PERIODS**

**TEXT BOOK:**

1. Dale H.Besterfiled, et at., “Total Quality Management”, Pearson Education Asia, Third Edition, Indian Reprint (2006).

**REFERENCE BOOKS:**

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, (6th Edition), South-Western (Thomson Learning), 2005.
2. Oakland, J.S. “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford, Third Edition (2003).
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd. (2006)
4. Janakiraman,B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd. (2006)

**IE9402 SIMULATION MODELING AND ANALYSIS L T P C**
**3 0 0 3**

**OBJECTIVE:**

To cover various aspects of discrete dynamic, stochastic systems modeling and conducting experiments with those models on a computer.

**UNIT I INTRODUCTION 3**

Systems – Modelling – types – systems components – Simulation basics

**UNIT II RANDOM NUMBERS/VARIATES 10**

Random numbers – methods of generation – random variates for standard distributions like uniform, exponential, Poisson, binomial, normal etc – Testing of Random variates – Monte Carlo Simulation

**UNIT III DESIGN OF SIMULATION EXPERIMENTS 12**

Steps on Design of Simulation Experiments – Development of models using of High-level language for systems like Queuing, Inventory, Replacement, Production etc., – Model validation and verification, Output analysis.

**UNIT IV SIMULATION LANGUAGES 12**

Need for simulation Languages – Comparisons & Selection of Languages – GPSS-ARENA- EXTEND – Study of any one of the languages

**UNIT V CASE STUDIES USING SIMULATION LANGUAGES 8**

**TOTAL: 45 PERIODS**

**REFERENCES**


1. Jerry Banks, John S Corson,Barry.L. Nelson,David M. Nicol and P.Shahabudeen, Discrete Event Systems Simulation, Pearson education, Fourth edition,2007.
2. Geoffrey Gordon, Systems Simulation, Prentice Hall, 2002
3. Law A M & Kelton W D, Simulation Modelling and analysis, Tata McGraw-Hill, 2003
4. David Kelton, Rondall P Sadowski, David T Sturrock, Simulation with Arena, Mc Graw Hill, 2004
5. Thomas J Schriber, Simulation Using GPSS, John Wiley,2002.
   http://www.bcnn.net


**IE9403 OPERATIONS SCHEDULING L T P C**
**3 0 0 3**

**OBJECTIVE:**

To impart knowledge on various scheduling techniques applicable to Job shop, Flow shop configurations.

**UNIT I SCHEDULING AND SEQUENCING 6**

Scheduling function – Scheduling theory – Sequencing and scheduling objectives – Constraints – Pure sequencing problem – Ready time – Flow time – Lateness –

Tardiness- In process inventory – SPT, EDD, WSPT – Regular measure of performance- Sequencing theorems.

**UNITII SINGLE MACHINE MODEL 10**

Minimization of number of tardy jobs: Hodgson's algorithm – Minimizing mean flow time: Smith's rule – Minimizing mean tardiness: Wilkerson Irwin algorithm – Dynamic programming approach – Branch and Bound algorithm – Neighbourhood search technique – Non simultaneous arrivals – Minimizing mean tardiness for dependent jobs – Minimizing weighted mean flow time: Horn's method, Sidney's algorithm- Sequence dependent set up times.

**UNITIII PARALLEL MACHINE MODEL 8**

Independent jobs: McNaughton's algorithm for makespan minimization– Heuristic procedures to minimize mean flow time and makespan – Minimizing mean weighted flow time: $H_1$ heuristic and $H_m$ heuristic– Dependent jobs: Hu's algorithm – Muntz Coffman algorithm.

**UNIT IV FLOW SHOP MODEL 10**

Characteristics – Johnson's algorithm – Extension of Johnson's rule – Campbell Dudek Smith algorithm – Palmer's heuristic approach – Start lag, Stop lag – Mitten's algorithm – Ignall Schrage algorithm - Despatch index heuristic

**UNIT V JOB SHOP MODEL 11**

Characteristics-Graphical description – Jackson's method – Feasible, Semi-active schedules – Active schedule generation – Non delay schedule generation – Heuristics schedule generation – Priority dispatching rules – simulation – Open shop scheduling

**REFERENCES:**


1. Introduction to sequencing and scheduling – Kenneth R.Baker John Wiley & Sons, New York, 2000.
2. Industrial scheduling – Dilip R.Sule, PWS Publishing company, Boston, 1997.


**IE 9404 DISCRETE SIMULATION LABORATORY L T P C**
**0 0 3 2**

**OBJECTIVE**

To give hands on experience with reference to computer based discrete system simulation experiments

1. Random Number Generation
   Mid Square, Constant Multiplier, Congruential
2. Random variates Generation
   Exponential, Poisson, Normal, Binomial
3. Testing of Random variates
   Chi-Square, KS, Run
4. Monte Carlo Simulation
   Random Walk Problem
5. Queuing Models
   Single, Multi Server
6. Other IE oriented models
   Inventory, Replacement, Production system etc

7-10 Use of Simulation Language/Package

**TOTAL: 45 PERIODS**

**IE9405 COMPREHENSION L T P C**
**0 0 2 1**

**AIM:**

To give a comprehensive knowledge and understanding in the various fields of Industrial Engineering

The objective of this comprehension is to achieve an understanding of the fundamentals of contemporary manufacturing systems including materials, manufacturing process, product and process control, computer integrated manufacture and quality. The students work in groups and solve a variety of problems given to them. The problems given to the students should be of real like industrial problems selected by a group of faculty members of the concerned department. A minimum of three small problems have to be solved by each group of students. The evaluation is based on continuous assessment by a group of Faculty Members constituted by the professor in-charge of the course.

**TOTAL: 30 PERIODS**

**IE9451 PROJECT WORK L T P C**
**0 0 12 6**

A Project topic must be selected either from published lists or the students themselves may propose suitable topics in consultation with their guides. The aim of the project work is to deepen comprehension of principles by applying them to a new problem which may be the design and manufacture of a device, a research investigation, a computer or management project or a design problem.

The progress of the project is evaluated based on a minimum of three reviews. The review committee may be constituted by the Head of the Department.

A project report is required at the end of the semester. The project work is evaluated jointly by external and internal examiners constituted by the Head of the Department based on oral presentation and the project report.

**ME9021 ENERGY CONSERVATION AND MANAGEMENT L T P C**
**3 0 0 3**

**AIM :**

To instruct the importance of energy conservation in both thermal and electrical energy and its management for the better utilization of resources.

**OBJECTIVE :**

At the end of the course, the student expected to do

(i) Understand and analyze the plant energy data
(ii) Energy audit and suggest methodologies for energy savings
(iii) Energy accounting and balance and
(iv) Able to utilize the available resources in optimal way

**PRE-REQUISITE : Nil**

**UNIT I IMPORTANCE OF ENERGY CONSERVATION AND MANAGEMENT 8**

World, national Energy consumption – environmental aspects – Energy prices, policies – Energy auditing : methodology, analysis, energy accounting – Measurements – Thermal and Electrical.

**UNIT II ELECTRICAL SYSTEMS 12**

AC / DC current systems, Demand control, power factor correction, load management, Motor drives : motor efficiency testing, energy efficient motors, motor speed control – Lighting : lighting levels, efficient options, daylighting, timers, Energy efficient windows – electrical distribution systems – Transformers – Power quality – harmonic distortion.

**UNIT III THERMAL SYSTEMS 10**

Boiler – efficiency testing, excess air control, Steam distribution & use – steam traps, condensate recovery, flash steam utilization, Thermal Insulation. Heat exchanger networking – concept of pinch, target settling, problem table approach.

**UNIT IV ENERGY CONSERVATION 8**

Energy conservation in Pumps, Fans (flow control) and blowers, Compressed Air Systems, Refrigeration and air conditioning systems – Waste heat recovery recuperators, heat sheets, heat pipes, heat pumps.

**UNIT V ENERGY MANAGEMENT, ECONOMICS 7**

Energy resource management – Energy Management information systems – Computerized energy management – Energy economics – discount rate, payback period, internal rate of Return, life cycle costing – Financing energy conservation Projects.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. L.C. Witte, P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.
2. O. Callaghn, P.W. "Design and Management for Energy Conservation", Pergamon Press, Oxford, 1981.

**REFERENCES:**

1.I.G.C. Dryden, "The Efficient Use of Energy" Butterworths, London, 1982
2.W.C. turner, "Energy Management Hand book" Wiley, New York, 1982.
3.W.R. Murphy and G. Mc KAY "Energy Management" Butterworths, London 1987.

**IE9021 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING L T P C 3 0 0 3**

**OBJECTIVE:**

- The purpose is to apprise the students on productivity improvement techniques for an organization and to create a system that response with flexibility of the changes through business process reengineering.

**UNIT I INTRODUCTION 3**

Basic concept and meaning of Productivity – Significance of Productivity – Factors affecting Productivity – Productivity cycle, Scope of Productivity Engineering and Management.

**UNIT II PRODUCTIVITY MEASUREMENT AND EVALUATION 9**

Productivity measurement in International, National and Industrial level – Total Productivity Model – Productivity measurement in Manufacturing and Service sectors – Performance Objective Productivity (PO) model – Need for Productivity Evaluation – Evaluation Methodology.

**UNIT III PRODUCTIVITY PLANNING AND IMPLEMENTATION 9**

Need for Productivity Planning – Short term and long term productivity planning – Productivity improvement approaches, Principles - Productivity Improvement techniques – Technology based, Material based, Employee based, Product based techniques – Managerial aspects of Productivity Implementation schedule, Productivity audit and control.

**UNIT IV REENGINEERING PROCESS 15**

Definition, Fundamentals of process reengineering – Principles, Methodology and guidelines for Organization Transformation, DSMCQ and PMP organization Transformation models – Process Improvement Models like PMI, Edosomwan, LMICIP and NPRDC Models.

**UNIT V BPR TOOLS AND IMPLEMENTATION 9**

Analytical and Process Tools and Techniques - Role of Information and Communication Technology in BPR – Requirements and steps in BPR Implementation – Case studies.

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Sumanth, D.J.Productivity Engineering and Management, TMH, New Delhi, 1990.
2. Edosomwan, J.A. Organizational Transformation and Process re- Engineering, British Cataloging in publications, 1996.
3. Premvrat, Sardana, G.D. and Sahay, B.S. Productivity Management - A systems approach, Narosa Publications, New Delhi, 1998.


**IE9022 SAFETY ENGINEERING AND MANAGEMENT L T P C**

**3 0 0 3**

**OBJECTIVE:**

To impart knowledge on safety engineering fundamentals and safety management practices

**UNIT I INTRODUCTION 9**

Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure vessels, Electrical Exposure.

**UNIT II CHEMICAL HAZARDS 9**

Chemical exposure – Toxic materials – Radiation Ionizing and Non-ionizing Radiation - Industrial Hygiene – Industrial Toxicology.

**UNIT III ENVIRONMENTAL CONTROL 9**

Industrial Health Hazards – Environmental Control –Industrial Noise- Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.

**UNIT IV ENVIRONMENTAL CONTROL 9**

System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), HAZOP analysis and Risk Assessment.

**UNIT V SAFETY REGULATIONS 9**

Explosions – Disaster management – catastrophe control, hazard control , FactoriesAct, Safety regulations Product safety – case studies.

**TOTAL: 45 PERIODS**

**REFERENCES**


1. John V Grimaldi, Safety Management, AITB S Publishers (2003)
2. Safety Manual, EDEL Engineering Consultancy (2000)
3. David L.Goetsch, Occupational Safety and Health for Technologists, Engineers and Managers, Pearson Education Ltd. 5th Edition 2005.

**IE9023 HUMAN RESOURCE MANAGEMENT L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To introduce the basic principles of group dynamics and associated concepts required for Human resource management in organizations

**UNIT I INDIVIDUAL BEHAVIOR 9**

Personality –Types –Influencing Personality – Learning Process, Attribute – Perception – Motivation Theories

**UNIT II GROUP BEHAVIOR 9**

Group Organization, Group Dynamics, Emergence of Informal Leader, Leadership Styles-theories,Group decision making, Inter personal Relations, Communication - Team.

**UNIT III DYNAMICS OF ORGANIZATIONAL BEHAVIOR 9**

Organizational Climate, the Satisfactory –Organizational change – the Change Process & Change Management.

**UNIT IV HUMAN RESOURCES PLANNING 9**

Requirements of Human Resources –HR audit, Recruitment-Selection-Interviews

**UNIT V HUMAN RESOURCES DEVELOPMENT 9**

Employee Training-Career Development-Performance Appraisal-Compensation-safety and Health-Employee Relation-Management Development.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

Stephen R. Robbins, “Organizational Behavior”, PHI, 1998.

**REFERENCES:**

1. David A. Decenzo & Stephen R. Robbins, “Personnel/Human Resources Management”, PHI, 1997.
2. Fred Lutherans, “Organizational Behavior”, Oxford University Press, 2000.

**IE9024 INFORMATION SYSTEMS ANALYSIS AND DESIGN L T P C**
**3 0 0 3**

**OBJECTIVE:**

To impart knowledge on the basics of systems analysis and design required for developing application software in a given environment.

**UNIT I OVERVIEW 6**

Information and Management - types of information, Examples of Information systems, Information Systems analysis overview, Information gathering - sources

**UNIT II DATA FLOW DIAGRAMS 10**

System Requirements specifications, Feasibility analysis, Data flow diagrams – logical and physical DFDs, Process specification methods, Decision tables

**UNIT III ER DIAGRAMS 12**

Logical database design – ER model, Normalizing relations; Data input methods; Database Management Systems – database design, Object oriented systems modeling

**UNIT IV E-COMMERCE 8**

Designing outputs, Security of Information systems, E-commerce

**UNIT V APPLICATIONS 9**

System design example: Document and data flow diagrams, Feasibility of the system, System specifications, Database design, Control, audit and test plan

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. V. Rajaraman, Analysis and Design of Information Systems, PHI, 2004
2. Jeffrey L Whitten et al, Systems Analysis and Design Methods, McGraHill,2003


**IE9025 ADVANCED OPTIMIZATION TECHNIQUES L T P C**
**3 0 0 3**

**OBJECTIVE**

Some of the Operations Research techniques which are not covered in the first level course are dealt with.

**UNIT I MULTI CRITERIA MODELS 9**

Data Envelopment Analysis, Multicriteria Decision Problems- Goal Programming, Analytic Hierarchy Process

**UNIT II NON –LINEAR MODELS -I 9**

Types of Non-linear programming problems, unconstrained optimization, Linearly Constrained Optimization, Quadratic Programming, Convex Programming,

**UNIT III NON –LINEAR MODELS –II 9**

KKT conditions for constrained optimization, Separable programming, Non-convex programming, Geometric programming

**UNIT IV MARKOV PROCESSES 9**

Markov Processes, Neural network based optimization

**UNIT V METAHEURISTICS 9**

Metaheuristics - Genetic Algorithms, Simulated Annealing, Ant Colony Optimization.

**TOTAL: 45 PERIODS**

**REFERENCES :**


1. Hillier and Liberman, Introduction to Operations Research, TMH, 2000
2. Singiresu S Rao, Engineering Optimization, Wiley,1998
3. Kalyanmoy Deb, Optimization for Engineering Design, PHI,2000
4. David R. Anderson, et al , An Introduction to Management Science – Quantitative approaches to Decision Making, Thomson,2003
5. Fred Glover et al., Handbook of Metaheuristics, Kluwer,2003

**IE9026 VALUE ENGINEERING AND PROJECT MANAGEMENT L T P C**
**3 0 0 3**

**OBJECTIVE:**
To give a brief account of the value analysis and engineering tool for productivity improvement through project managemen

**UNIT I VALUE ENGINEERING BASICS 9**
Origin of Value Engineering, Meaning of value, Definition of Value Engineering and Value analysis, Difference between Value analysis and Value Engineering, Types of Value, function - Basic and Secondary functions, concept of cost and worth, creativity In Value Engineering.

**UNIT II VALUE ENGINEERING JOB PLAN AND PROCESS 9**
Seven phases of job plan, FAST Diagram as Value Engineering Tool, Behavioural and organizational aspects of Value Engineering, Ten principles of Value analysis, Benefits of Value Engineering.

**UNIT III PROJECT FORMULATION AND APPRAISAL 9**
Project Management – An overview, Feasibility and Technical analysis, Marketing feasibility, Financial and Economic feasibility, Formulation of Detailed Project Reports (DPR).

**UNIT IV PROJECT IMPLEMENTATION AND CONTROL 9**
Project planning, Project organization, Tools and techniques of project management, Project management Information system, Human resources, Financial aspects.

**UNIT V PROJECT COMPLETION AND EVALUATION 9**
Monitoring and Control of project, Integrated project management control system, Managing transition from project to operations, project review.

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. Mudge, Arthur E. "Value Engineering"- A systematic approach, McGraw Hill, New York, 2000.
2. Martandtelsang, Industrial Engineering and Production Management" S.Chand and Company LTd., New Delhi, 2002.
3. Choudhury, S. "Project scheduling and monitoring in practice, South Asian Publishers, New Delhi, 2001.
4. Goodman, L.J. Project planning and Management – An integrated system for improving productivity, Van Norstand, New York, 2000.
5. Kerzner, H. "Project Management" A system for approach to planning, scheduling and controlling 2nd Rf/CBS publishers, Delhi, 2002.
6. P.Gopalakrishnan, Text book of Project Management, Macmillan, India, 2000.


**IE9027 TECHNOLOGY MANAGEMENT L T P C**
**3 0 0 3**

**UNIT I INTRODUCTION 9**
Technology management - Scope, components, and overview. Technology and environment, Technology and society, Technology Impact analysis, environmental, social, legal, political aspects, techniques for analysis - steps involved. Technology policy strategy: Science and technology Policy of India, implications to industry.

**UNIT II TECHNOLOGY FORECASTING MODELS 9**

Technology forecasting - need, methodology and methods - trend Analysis, Analogy, Delphi, Soft System Methodology, Mathematical Models, Simulation, and System Dynamics.

**UNIT III EVALUATION METHODS 9**

Technology Choice and Evaluation - Methods of analysing alternate technologies, Techno-economic feasibility studies, Need for multi-criteria considerations such as, social, environmental, and political, Analytic hierarchy method, Fuzzy multi-criteria decision making, and other methods.

**UNIT IV TECHNOLOGY TRANSFER 9**

Technology Transfer and Acquisition - Import regulations, Implications of agreements like Uruguay Round and WTO, Bargaining process, Transfer option, MOU-Technology Adoption and Productivity - Adopting technology-human interactions, Organisational redesign and re-engineering, Technology productivity.

**UNIT V TECHNOLOGY INNOVATION 9**

Technology Absorption and Innovation - present status in India, Need for new outlook, Absorption strategies for acquired technology, creating new/improved technologies, Innovations. Technology Measurement- Technology Audit.

**TOTAL: 45 PERIODS**

**TEXT BOOK**

Richard C. Dorf, Technology Management Handbook, CRC,1999

**REFERENCES**

1. Joseph M. Putti, Management – A Functional Approach, McGraw Hill, 1997
2. Kenneth C. Lauden , MIS: Organisation and Technology, Prentice Hall, 1995
3. James A.Senn, Information technology in Business, Prentice Hall, 1995
4. Ronald J. Jordan, Security analysis and Portfolio Management, Prentice Hall, 1995
5 .Irvin M. Rubin, Organisational behavior an experimental approach, Prentice Hall, 1995
6.Gerard H. Gaynor, Handbook of Technology Management, McGraw-Hill Professional, 1996

**IE9028 MODELLING OF MANUFACTURING SYSTEMS L T P C**
**3 0 0 3**

**OBJECTIVE:**

To cover some of the modeling paradigms applicable for discrete items manufacturing systems and evaluation of such systems performance.

**UNIT I FOCUSED FACTORIES 9**

Manufacturing Systems and Models, Focused factory types, Group Technology – assigning machines to groups, assigning parts to machines, Mathematical program for group formation

**UNIT II UNPACED PRODUCTION LINES 9**

Production lines – Paced with and without buffers – computing system effectiveness; unpaced lines – impact of random processing times and recovery of throughput through buffers

**UNIT III FMS PLANNING MODELS 9**

FMS planning and Control Hierarchy – part selection and loading problems – knapsack and loading heuristic

**UNIT IV MARKOV MODELS 9**

Stochastic processes in manufacturing, Markov chain models – DTMC and CTMC, steady state analysis, Simulation models of manufacturing systems

**UNIT V QUEUING AND PETRINET MODELS 9**

Queuing networks in manufacturing – Jackson and Gordon Newell, product form solution, Petrinets in manufacturing – basic concepts, stochastic petrinets, system performance measure

**TOTAL: 45 PERIODS**

**REFERENCES**


1. Ronald G Askin, "Modeling and Analysis of Manufacturing systems", Wiley sons, 2003.
2. Viswanadham and Narahari, "Performance modeling of automated manufacturing systems", PHI, 2003.
3. Nicholas J M, "Competitive Manufacturing Management", TMH, 2001.
4. Buzacot and Shantikumar, "Queueing networks in Manufacturing", Wiley Sons, 2000.
5. Reisig W, "System Design Using Petrinets", Springer, 2000.


**IE9029 COMPUTATIONAL METHODS & ALGORITHMS L T P C**
**3 0 0 3**

**OBJECTIVE**

- A brief introduction to algorithmic design tools with some applications

**UNIT I INTRODUCTION 5**

Review of C/C++ - writing and debugging large programs-controlling numerical errors

**UNIT II ALGORITHM DESIGN METHODS 12**

Greedy – divide and conquer – backtracking – branch & bound – heuristics- Meta heuristics

**UNIT III BASIC TOOLS 12**

Structured approach – networks – trees – data structures

**UNIT IV COMPUTATIONAL PERFORMANCE 6**

Time complexity – space complexity – algorithm complexity

**UNIT V APPLICATIONS 10**

Sorting – searching - net works – scheduling – optimisation models – IE applications

**TOTAL : 45 PERIODS**

**REFERENCES:**


1. Goodman S F & Headtruemu ST , Introduction to design of algorithms, McGraw Hill,2002
2. Sahni, Data Structures, algorithms and applications in C++, McGraw Hill, 2003
3. Dromey,R.G.,How to solve it with computers?,PHI,2002

4. Alfred V. Aho , Jeffrey D. Ullman and John E. Hopcroft,Data Structures and Algorithms,Addison-Wesley ,1993.

**IE9030 DECISION SUPPORT AND INTELLIGENT SYSTEMS L T P C**
**3 0 0 3**

**OBJECTIVE:**
To impart knowledge on basics of DSS and Knowledge based systems

**UNIT I INTRODUCTION 5**
Managerial decision making, system modeling and support-preview of the modeling process-phases of decision making process.

**UNIT II ANALYSIS 10**
DSS components- Data warehousing, access, analysis, mining and visualization-modeling and analysis-DSS development.

**UNIT III TECHNOLOGIES 10**
Group support systems- enterprise DSS- supply chain and DSS-knowledge management methods, technologies and tools.

**UNIT IV EXPERT SYSTEMS 10**
Artificial intelligence and expert systems-concepts, structure, types-knowledge acquisition and validation-difficulties, methods, selection.

**UNIT V SEMANTIC NETWORKS 10**
Representation in logic and schemas, semantic networks, production rules and frames, inference techniques, intelligent system development, implementation and integration of management support systems.

**TOTAL: 45 PERIODS**

**REFERENCES**

1. Efraim Turban and Jay E Aronson, Decision Support and Intelligent Systems, Pearson education Asia, Sixth edition, 2002.
2. S S Mitra, Decision support systems, tools and techniques, John Wiley, 1996.
3. Elain Rich and Kevin Knight, Artificial intelligence, TMH,1993.

**IE9031 EVOLUTIONARY OPTIMIZATION L T P C**
**3 0 0 3**

**OBJECTIVE**
To cover some of the evolutionary algorithms and their applications in optimization

**UNIT I INTRODUCTION 9**
Introduction to evolutionary computation, Evolutionary computation and AI, Historical branches of evolutionary computation

**UNIT II SEARCH SCHEMA 9**
Search operators, Selection schemes, Ranking methods, Importance of representation

**UNIT III EVOLUTIONARY ALGORITHMS 9**

Evolutionary combinatorial optimization – evolutionary algorithms, Constraint handling

**UNIT IV GENETIC PROGRAMMING 9**

Genetic programming – steps, Search operators on trees, examples

**UNIT V MULTIOBJECTIVE OPTIMISATION 9**

Pareto optimality, Multiobjective evolutionary algorithms, Analysis of evolutionary algorithms

**REFERENCES:**


1. W Banzhaf et al , Genetic Programming – An introduction, Morgan Kanfmann Publications (1999)
2. X Yao, "Evolutionary computations – Theory and Applications", World Scientific Publications (1999)
3. J Baeck, "Handbook of Evolutionary computation", IOS Press, 1997.
4. Goldberg D E , Genetic Algorithms in search, optimization, Addison Wesley (1989)


**IE9032 SYSTEMS ENGINEERING L T P C**
**3 0 0 3**

**OBJECTIVE :**

- To cover the basics of systems engineering study steps and associated techniques in the systems analysis.

**UNIT I INTRODUCTION 6**

Definitions, Systems theory, Life-Cycle phases, Systems Engineering processes, Seven-phase and twenty-two phase life cycle for systems acquisition.

**UNIT II FORMULATION OF ISSUES 9**

Problem or Issue identification, Formulation of issues with an example – Identification of needs, alterables, constraints, Value system design, Requirements statement, Generation of Alternatives or System synthesis, Feasibility studies.

**UNIT III ANALYSIS OF ALTERNATIVES 12**

Analysis of systems with uncertain and imperfect information, structural modeling – trees, causal loops, and influence diagrams, system dynamics models, Economic models, Reliability models, Discrete event models.

**UNIT IV DECISION ASSESSMENT 9**

Interpretation of alternative courses of action, Formal Decisions – prescriptive and normative decision assessments, Descriptive decision models – Group decision making.

**UNIT V SYSTEMS ENGINEERING MANAGEMENT 9**

Organizational structures, Methods for systems Engineering Management, Human and cognitive factors in Systems Engineering and Systems Management.

**TOTAL: 45 PERIODS**

**TEXT BOOK**


1. Andrew P.Sage, James E.Armstrong Jr, "Introduction to Systems Engineering", John Wiley and Sons Inc. 2000.


**REFERENCES:**

1. Andrew P.Sage, “Systems Engineering”, John Wiley & Sons, 1992.
2. Andrew P.Sage, William B.Rouse, “Hand book of Systems Engineering and Management”, John Wiley & Sons, 1999.

**IE9033 SUPPLY CHAIN MANAGEMENT L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To cover the basics of supply chain concepts, associated networks, tools and techniques required for evaluating various supply chain processes.

**UNIT I STRATEGIC FRAMEWORK 5**

Objective, decision phases, process views, examples, strategic fit, supply chain drivers and metrics

**UNIT II SUPPLY CHAIN NETWORKS 10**

Distribution networks, Facility networks and design options, Factors influencing, Models for facility location and capacity allocation, Transportation networks and design options, Evaluating network design decisions

**UNIT III MANAGING DEMAND AND SUPPLY IN A SUPPLY CHAIN 10**

Predictable variability in a supply chain, Economies of scale and uncertainty in a supply chain – Cycle and safety Inventory, Optimum level of product availability, Forward Buying, Multi-echelon cycle inventory

**UNIT IV SOURCING AND PRICING IN A SUPPLY CHAIN 10**

Cross-Functional drivers, Role of sourcing in a supply chain, Logistics providers, Procurement process, Supplier selection, Design collaboration, Role of Pricing and Revenue Management in a supply chain

**UNIT V INFORMATION TECHNOLOGY AND COORDINATION IN A SUPPLY CHAIN 10**

The role of IT in supply chain, The supply chain IT frame work, Customer Relationship Management, Supplier relationship management, Future of IT in supply chain, E-Business in supply chain, Bullwhip effect – Effect of lack of co-ordination in supply chain, Building strategic partnerships, CPFR

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Sunil Chopra and Peter meindl, “Supply Chain Management , Strategy, Planning, and operation”, PHI, Third edition,2007

**REFERENCES:**

1. Jeremy F.Shapiro, “Modeling the supply chain”, Thomson Duxbury ,2002
2. James B.Ayers, “Handbook of Supply chain management”, St.Lucle press, 2000

**IE9034 MAINTENANCE ENGINEERING AND MANAGEMENT L T P C**
**3 0 0 3**

**OBJECTIVE:**

- To cover maintenance strategies, associated models for application and evaluation in different types of industries

**UNIT I MAINTENANCE CONCEPT 8**

Need for Maintenance – Maintenance management – Tero technology – Challenges of physical asset management – Scope of Maintenance department – Maintenance organization – Maintenance costs – Imperfect maintenance – Toyota maintenance concept – Maintenance policies: PM, CM, DOM, OM – Condition monitoring.

**UNIT II MAINTENANCE MODELS 10**

Probability models in maintenance – Choice between PM and b/d maintenance – Optimal PM schedule and quality loss – Inspection decisions: Maximization of profit – Minimization of downtime – Analysis of downtime – Repair time distribution: exponential, lognormal – System repair time – Maintainability prediction – Corrective maintenance downtime – Design for maintainability.

**UNIT III MAINTENANCE LOGISTICS 12**

Maintenance planning – Maintenance scheduling – Priority systems – Proactive/reactive maintenance – Minimum/extensive maintenance – Work order form – Spare parts control: setting reorder point – Overall part availability – unique/interchangeable spares – Ebel graph – Capital spare – Maintenance resource requirements – Queuing theory applications: Optimal number of workshop machines – Optimal repair effort – Maintenance crew size – use of learning curves – simulation – Human factors in maintenance.

**UNIT IV REPLACEMENT MODELS 9**

Component replacement decisions – Assumptions –Model for equipment whose operating cost increases with use – Preventive replacement age of item subject to breakdown – Preventive replacement interval/age: minimization of downtime, Capital equipment replacement decisions

**UNIT V ADVANCED MAINTENANCE 6**

Total Productive Maintenance – Chronic and sporadic losses – Six big losses – Equipment effectiveness – Autonomous maintenance – Reliability Centered Maintenance – CMMS – Software maintenance.

**TOTAL: 45 PERIODS**

**REFERENCES:**


1. An introduction to Reliability and Maintainability Engineering –Charles E.Ebeling, Tata McGraw-Hill, New Delhi, 2003.
2. Maintenance, Replacement and Reliability –Andrew K.S.Jardine and Albert H.C.Tsang, Taylor & Francis, New York, 2006.
3. Autonomous maintenance in seven steps – Masaji Tajiri and Fumio Gotoh, Productivity Inc., Oregon, 1999.


**ME9029 AUTOMOBILE ENGINEERING L T P C**
**3 0 0 3**

**AIM :**

Impartation of basic principles of Automotive Vehicular systems with suitable illustrations and numerical problems ; also enlightenment of development trends.

**OBJECTIVE :**

To provide a comprehensive view of automobile engineering to the students.

**PREREQUISITE :**

Other branch students may be offered this course without any preconditions. However, a orientation programme lasting a duration of 10 hours may be offered on selected topics like thermodynamics and vehicle mechanics.

**UNIT I INTRODUCTION 5**

Basic layouts of automotive vehicles including electric and hybrid electric systems, specifications and performance parameters of vehicles. Types of vehicle bodies. & chasses.

**UNIT II ENGINE SYSTEMS 10**

Reciprocating engine systems, Rotary engine systems, Electric motors, Hybrid systems, Gas turbine systems. Development trends like GDI and HCCI engine systems, complex hybrid electric systems, closed loop controls in piston engine systems, Alternate Fuel systems for propulsion engines. Vehicular pollutants emission and their controls. Three Way Catalytic converter features. Electronic Engine Management systems.

**UNIT III TRANSMISSION SYSTEM 10**

Types of Clutch, gear box (manual and automatic), propeller shafting, differential and types of rear axle.

**UNIT IV AUTOMOTIVE SAFETY HANDLING AND COMFORT SYSTEMS 10**

Braking System, Steering System, Suspension system, Electrical system, Safety systems, HVAC system.

**UNIT V TESTING AND SERVICING OF AUTOMOBILES 10**

A brief discussion on the following :
Engine Tuning
Chassis Dynamometry
Tests for emissions of pollutants like HC, CO, NOx and particulates
Wind tunnel Testing of vehicles

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Automotive Mechanics, William H Crouse and Donald L. Anglin, Tata McGraw Hill Publishing Company Ltd., 2004, Tenth Edition.

**REFERENCES:**

1. Automotive Handbook, Bosch, Robert Bosch GmbH, Germany 2004, Sixth Edition.
2. Automotive Technology – A Systems Approach, Jack Erjavek, Thomson Learning, 3rd Edition, 1999.

**ME9301 DESIGN OF JIGS, FIXTURES AND PRESS TOOLS L T P C**
**3 0 0 3**

**AIM:**

To appreciate and understand the importance of tool design in the overall product cycle

**OBJECTIVES:**

- To understand the functions and design principles of Jigs, fixtures and press tools
- To gain proficiency in the development of required views of the final design.

**UNIT I LOCATING AND CLAMPING PRINCIPLES: 8**

Objectives of tool design- Function and advantages of Jigs and fixtures – Basic elements – principles of location – Locating methods and devices – Redundant Location – Principles of clamping – Mechanical actuation – pneumatic and hydraulic actuation Standard parts – Drill bushes and Jig buttons – Tolerances and materials used.

**UNIT II JIGS AND FIXTURES 10**

Design and development of jigs and fixtures for given component- Types of Jigs – Post, Turnover, Channel, latch, box, pot, angular post jigs – Indexing jigs – General principles of milling, Lathe, boring, broaching and grinding fixtures – Assembly, Inspection and Welding fixtures – Modular fixturing systems- Quick change fixtures.

**UNIT III PRESS WORKING TERMINOLOGIES AND ELEMENTS OF CUTTING DIES 10**

Press Working Terminologies - operations – Types of presses – press accessories – Computation of press capacity – Strip layout – Material Utilization – Shearing action – Clearances – Press Work Materials – Center of pressure- Design of various elements of dies – Die Block – Punch holder, Die set, guide plates – Stops – Strippers – Pilots – Selection of Standard parts – Design and preparation of four standard views of simple blanking, piercing, compound and progressive dies.

**UNIT IV BENDING FORMING AND DRAWING DIES 10**

Difference between bending, forming and drawing – Blank development for above operations – Types of Bending dies – Press capacity – Spring back – knockouts – direct and indirect – pressure pads – Ejectors – Variables affecting Metal flow in drawing operations – draw die inserts – draw beads- ironing – Design and development of bending, forming, drawing reverse re-drawing and combination dies – Blank development for axisymmetric, rectangular and elliptic parts – Single and double action dies.

**UNIT V MISCELLANEOUS TOPICS 7**

Bulging, Swaging, Embossing, coining, curling, hole flanging, shaving and sizing, assembly, fine Blanking dies – recent trends in tool design- computer Aids for sheet metal forming Analysis – basic introduction - tooling for numerically controlled machines- setup reduction for work holding – Single minute exchange of dies – Poka Yoke - Course should be supplemented with visits to industries.
(Use of Approved design Data Book permitted).

**TOTAL: 45 PERIODS**

**TEXT BOOKS**


1. Joshi, P.H. “Jigs and Fixtures”, Second Edition, Tata McGraw Hill Publishing Co., Ltd., New Delhi, 2004.
2. Donaldson, Lecain and Goold “Tool Design”, III rd Edition Tata McGraw Hill, 2000.


**REFERENCES:**


1. K. Venkataraman, “Design of Jigs Fixtures & Press Tools”, Tata McGraw Hill, New Delhi, 2005.Kempster, “Jigs and Fixture Design”, Hoddes and Stoughton – Third Edition 1974.
2. Joshi, P.H. “Press Tools” – Design and Construction”, Wheels publishing, 1996.
3. Hoffman “Jigs and Fixture Design” – Thomson Delmar Learning, Singapore, 2004.
4. ASTME Fundamentals of Tool Design Prentice Hall of India.
5. Design Data Hand Book, PSG College of Technology, Coimbatore.

**ME9351 FINITE ELEMENT ANALYSIS L T P C**
**3 0 0 3**

**AIM:**

To appreciate the need for and applications of numerical techniques for solving problems in mechanical Engineering**.**

**OBJECTIVES**

- To introduce the concepts of Mathematical Modeling of Engineering Problems.
- To appreciate the use of FEM to a range of Engineering Problems.

**UNIT I INTRODUCTION 9**

Historical Background – Mathematical Modeling of field problems in Engineering – Governing Equations – Discrete and continuous models – Boundary, Initial and Eigen Value problems – Weighted Residual Methods – Variational Formulation of Boundary Value Problems – Ritz Technique – Basic concepts of the Finite Element Method.

**UNIT II ONE-DIMENSIONAL PROBLEMS 9**

One Dimensional Second Order Equations – Discretization – Element types- Linear and Higher order Elements – Derivation of Shape functions and Stiffness matrices and force vectors. Assembly of Matrices - solution of problems from solid mechanics and heat transfer- Longitudinal vibration frequencies and mode shapes. Fourth Order Beam Equation – Transverse deflections and Natural frequencies of beams.

**UNIT III TWO DIMENSIONAL SCALAR VARIABLE PROBLEMS 9**

Second Order 2D Equations involving Scalar Variable Functions – Variational formulation – Finite Element formulation – Triangular elements – Shape functions and element matrices and vectors. Application to Field Problems - Thermal problems – Torsion of Non circular shafts – Quadrilateral elements – Higher Order Elements.

**UNIT IV TWO DIMENSIONAL VECTOR VARIABLE PROBLEMS 9**

Equations of elasticity – Plane stress, plane strain and axisymmetric problems – Body forces and temperature effects – Stress calculations - Plate and shell elements.

**UNIT V ISOPARAMETRIC FORMULATION AND MISCELLANEOUS TOPICS 9**

Natural co-ordinate systems – Isoparametric elements – Shape functions for isoparametric elements – One and two dimensions – Serendipity elements – Numerical integration and application to plane stress problems - Matrix solution techniques – Solutions Techniques to Dynamic problems –

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**

1. J Seshu. P. “Textbook of Finite Element Analysis” Prentice Hall of India, 2003.
2.J. N. Reddy, “ Finite Element Method” Tata McGraw Hill, 2003.

**REFERENCES:**

1. Chandrupatla and Belegundu, “Introduction to Finite Elements in Engineering” PHI / Pearson Education, 2003.
2. Logan. D.L. “A first course in Finite Element Method”, Thomson Asia Pvt. Ltd., 2002.

3. Cook R.D., Malkus. D.S. Plesha, ME., “Concepts and Applications of Finite Element Analysis”, John – Wiley Sons 2003.
4. S.S. Rao, “The Finite Element Method in Engineering “Butter worth Heinemann, 2001.

**MF9021 PRODUCT DESIGN AND DEVELOPMENT L T P C**
**3 0 0 3**

**AIM:**

The course aims at providing the basic concepts of product design, product features and its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

**OBJECTIVE:**

The student will be able to design some products for the given set of applications; also the knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.

**UNIT I INTRODUCTION 5**

Need for IPPD – Strategic importance of Product development – integration of customer, designer, material supplier and process planner, Competitor and customer – Behaviour analysis. Understanding customer – prompting customer understanding – involve customer in development and managing requirements – Organization – process management and improvement – Plan and establish product specifications.

**UNIT II CONCEPT GNERATION AND SELECTION 5**

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits.

**UNIT III PRODUCT ARCHITECTURE 10**

Implications – Product change – variety – component standardization – product performance – manufacturability – product development management – establishing the architecture – creation – clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications.

**UNIT IV INDUSTRIAL DESIGN 10**

Integrate process design – Managing costs – Robust design – Integrating CAE, CAD, CAM tools – Simulating product performance and manufacturing processes electronically – Need for industrial design – impact – design process – investigation of for industrial design – impact – design process – investigation of customer needs – conceptualization – refinement – management of the industrial design process – technology driven products – user – driven products – assessing the quality of industrial design.

**UNIT V DESIGN FOR MANUFACTURING AND PRODUCT DEVELOPMENT 15**

Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes – Economic Analysis – Understanding and

representing tasks – baseline project planning – accelerating the project – project execution.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. Kari T.Ulrich and Steven D.Eppinger,"Product Design and Development", McGrtaw-Hill International Edns. 1999.

**REFERENCES:**

1. Kemnneth Crow,"Concurrent Engg./Integrated Product Development",DRM Associates,26/3, Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal,"Effective Product Design and Development", Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh,"Tool Design –Integrated Methods for Successful Product Engineering", Addison Wesley Publishing, New york, NY.

**WEB REFERENCE BOOK:**
http://www.me.mit/.2.7444.

**MF9031 ROBOTICS LT P C**
**3 0 0 3**

**AIM:**
To provide in-depth knowledge in various elements of Industrial Robotics

**OBJECTIVE:**
The objective of this course in to impart knowledge in the fundamentals of Industrial Robotics, viz. Robot Anatomy, Drives, Sensors, end effectors, Robot kinematics and programming

**UNIT I FUNDAMENTALS OF ROBOT 8**
Robot – Definition – Robot Anatomy – Co ordinate Systems, Work Envelope Types and classification – Specifications – pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load – Robot Parts and their Functions – Need for Robots – Different Applications.

**UNIT II ROBOT DRIVE SYSTEMS AND END EFFECTORS 9**
Pneumatic Drives – Hydraulic Drives – Mechanical Drives – Electrical Drives – D.C. Servo Motors, Stepper Motor, A.C. Servo Motors – Salient Features, Applications and Comparison of all these Drives. End Effectors – Grippers – Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

**UNIT III SENSORS AND MACHINE VISION 10**
Requirements of a sensor, Principles and Applications of the following types of Sensors – Types of sensors – contact and non contact sensors.

**UNIT IV ROBOT KINEMATICS AND ROBOT PROGRAMMING 9**

Homogeneous Transformation equation – DH representation - Forward kinematics, Inverse Kinematics and Differences; Forward Kinematics and Reverse Kinematics of manipulators with Three Degrees of Freedom, Six Degrees of freedom – Deviations and problems.

Lead Through Programming, Robot Programming Languages – VAL programming – Motion Commands, Sensor Commands, End Effecter commands and simple programs.

**UNIT V IMPLEMENTATION AND ROBOT ECONOMICS 9**

Advanced Robotics – Micro and Bio robotics - Implementation of Robots in Industries – Various Steps; Safety considerations for Robot Operations; Economic Analysis of Robots – Pay back method, Euac Method, Rate of Return Method.

**TOTAL: 45 PERIODS**

**TEXT BOOK:**

1. M.P.Groover, "Industrial Robotics – Technology, Programming and Applications", McGraw Hill, 2001.

**REFERENCES:**

1. Fu, K.S.Gonzaiz R.C., and Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book Co., 1987.
2. Yoram Koren, "Robotics for Engineers", McGraw Hill Book Co., 1992.
3. Janakiraman, P.A., "Robotics and Image Processing", Tata McGraw Hill, 1995.
4. Surendar Kumar, "Industrial Robots and Computer Integrated Manufacturing", Oxford and IBH Publishing Co. Pvt. Ltd., 1991.
5. S.R.Deb"Robotics Technology oand Flexible Automation" Tata McGraw Hill Book Co., 1994.

**MF9353 ELECTRONICS MANUFACTURING TECHNOLOGY L T P C**
**3 0 0 3**

**AIM:**

To import knowledge on electronics manufacturing and packaging technology.

**OBJECTIVES:**

- Upon the completion of the subject, student will be able to:
- Understand wafer preparation and PCB fabrication
- Know the types of Mounting Technologies and components for electronics assembly
- Appreciate SMT process in detail.
- Know various Defects, Inspection Equipments SMT assembly process.
- Learn repair, rework and quality aspects of Electronics assemblies.

**UNIT I INTRODUCTION TO ELECTRONICS MANUFACTURING 8**

History, definition, wafer preparation by growing, machining, and polishing, diffusion, microlithography, etching and cleaning, Printed circuit boards, types- single sided, double sided, multi layer and flexible printed circuit board, design, materials, manufacturing, inspection.

**UNIT II COMPONENTS AND PACKAGING 9**

Introduction to packaging, types-Through hole technology(THT) and Surface mount technology(SMT), Through hole components – axial, radial, multi leaded, odd form. Surface-mount components- active, passive. Interconnections - chip to lead interconnection, die bonding, wire bonding, TAB, flip chip, chip on board, multi chip module, direct chip array module, leaded, leadless, area array and embedded packaging, miniaturization and trends.

**UNIT III SURFACE MOUNT TECHNOLOGY PROCESS 12**

Introduction to the SMT Process, SMT equipment and material handling systems, handling of components and assemblies - moisture sensitivity and ESD, safety and precautions needed, IPC and other standards, stencil printing process - solder paste material, storage and handling, stencils and squeegees, process parameters, quality control. Component placement- equipment type, flexibility, accuracy of placement, throughput, packaging of components for automated assembly, Cp and Cpk and process control. soldering- reflow process, process parameters, profile generation and control, solder joint metallurgy, adhesive, underfill and encapsulation process - applications, materials, storage and handling, process and parameters.

**UNIT IV INSPECTION AND TESTING 9**

Inspection techniques, equipment and principle - AOI, X-ray. Defects and Corrective action - stencil printing process, component placement process, reflow soldering process, underfill and encapsulation process, electrical testing of PCB assemblies- In circuit test, functional testing, fixtures and jigs.

**UNIT V REPAIR, REWORK, QUALITY AND RELIABILITY OF ELECTRONICS ASSEMBLIES 7**

Repair tools, methods, rework criteria and process, thermo-mechanical effects and thermal management, Reliability fundamentals, reliability testing, failure analysis, design for manufacturability, assembly, reworkability, testing, reliability, and environment.

**TOTAL: 45 PERIODS**

**TEXT BOOKS:**


1. Surface Mount Technology –Principles and practice by Ray Prasad – second edition , Chapman and Hall ,1997 ,New York , ISBN 0-41-12921-3
2. Fundamentals of microsystem packaging by Rao.R .Tummala, Mc -Graw Hill 2001 , ISBN 00-71-37169-9


**REFERENCES:**


1. Failure Modes and Mechanisms in Electronic Packages, Puligandla Viswanadham and Pratap Singh, Chapman and Hall, New York , N.Y. ISBN 0-412-105591-8
2. Area Array Interconnection Handbook, Paul Totta and Karl Puttlitz, and Kathleen Stalter , Kluwer Academic Publishers, Norwell, MA, USA, 2001. ISBN 0-7923-7919-5.
3. Reflow Soldering Process and Trouble Shooting SMT,BGA,CSP and Flip Chip
4. Technologies by Ning-Cheng Lee,Elsevier Science, ISBN 0-7506-7218-8.
5. Surface Mount Technology Terms and Concepts by Zarrow , Phil, Elsevier Science and Technology,1997.ISBN 0750698756
6. Electronic Packaging and Interconnection Handbook, by C.A.Harper, Second Edition, McGraw Hill Inc., New York, N.Y.,1997,ISBN 0-07-026694-8

7.. www.ipc.org

8. www.smta.org

**MF9402 FLEXIBLE MANUFACTUIRNG SYSTEMS L T P C**
**3 0 0 3**

**AIM:**
To impart knowledge on group technology, simulation, computer control, automatic manufacturing systems and factory of the future.

**OBJECTIVE:**
At the end of this course the student should be able to understand
- Modern manufacturing systems
- To understand the concepts and applications of flexible manufacturing systems

**UNIT I PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS 9**
Introduction to FMS - scope – types – benefits – major elements – Types of flexibility – FMS application and flexibility - optimization – Single product, N – product, single batch, N – Batch scheduling problem –Knowledge based scheduling system.

**UNIT II COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLE MANUFACTURING SYSTEMS 9**
Introduction – Composition of FMS – Hierarchy of computer control – Computer control of work center and assembly lines – FMS supervising computer control - Types of software specification and selection – trends.

**UNIT III FMS SIMULATION AND DATA BASE 9**
Application of simulation–model of FMS–simulation software – limitation – manufacturing data systems–data flow–FMS database systems–planning for FMS database.

**UNIT IV GROUP TECHNOLOGY AND JUSTIFICATION OF FMS 9**
Introduction - matrix formulation – Mathematical Programming formulation – Graph Formulation – Knowledge based system for group technology - Application of possibility distributions in FMS systems justification.

**UNIT V APPLICATIONS OF FMS AND FACTORY OF THE FUTURE 9**
FMS application in aerospace machining sheet metal fabrication, prismatic component production - FMS development towards factories of the future – Artificial intelligence and Expert systems in FMS – Design Philosophy and Characteristics for Future.

**TOTAL:45 PERIODS**

**TEXT BOOK :**

1. Jha, N.K. “Handbook of Flexible Manufacturing Systems ", Academic Press Inc., 1991.

**REFERENCES :**

1. Radhakrishnan P. and Subramanyan S., “CAD / CAM / CIM ", Wiley Eastern Ltd., New Age International Ltd., 1994.
2. Raouf, A. and Ben-Daya, M., Editors, “Flexible manufacturing systems: recent development”, Elsevier Science, 1995.
3. Groover M.P., “Automation, Production Systems and Computer Integrated Manufacturing ", Prentice-Hall of India Pvt. Ltd., New Delhi, 1996.
4. Kalpakjian, “Manufacturing Engineering and Technology ", Addison-Wesley Publishing Co., 1995.
5. Taiichi Ohno, Toyota, “Production System Beyond Large-Scale production ", Productivity Press (India) Pvt. Ltd., 1992.

**MG9071 MARKETING MANAGEMENT L T P C**
**3 0 0 3**

**OBJECTIVE:**
To introduce the basic concepts of marketing, product pricing, marketing planning and sales promotion.

**UNIT I CONCEPTS IN MARKETING 9**
Definition, Marketing Process, Dynamics, Needs, Wants and Demands, Marketing Concepts, Environemnt, Mix, Types, Philosophies, Selling vs Marketing, Consumer Goods, Industrial Goods, Product, Hierarchy.

**UNIT II BUYING BEHAVIOUR AND MARKET SEGMENTATION 9**
Cultural, Demographic factors, Motives, Types, Buying Decisions, Segmentation factors, Demographic, Psycho graphic and Geographic Segmentation, Process, Patterns.

**UNIT III PRODUCT PRICING AND MARKETING RESEARCH 9**
Objectives, Pricing, Decisions and Pricing Methods, Pricing Management, Introduction, Uses, Process of Marketing Research.

**UNIT IV MARKETING PLANNING AND STRATEGY FORMULATION 9**
Components of a Marketing Plan, Strategy Formulation and the Marketing Process, Implementation, Portfolio Analysis, BCG, GEC Grids.

**UNIT V ADVERTISING, SALES PROMOTION & DISTRIBUTION 9**
Characteristics, Impact, Goals, Types, Sales Promotion – Point of purchase, Unique Selling Propositions, Characteristics, Wholesaling, Retailing, Channel Design, Logistics, Modern Trends in Retailing.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**


1. Govindarajan, M., “Modern Marketing Management”, Narosa Publishing House, New Delhi 1999.
2. Green Paul, E. and Donald Tull, “Research for Marketing Decisions”, 1975.
3. Ramaswamy, V.S. and S.Namakumari, “Marketing Environment Planning, Implementation and control the Indian Context”, 1990.


**REFERENCE :**


1. Philip Kotler, “Marketing Management – Analysis Planning Implementation and Control”.


**MG9072 ENTREPRENEURSHIP DEVELOPMENT L T P C**
**3 0 0 3**

**OBJECTIVE**
Study of this subject provides an understanding of the scope of an entrepreneur, key areas of development, financial assistance by the institutions, methods of taxation and tax benefits, etc.

**UNIT I ENTREPRENEURSHIP 9**
Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship in Economic Growth, Factors Affecting Entrepreneurial Growth.

**UNIT II MOTIVATION 9**

Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self Rating, Business Game, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

**UNIT III BUSINESS 9**

Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

**UNIT IV FINANCING AND ACCOUNTING 9**

Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT / CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

**UNIT V SUPPORT TO ENTREPRENEURS 9**

Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

**TOTAL : 45 PERIODS**

**TEXT BOOKS:**


1. S.S.Khanka "Entrepreneurial Development" S.Chand & Co. Ltd. Ram Nagar New Delhi, 1999.
2. Kurahko & Hodgetts, " Enterprenuership – Theory, process and practices", Thomson learning 6th edition.


**REFERENCES:**


1. Hisrich R D and Peters M P, "Entrepreneurship" 5th Edition Tata McGraw-Hill, 2002.
2. Mathew J Manimala," Enterprenuership theory at cross roads: paradigms and praxis" Dream tech 2nd edition 2006.
3. Rabindra N. Kanungo "Entrepreneurship and innovation", Sage Publications, New Delhi, 1998.
4. EDII " Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development" Institute of India, Ahmadabad, 1986.


**MA9262 NUMERICAL METHODS L T P C**
**3 1 0 4**

**UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS (10 +3)**

Solution of algebraic and transcendental equations - Fixed point iteration method – Newton-Raphson method- Solution of linear system of equations - Gauss Elimination method – Pivoting - Gauss-Jordan methods – Iterative methods of Gauss-Jacobi and Gauss-Seidel - Matrix Inversion by Gauss-Jordan method - Eigenvalues of a matrix by Power method and by Jacobi's method.

**UNIT II INTERPOLATION AND APPROXIMATION (8 + 3)**

Interpolation with unequal intervals - Lagrange interpolation – Newton's divided

difference interpolation – Cubic Splines - Interpolation with equal intervals - Newton's forward and backward difference formulae.

**UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION (9 + 3)**

Approximation of derivatives using interpolation polynomials - Numerical integration using Trapezoidal, Simpson's 1/3 and Simpson's 3/8 rules – Romberg's method - Two point and three point Gaussian quadrature formulae – Evaluation of double integrals by Trapezoidal and Simpson's rules.

**UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS (9 + 3)**

Single step-methods - Taylor's series method - Euler's method - Modified Euler's method - Fourth order Runge-Kutta method for solving first and second order equations - Multi-step methods - Milne's and Adams-Bashforth predictor-corrector methods for solving first order equations.

**UNIT V BOUNDARY VALUE PROBLEMS IN ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS ( 9 + 3)**

Finite difference methods for solving two-point linear boundary value problems. Finite difference techniques for the solution of two dimensional Laplace's and Poisson's equations on rectangular domain – One dimensional heat-flow equation by explicit and implicit (Crank Nicholson) methods - One dimensional wave equation by explicit method.

**L = 45 T = 15 TOTAL :60 PERIODS**

**TEXT BOOKS:**


1. Grewal, B.S. and Grewal,J.S., " Numerical methods in Engineering and Science", 6th Edition, Khanna Publishers, New Delhi, 2004.
2. Sankara Rao, K. "Numerical methods for Scientists and Engineers', 3rd Edition Prentice Hall of India Private Ltd., New Delhi, 2007.


**REFERENCE BOOKS:**


1. Chapra, S. C and Canale, R. P. "Numerical Methods for Engineers", 5th Edition, Tata McGraw-Hill, New Delhi, 2007.
2. Gerald, C. F. and Wheatley, P. O., "Applied Numerical Analysis", 6th Edition, Pearson Education Asia, New Delhi, 2006.
3. Brian Bradie, "A friendly introduction to Numerical analysis", Pearson Education Asia, New Delhi, 2007.


**PT9071 PACKAGING MATERIALS & TECHNOLOGY L T P C**
**3 0 0 3**

**OBJECTIVE:**

To study the fundamentals of packaging, manufacturing process, packaging materials and package testing.

**UNIT I FUNDAMENTALS OF PACKAGING 6**

Definition, functions of packaging, types and selection of package, Packaging hazards, interaction of package and contents, materials and machine interface, Environmental and recycling considerations - life cycle assessment

Package Design - Fundamentals, factors influencing design, stages in package development,graphic design, Structural design – simulation softwares

**UNIT II PACKAGING MATERIALS 11**

Major Plastic packaging materials viz. Polyolefins, Polystyrene, Polyvinylchloride, Polyesters, Polyamides (Nylons), Polycarbonate and newer materials such as High Nitrile Polymers, Polyethylene Napthalate (PEN), Nanomaterials, biodegradable materials – properties and applications, recycling; Wood, Paper, Textile, Glass, Metals - Tin, Steel, aluminum, Labelling materials, Cushioning Materials – properties and areas of application.

**UNIT III CONVERSION TECHNOLOGY 12**

Extrusion – Blown film, cast film, sheet, multilayer film & sheet, Lamination, Injection moulding, Blow moulding, Thermoforming; Cartoning Machinery, Bottling, Can former, Form Fill and Seal machines, Corrugated box manufacturing machineries, Drums – types of drums, moulded pulp containers, Closures, Application of Robotics in packaging.

Surface treatment for printing, Printing processes – offset, flexo, gravure and pad printing

**UNIT IV SPECIALITY PACKAGING 9**

Aerosol packaging, Shrink and Stretch wrapping, Blister packaging, Anti-static packaging, Aseptic packaging, Active packaging, Modified Atmospheric Packaging, Ovenable package; Cosmetic packaging, Hardware packaging, Textile packaging, Food packaging; Child resistant and Health care packaging, Export packaging, Lidding, RFID in packaging.

**UNIT V TESTING 7**

Package Testing – Drop test, Impact test, Vibration Test, Stacking and Compression test, Packaging Materials Testing: Mechanical – Tensile, tear burst, impact, compression test, Elongation, barrier properties - WVTR test, Adhesion test, Optical – Gloss, haze and clarity; Chemical Resistance test – solvents and chemicals, solubility test, burning test, solvent retention; Hardness and corrosion test for metals; Clarity and brittleness test for glass.

**TOTAL:45 PERIODS**

**TEXT BOOKS:**


1. Aaron L.Brody & Kenneth S.Marsh, “Encyclopedia of Packaging Technology”,John Wiley Interscience Publication, II Edition, 1997.
2. F.A. Paine, “Fundamentals of Packaging”, Brookside Press Ltd., London, 1990.
3. A.S.Athayle, “Plastics in Flexible Packaging”, Multi-tech Publishing Co., First Edition, 1992.


**REFERENCES:**


1. Mark J.Kirwar, “Paper and Paperboard Packaging Technology”, Blackwell Publishing, 2005
2. “Handbook of Package Design Research”, Water stem Wiley Intrascience, 1981.
3. Paine, “Packaging Development”, PIRA International, 1990.
4. Arthur Hirsch, “Flexible Food Packaging”, Van Nostor and Reinhold, New York, 1991.
5. E.P.Danger, “Selecting Colour for Packaging”, Grover Technical Press, 1987.
6. Susan E.M.Salke & et al, Plastics Packaging, Hansar, 2nd edition 2004.
7. Bill Stewart, “Packaging Design Strategies”, Pira International Ltd, 2nd Edition 2004.
8. Gunilla Johnson, “Corrugated Board Packaging”, PIRA International, 1993.

**GE9021 PROFESSIONAL ETHICS IN ENGINEERING L T P C**
**3 0 0 3**

**AIM:**

To sensitize the engineering students on blending both technical and ethical responsibilities.

**OBJECTIVES:**

- Identify the core values that shape the ethical behavior of an engineer.
- Utilize opportunities to explore one's own values in ethical issues.
- Become aware of ethical concerns and conflicts.
- Enhance familiarity with codes of conduct.
- Increase the ability to recognize and resolve ethical dilemmas.

**UNIT I ENGINEERING ETHICS 9**

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories

**UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9**

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

**UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9**

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal

**UNIT IV RESPONSIBILITIES AND RIGHTS 9**

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

**UNIT V GLOBAL ISSUES 9**

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

**TOTAL : 45 PERIODS**

**TEXT BOOKS :**


1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York (2005).
2. Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thompson Learning, (2000).


**REFERENCES :**


1. Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, (1999).
2. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, (2003)
3. Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, (2001)
4. Prof. (Col) P S Bajaj and Dr. Raj Agrawal, "Business Ethics – An Indian Perspective", Biztantra, New Delhi, (2004)
5. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford

University Press, (2003)

**GE9023 FUNDAMENTALS OF NANOSCIENCE L T P C**
**3 0 0 3**

**AIM:**

To make the students understand the importance ,relevance and potentialities of this emerging field of study.

**OBJECTIVES:**

- Study the basic nano technology and nano science.
- Understand interdisciplinary nature of this field.
- Understand the important role of physics, chemistry ,biology.
- Recognize that the rules of nano science are fundamentally different than those we experience.
- Study the basic fabrication strategies of nano science.

**UNIT I INTRODUCTION 10**

Nanoscale Science and Technology- Implications for Physics, Chemistry, Biology and Engineering-Classifications of nanostructured materials- nano particles-quantum dots, nanowires-ultra-thinfilms-multilayered materials. Length Scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal properties. Introduction to properties and motivation for study (qualitative only).

**UNIT II PREPARATION METHODS 10**

Bottom-up Synthesis-Top-down Approach: Precipitation, Mechanical Milling, Colloidal routes, Self-assembly, Vapour phase deposition, MOCVD, Sputtering, Evaporation, Molecular Beam Epitaxy, Atomic Layer Epitaxy, MOMBE.

**UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 5**

Introduction to optical/UV electron beam and X-ray Lithography systems and processes, Wet etching, dry (Plasma /reactive ion) etching, Etch resists-dip pen lithography

**UNIT IV PREPARATION ENVIRONMENTS 10**

Clean rooms: specifications and design, air and water purity, requirements for particular processes, Vibration free environments: Services and facilities required. Working practices, sample cleaning, Chemical purification, chemical and biological contamination, Safety issues, flammable and toxic hazards, biohazards.

**UNIT V CHARECTERISATION TECHNIQUES 10**

X-ray diffraction technique, Scanning Electron Microscopy - environmental techniques, Transmission Electron Microscopy including high-resolution imaging, Surface Analysis techniques- AFM, SPM, STM, SNOM, ESCA, SIMS-Nanoindentation

**TOTAL:45 PERIODS**

**TEXT BOOKS:**

1. A.S. Edelstein and R.C. Cammearata, eds., “Nanomaterials: Synthesis, Properties and Applications”, Institute of Physics Publishing, Bristol and Philadelphia, 1996.
2. N John Dinardo, “Nanoscale charecterisation of surfaces & Interfaces”, 2nd Edition, Weinheim Cambridge, Wiley-VCH, 2000

**REFERENCES:**

1. G Timp (Editor), “Nanotechnology”, AIP press/Springer, 1999

2. Akhlesh Lakhtakia (Editor), “The Hand Book of Nano Technology,Nanometer Structure”, Theory, Modeling and Simulations”, Prentice-Hall of India (P) Ltd, New Delhi, 2007.