VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
SCHEME OF TEACHING AND EXAMINATION

III SEMESTER Mechatronics

Sl. No	Sub Code	Title	Teaching Dept.	Teaching hrs/ Week		Examination			
				Theory	Pract	Duration	I.A. Marks	Theory / Pract	Total Marks
1	06 MAT 31	Engg. Mathematics III	Maths	04	__	3	25	100	125
2	06 MT 32	Material Science & Metallurgy	ME	04	__	3	25	100	125
3	06 MT 33	Mechanics of Materials	ME	04	__	3	25	100	125
4	06 MT 34	Fluid Mechanics	ME	04	__	3	25	100	125
5	06 MT 35	Analog & Digital Electronics	EC	04	__	3	25	100	125
6	06 MT 36	Signals & Systems	EC	04	__	3	25	100	125
7	06 MT 37	Material Testing& Metallurgy Lab	ME	__	3	3	25	50	75
8	06 MT 38	Analog & Digital Electronics lab	EC	__	3	3	25	50	75
TOTAL				24	6	24	200	700	900

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
SCHEME OF TEACHING AND EXAMINATION

IV SEMESTER Mechatronics

Sl. No	Sub Code	Title	Teaching Dept.	Teaching hrs/ Week		Examination			
				Theory	Pract	Duration	I.A. Marks	Theory / Pract	Total Marks
1	06 MAT 41	Engg. Mathematics IV	Maths	04	__	3	25	100	125
2	06 MT 42	Manufacturing Technology	ME	04	__	3	25	100	125
3	06 MT 43	Kinematics of Machinery	ME	04	__	3	25	100	125
4	06 MT 44	Power Electronics	EC	04	__	3	25	100	125
5	06 MT 45	Instrumentation & Measurements	EC	04	__	3	25	100	125
6	06 MT 46	Electrical Machines and Drives	EE	04	----	3	25	100	125
7	06 MT 47	Power Electronics Lab	EC	__	3	3	25	50	75
8	06 MT 48	Electrical Machines and Drives Lab	EE	__	3	3	25	50	75
TOTAL				24	6	24	200	700	900

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
SCHEME OF TEACHING AND EXAMINATION

V SEMESTER Mechatronics

Sl. N o	Sub Code	Title	Teaching Dept.	Teaching hrs/ Week		Examination			
				Theory	Pract	Duration	I.A. Marks	Theory / Pract	Total Marks
1	06 MT 51	Metrology and Measurements	ME	04	__	3	25	100	125
2	06 MT 52	Computer Graphics	ME	04	__	3	25	100	125
3	06 MT 53	Hydraulics & Pneumatics	ME	04	__	3	25	100	125
4	06 MT 54	Microcontroller	EC	04	__	3	25	100	125
5	06 MT 55	Automotive Electronics	EC	04	__	3	25	100	125
6	06 MT 56	Sensors & Network	EC	04	----	3	25	100	125
7	06 MT 57	Metrology & measurements Lab	ME	__	3	3	25	50	75
8	06 MT 58	Microcontroller & PLC Lab	EC	__	3	3	25	50	75
TOTAL				24	6	24	200	700	900

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELGAUM
SCHEME OF TEACHING AND EXAMINATION

VI SEMESTER Mechatronics

Sl. N o	Sub Code	Title	Teaching Dept.	Teaching hrs/ Week		Examination			
				Theory	Pract	Duration	I.A. Marks	Theory / Pract	Total Marks
1	06 AL61	Management & Entrepreneurship	ME	04	__	3	25	100	125
2	06 MT 62	Modeling & Simulation	ME	04	__	3	25	100	125
3	06 MT 63	Micro and Smart Systems Technology	ME	04	__	3	25	100	125
4	06 MT 64	Embedded Systems	EC	04	__	3	25	100	125
5	06 MT 65	Advanced Computer Programming	EC	04	__	3	25	100	125
6	06 MT 66X	Elective I	EC	04	__	3	25	100	125
7	06 MT 67	Micro and Smart Systems Technology Lab	ME	__	3	3	25	50	75
8	06 MT68	Advanced Computer Programming Lab	EC	__	3	3	25	50	75
TOTAL				24	6	24	200	700	900

ELECTIVE - I

06MT661 – Computer Vision
06MT662 – Operating Systems
06MT663 – Electrical/Hybrid Vehicles
06MT664 – PLC
06MT665 – Communication System

Sl. No	Sub Code	Title	Teaching Dept.	Teaching hrs/ Week		Examination			
				Theory	Pract	Duration	I.A. Marks	Theory / Pract	Total Marks
1	06 MT 71	Thermodynamics & Heat Transfer	ME	04	__	3	25	100	125
2	06 MT 72	Robotics & Machine Vision Systems	ME	04	__	3	25	100	125
3	06 MT 73	Wireless Networks	EC	04	__	3	25	100	125
4	06 MT 74	Digital Signal Processing	EC	04	__	3	25	100	125
5	06 MT 75X	Elective – II	ME	04	__	3	25	100	125
6	06 MT 76X	Elective – III	EC	04	__	3	25	100	125
7	06 MT L77	Robotics Lab	ME	__	3	3	25	50	75
8	06 MT 78	DSP (HW + MAT Lab)	EC	__	3	3	25	50	75
TOTAL				24	6	24	200	700	900

ELECTIVE – II

06MT751 – Smart Materials
06MT752 – MIS
06MT753 – Artifical Intelligence
06MT754 – Mechanical Vibrations
06MT755 – Operation Research

ELECTIVE – III

06MT761 – Real Time systems
06MT762 – Image Processing
06MT763 – Display Systems
06MT764 – Soft Computing
06MT765 – Safety and Security of Mechatronics Systems

VIII SEMESTER Mechatronics

Sl. No	Sub Code	Title	Teaching Dept.	Teaching hrs/ Week		Examination			
				Theory	Pract	Duration	I.A. Marks	Theory / Pract	Total Marks
1	06 MT 81	Rapid Prototyping	ME	04	__	3	25	100	125
2	06 MT 82	Reliability & Fault Tolerance	ME/EC	04	__	3	25	100	125
3	06 MT 83X	Elective IV	ME	04	__	3	25	100	125
4	06 MT 84X	Elective V	EC	04	__	3	25	100	125
5	06 MT85	Project Work			6	3	100	100	200
6	06 MT 86	Seminar on Current Topics		__	3	__	50	__	50
TOTAL				12	9	15	250	500	750

ELECTIVE – V

06MT831 – Nano Technology
06MT832 – DBMS
06MT833 – Design of Experiments
06MT834 – Finite Element Analysis
06MT835 – Industrial Engineering & Ergonomics

ELECTIVE - VI

06MT841 – Wireless Communication
06MT842 – Audio & Video Processing
06MT843 – Virtual Instrumentaion
06MT844 – DSP Architectures & Algorithms
06MT845 – Low Power RF

ENGINEERING MATHEMATICS – III

CODE: 10 MAT 31	**IA Marks: 25**
Hrs/Week: 04	**Exam Hrs: 03**
Total Hrs: 52	**Exam Marks:100**

PART-A

Unit-I: FOURIER SERIES

Convergence and divergence of infinite series of positive terms, definition and illustrative examples*
Periodic functions, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period, half range Fourier series. Complex form of Fourier Series. Practical harmonic analysis.   **[7 hours]**

Unit-II: FOURIER TRANSFORMS

Infinite Fourier transform, Fourier Sine and Cosine transforms, properties, Inverse transforms   **[6 hours]**

Unit-III: APPLICATIONS OF PDE

Various possible solutions of one dimensional wave and heat equations, two dimensional Laplace's equation by the method of separation of variables, Solution of all these equations with specified boundary conditions. D'Alembert's solution of one dimensional wave equation.

[6 hours]

Unit-IV: CURVE FITTING AND OPTIMIZATION
Curve fitting by the method of least squares- Fitting of curves of the form

$$y = ax+b, \quad y = a\,x^2 + b\,x + c, \; y = a\,e^{bx}, \; \mathrm{y} = ax^b$$

Optimization: Linear programming, mathematical formulation of linear programming problem (LPP), Graphical method and simplex method.
[7 hours]

PART-B

Unit-V: NUMERICAL METHODS - 1

Numerical Solution of algebraic and transcendental equations: Regula-falsi method, Newton - Raphson method. Iterative methods of solution of a system of equations: Gauss-seidel and Relaxation methods. Largest eigen value and the corresponding eigen vector by Rayleigh's power method.

Unit-VI: NUMERICAL METHODS – 2

Finite differences: Forward and backward differences, Newton's forward and backward interpolation formulae. Divided differences - Newton's divided difference formula, Lagrange's interpolation formula and inverse interpolation formula.

Numerical integration: Simpson's one-third, three-eighth and Weddle's rules (All formulae/rules without proof)

[7 hours]

Unit-VII: NUMERICAL METHODS – 3

Numerical solutions of PDE – finite difference approximation to derivatives, Numerical solution of two dimensional Laplace's equation, one dimensional heat and wave equations   **[7 hours]**

Unit-VIII: DIFFERENCE EQUATIONS AND Z-TRANSFORMS

Difference equations: Basic definition; Z-transforms – definition, standard Z-transforms, damping rule, shifting rule, initial value and final value theorems. Inverse Z-transform. Application of Z-transforms to solve difference equations.

[6 hours]

Note: * In the case of illustrative examples, questions are not to be set.

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Latest edition, Khanna Publishers
2. Erwin Kreyszig, Advanced Engineering Mathematics, Latest edition, Wiley Publications.

Reference Book:

1. B.V. Ramana, Higher Engineering Mathematics, Latest edition, Tata Mc. Graw Hill Publications.
2. Peter V. O'Neil, Engineering Mathematics, CENGAGE Learning India Pvt Ltd.Publishers

ENGINEERING MATHEMATICS – IV

CODE: 10 MAT 41   **IA Marks: 25**
Hrs/Week: 04   **Exam Hrs: 03**
Total Hrs: 52   **Exam Marks:100**

PART-A

Unit-I: NUMERICAL METHODS - 1

Numerical solution of ordinary differential equations of first order and first degree; Picard's method, Taylor's series method, modified Euler's method, Runge-kutta method of fourth-order. Milne's and Adams - Bashforth predictor and corrector methods (No derivations of formulae).

[6 hours]

Unit-II: NUMERICAL METHODS – 2

Numerical solution of simultaneous first order ordinary differential equations: Picard's method, Runge-Kutta method of fourth-order.
Numerical solution of second order ordinary differential equations: Picard's method, Runge-Kutta method and Milne's method.

[6 hours]

Unit-III: Complex variables – 1

Function of a complex variable, Analytic functions-Cauchy-Riemann equations in cartesian and polar forms. Properties of analytic functions.
Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines.

[7 hours]

Unit-IV: Complex variables – 2

Conformal Transformations: Bilinear Transformations. Discussion of Transformations: $w = z^2$, $w = e^z$, $w = z + (a^2 / z)$. Complex line integrals- Cauchy's theorem and Cauchy's integral formula.

[7 hours]

PART-B

Unit-V: SPECIAL FUNCTIONS

Solution of Laplace equation in cylindrical and spherical systems leading Bessel's and Legendre's differential equations, Series solution of Bessel's differential equation leading to Bessel function of first kind. Orthogonal property of Bessel functions. Series solution of Legendre's differential equation leading to Legendre polynomials, Rodrigue's formula.

[7 hours]

Unit-VI: PROBABILITY THEORY - 1

Probability of an event, empherical and axiomatic definition, probability associated with set theory, addition law, conditional probability, multiplication law, Baye's theorem.

[6 hours]

Unit-VII: PROBABILITY THEORY- 2

Random variables (discrete and continuous), probability density function, cumulative density function. Probability distributions – Binomial and Poisson distributions; Exponential and normal distributions.

[7 hours]

Unit-VIII: SAMPLING THEORY

Sampling, Sampling distributions, standard error, test of hypothesis for means, confidence limits for means, student's t-distribution. Chi -Square distribution as a test of goodness of fit

[6 hours]

Text Books:

1. B.S. Grewal, Higher Engineering Mathematics, Latest edition, Khanna Publishers
2. Erwin Kreyszig, Advanced Engineering Mathematics, Latest edition, Wiley Publications.

Reference Book:

1. B.V. Ramana, Higher Engineering Mathematics, Latest edition, Tata Mc. Graw Hill Publications.
2. Peter V. O'Neil, Engineering Mathematics, CENGAGE Learning India Pvt Ltd.Publishers

MATERIAL SCIENCE AND METALLURGY

Sub Code	: 06MT32	**IA Marks**	: 25
Hrs/week	: 04	**Exam Hours**	: 03
Total Lecture Hrs	: 52	**Exam Marks:**	100

PART - A

UNIT - 1

Crystal Structure: BCC, FCC and HCP Structures, coordination number and atomic packing factors, crystal imperfections -point line and surface imperfections. Atomic Diffusion: Phenomenon, Flick's laws of diffusion, factors affecting diffusion.

06 Hours

UNIT - 2

Mechanical Behaviour: Stress-strain diagram showing ductile and brittle behaviour of materials, linear and non linear elastic behaviour and properties, mechanical properties in plastic range, yield strength offset yield strength, dutility, ultimate tensile strength, toughness. Plastic deformation of single crystal by slip and twinning.

06 Hours

UNIT - 3

Fracture: Type I, Type II and Type III.

Creep: Description of the phenomenon with examples. three stages of creep, creep properties, stress relaxation.

Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and SN diagram.

07 Hours

UNIT - 4

Solidification: Mechanism of solidification, Homogenous and Hetrogeneous nucleation, crystal growth, cast metal structures.

Phase Diagram I: Solid solutions Hume Rothary rule substitional, and interstitial solid solutions, intermediate phases, Gibbs phase rule.

07 Hours

PART - B

UNIT - 5

Phase Diagram II: Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Iron carbon equilibrium diagram description of phases, solidification of steels and cast irons, invariant reactions.

06 Hours

UNIT - 6

Heat treating of metals: TTT curves, continous cooling curves, annealing and its types. normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flarne hardening and induction hardening, age hardening of aluminium-copper alloys.

07 Hours

UNIT - 7

Ferrous and non ferrous materials: Properties, Compostion and uses of
- Grey cast iron, malleable iron, S.G iron and steel
- Copper alloys-brasses and bronzes.
    Aluminium alloys-Al-Cu,Al-Si,Al-Zn alloys.

06 Hours

UNIT - 8

Composite Materials: Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP' sand MMC's advantages and application of composites.

07 Hours

TEXT BOOKS:

1. **Foundations of Materials Science and Engineering,** Smith, 3rd Edition McGraw Hill, 2009

2. **Materials Science, Shackleford., & M. K. Muralidhara,** Pearson Publication – 2007.

REFERENCE BOOKS:

1. **An introductionn to Metallurgy; Alan Cottrell**, University Press India Oriental Longman Pvt. Ltd., 1974.

2. **Engineering Materials Science**, W.C.Richards, PHI, 1965

3. **Physical Metallurgy**; Lakhtin, Mir Publications

4. **Materials Science and Engineering,** V.Raghavan , PHI, 2002

5. **Elements of Materials Science and Engineering,** H. VanVlack, Addison- Wesley Edn., 1998

6. **Materials Science and Engineering,**William D. Callister Jr., John Wiley & Sons. Inc, 5th Edition, 2001.

7. **The Science and Engineering of Materials,** Donald R. Askland and Pradeep.P. Phule, Thompson Learning, 4^{lh} Ed., 2003.

MECHANICS OF MATERIALS

Sub Code	**: 06MT33**	**IA Marks**	**: 25**
Hrs/week	**: 04**	**Exam Hours**	**: 03**
Total Lecture Hrs	**: 52**	**Exam Marks:**	**100**

PART-A

UNIT 1:

Simple Stress and Strain: Introduction, Stress, strain, mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain relation - behaviour in tension for Mild steel, cast iron and non ferrous metals. Extension / Shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self weight, Principle of super position.

07 Hours

UNIT 2:

Stress in Composite Section: Volumetric strain, expression for volumetric strain, elastic constants, simple shear stress, shear strain, temperature stresses (including compound bars).

06 Hours

UNIT 3:

Compound Stresses: Introduction, Plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress.

07 Hours

UNIT 4:

Energy Methods: Work and strain energy, Strain energy in bar/beams, castiglinios theorem, Energy methods.
Thick and Thin Cylinder Stresses in thin cylinders, changes in dimensions of cylinder (diameter,   length and volume). Thick cylinders Lame's equation (compound cylinders not included).

06 Hours

PART-B

UNIT 5:

Bending Moment and Shear Force in Beams: Introduction, Types of beams, loads and reactions, shear forces and bending moments, rate of loading, sign conventions, relationship between shear force and bending moments. Shear force and bending moment diagrams for different beams subjected to concentrated loads, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple for different types of beams.

07 Hours

UNIT 6:

Bending and Shear Stresses in Beams: Introduction, Theory of simple bending, assumptions in simple bending. Bending stress equation, relationship between bending stress,radius of curvature, relationship between bending moment and radius of curvature.Moment carrying capacity of a section.Shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections. (composite / flotched beams not included).

07 Hours

UNIT 7:

Deflection of Beams: Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple. Macaulay's method

06 Hours

UNIT 8:

Torsion of Circular Shafts and Elastic Stability of Columns: Introduction. Pure torsion,
assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts. Power transmitted by solid and hollow circular shafts
Columns: Euler's theory for axially loaded elastic long columns. Derivation of Euler's load for various end conditions, limitations of Euler's theory, Rankine's formula.

06 Hours

<u>**TEXT BOOKS:**</u>

1.**"Mechanics of Materials",** by R.C.Hibbeler, Printice Hall. Pearson Edu., 2005
2.**"Mechanics of materials",** James.M.Gere, Thomson, Fifth edition 2004.
3.**"Mechanics of materials",** in S.I. Units, Ferdinand Beer & Russell Johnstan, TATA Mc   GrawHill- 2003.

<u>**REFERENCE BOOKS:**</u>

1. **"Strength of Materials",** S.S. Rattan, Tata McGraw Hill, 2009
2. **"Strength of Materials",** S.S.Bhavikatti, Vikas publications House -1 Pvt. Ltd., 2nd Ed., 2006.
3. **"Mechanics of Materials",** K.V. Rao, G.C. Raju, First Edition, 2007
4. **"Engineering Mechanics of Solids**", Egor.P. Popov, Pearson Edu. India, 2nd, Edison, 1998.
5. **"Strength of Materials",** W.A. Nash, Sehaum's Outline Series, Fourth Edition-2007.

FLUID MECHANICS

Sub Code	: 06MT34	**IA Marks**	: 25
Hrs/week	: 04	**Exam Hours**	: 03
Total Lecture Hrs	: 52	**Exam Marks**	: 100

PART – A

UNIT-1

<u>Properties of Fluids:</u> Introduction, Properties of fluids, viscosity, thermodynamic properties, surface tension, capillarity, vapour pressure and cavitation

06 Hours

UNIT-2

<u>Fluid Statics</u> : Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple manometers and differential manometers. Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces, curved surface submerged in liquid.

07 Hours

UNIT-3

<u>Buoyancy and Fluid Kinematics:</u>
Buoyancy, center of buoyancy, metacentre and metacentric height, conditions of equilibrium of floating and submerged bodies, determination of Metacentric height experimentally and theoretically.
<u>Kinematics:</u> Types of fluid flow, continuity equation in 2D and 3D (Carversian Co-ordinates only, velocity and acceleration, velocity potential function and stream function.

07 Hours

UNIT-4

<u>Fluid Dynamics:</u> Introduction equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation.

06 Hours

PART-B

UNIT-5

<u>Fluid Flow Measurements</u> : Venturimeter, orificemeter, pitot-tube, vertical orifice, V-Notch and rectangular notches.
<u>Dimensional Analysis</u> : Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham π theorem, dimensionless numbers, similitude, types of similtudes.

07 Hours

UNIT-6

<u>Flow through pipes</u> : Minor losses through pipes. Darey's and Chezy's equation for loss of head due to friction in pipes. HGL andTEL.

06 Hours

UNIT-7

Laminar flow and viscous effects : Reyonold's number, critical Reynold's number, laminar flow through circular pipe-Hagen Poiseille's equation, laminar flow between parallel and stationary plates.

06 Hours

UNIT-8

Flow past immersed bodies : Drag, Lift, expression for lift and drag, boundary layer concept, displacement, momentum and energy thickness.
Introduction to compressible flow : Velocity of sound in a fluid, Mach nuber, Mach cone, propogation of pressure waves in a compressible fluid.

07 Hours

TEXT BOOKS:

1. Fluid Mechanics by Oijush.K.Kundu, IRAM COCHEN, ELSEVIER, 3rd Ed. 2005.

2. Fluid Mechancis by Dr. Bansal, R.K.Lakshmi Publications, 2004.

REFERENCE BOOKS:

1. Fluid Mechanics and hydraulics, Dr.Jagadishlal: Metropolitan Book Co-Ltd., 1997.

2. Fluid Mechanics (SI Units), Yunus A. Cingel John M.Oimbala. Tata MaGrawHill, 2006.

3. Fluid Mechanics by John F.Douglas, Janul and M.Gasiosek and john A.Swaffield, Pearson Education Asia, 5th ed., 2006

4. Fluid Mechanics and Fluid Power Engineering, Kumar.D.S, Kataria and Sons., 2004

5. Fluid Mechanics -. Merle C. Potter, Elaine P.Scott. Cengage learning

METALLOGRAPHY AND MATERIAL TESTING LABORATORY

Sub Code	**: 06 MT37**	**IA Marks**	**: 25**
Hrs/week	**: 03**	**Exam Hours**	**: 03**
Total Lecture Hrs	**: 48**	**Exam Marks**	**: 50**

PART – A

1. Preparation of specimen for Metallograpic examination of different engineering materials. Identification of microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.

2. Heat treatment: Annealing, normalizing, hardening and tempering of steel. Hardness studies of heat-treated samples.
3. To study the wear characteristics of ferrous, non-ferrous and composite materials for different parameters.
4. Non-destructive test experiments like,
    (a). Ultrasonic flaw detection
    (b). Magnetic crack detection
    (c). Dye penetration testing. To study the defects of Cast and   Welded   specimens

PART – B

1. Tensile, shear and compression tests of metallic and non metallic specimens using Universal Testing Machine
2. Torsion Test
3. Bending Test on metallic and nonmetallic specimens.
4. Izod and Charpy Tests on M.S,C.I Specimen.
5. Brinell, Rockwell and Vickers's Hardness test.
6. Fatigue Test.

Scheme of Examination:

ONE question from part -A: 20 Marks

ONE question from part -B: 20 Marks

Viva -Voice: 10 Marks

        Total: 50 Marks

MANUFACTURING TECHNOLOGY

Sub Code	: 06MT42	**IA Marks**	: 25
Hrs/week	: 04	**Exam Hours**	: 03
Total Lecture Hrs	: 52	**Exam Marks**	: 100

PART – A

UNIT - 1
Theory of Metal Cutting: Single point cutting tool nomenclature, geometry. Mechanics of Chip Formation,Types of Chips. Merchants circle diagram and analysis, Ernst Merchant's solution, shear angle relationship, problems of Merchant's analysis. Tool Wear and Tool failure, tool life. Effects of cutting parameters on tool life. Tool Failure Criteria, Taylor's Tool Life equation. Problems on tool life evaluation.

07 Hours.

UNIT - 2
Cutting Tool Materials: Desired properties and types of cutting tool materials – HSS, carbides coated carbides, ceramics. Cutting fluids. Desired properties, types and selection. Heat generation in metal cutting, factors affecting heat generation. Heat distribution in tool and workpiece and chip. Measurement of tool tip temperature.

06 Hours.

UNIT - 3
Turning (Lathe), Shaping and Planing Machines: Classification, constructional features of Turret and Capstan Lathe. Tool Layout, shaping Machine, Planing Machine, Driving mechanisms of lathe, shaping and planing machines, Different operations on lathe, shaping machine and planing machine. Simple problems on machinery time calculations

07 Hours.

UNIT - 4
Drilling machines: Classification, constructional features, drilling & related operations. Types of drill & drill bit nomenclature, drill materials.

06 Hours.

Milling machines: Classification, constructional features, milling cutters nomenclature, milling operations, up milling and down milling concepts. Various milling operations.
Indexing: Simple, compound, differential and angular indexing calculations. Simple problems on simple and compound indexing.

06 Hours.

PART – B

UNIT - 5
NC, CNC, DNC Technology: NC, CNC, DNC, modes, NC elements, advantages and limitations of NC, CNC.Introduction to NC machines- Principles of operation. Axes of NC machine-Coordinate systems.

6 Hours

UNIT - 6

Introduction to CNC machines: Basics of Turning tool Geometry, ATC, Programming methods. – Manual part programming, Milling, Turning, (Simple programs), Computer Aided part programming (simple problems)

6 Hours

UNIT - 7

DNC, Types, Applications, Types of CNC Programming Softwares, Over view CNC machining centers, Turning center,

6 Hours

UNIT - 8

Non-traditional machining processes: Need for non traditional machining, Principle, equipment & operation of Laser Beam, Plasma Arc Machining, Electro Chemical Machining, Ultrasonic Machining, Abrasive Jet Machining, Water Jet Machining, Electron Beam Machining, Electron Discharge Machining and Plasma Arc Machining.

08 Hours

TEXT BOOKS:

1. **NC Machine Programming and Software Design** – ChnoHwachang, Michel. A. Melkanoff, Prentice Hall, 1989.

2. **Manufacturing Technology**", Serope Kalpakjain, Steuen.R.Sechmid, Pearson Education Asia, 5th Ed. 2006.

REFERENCE BOOKS:

1. **"Process and Materials of Manufacturing**", Roy A Lindberg, 4th Ed. Pearson
   Edu. 2006.

2. **Workshop Technology,** Hazara Choudhry, Vol-II, Media Promoters & Publishers Pvt. Ltd. 2004

3. **Automation Production system and Computer Integrated Manufacturing**
   Mikell.O. Grover, PHI, New Delhi, 2002

4. **Production Technology,** HMT, Tata MacGraw Hill, 2001.

5. **Manufacturing Science**, Amitabha Ghosh and Mallik, affiliated East West Press, 2003.

6. **Fundamentals of Metal Machining and Machine Tools,** G. Boothroyd, McGraw Hill, 2000.

KINEMATICS OF MACHINES

Sub Code	: 06MT43	**IA Marks**	: 25
Hrs/week	: 04	**Exam Hours**	: 03
Total Lecture Hrs	: 52	**Exam Marks**	: 100

PART - A

UNIT 1:

Introduction: Definitions Link or element, kinematic pairs, Degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Structure, Mobility of Mechanism, Inversion, Machine.

Kinematic Chains and Inversions: Inversions of Four bar chain; Single slider crank chain and Double slider crank chain.

07 Hours

UNIT 2:

Mechanisms: Quick return motion mechanisms-Drag link mechanism, Whitworth mechanism and Crank and slotted lever Mechanism.

Straight line motion mechanisms Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms -Geneva wheel mechanism and Ratchet and Pawl mechanism. Toggle mechanism, Pantograph, Ackerman steering gear mechanism.

06 Hours

UNIT 3:

Velocity and Acceleration Analysis of Mechanisms (Analytical Methods): Analysis of four bar chain and slider crank chain using analytical expressions. (Use of complex algebra and vector algebra)

06 Hours

UNIT 4:

Cams: Types of cams, Types of followers. Displacement, Velocity and, Acceleration time curves for cam profiles. Disc cam with reciprocating follower having knife-edge, roller and flat-face follower, Disc cam with oscillating roller follower. Follower motions including SHM, Uniform velocity, uniform acceleration and retardation and Cycloidal motion.

07 Hours

PART B

UNIT 5:
FRICTION AND BELT DRIVES: Definitions: Types of Friction: Laws of friction, Friction in Pivot and Collar Bearings. Belt Drives: Flat Belt Drives, Ratio of Belt Tensions, Centrifugal Tension, Power Transmitted.

6 Hours

UNIT 6:

GYROSCOPE: Vectorial Representation of Angular Motion, Gyroscopic Couple. Effect of Gyroscopic Couple on Ship, Plane Disc, Aeroplane, Stability of Two Wheelers and Four Wheelers.

6 Hours

UNIT - 7

Spur Gears: Gear terminology, law of gearing, Characteristics of involute action, Path of contact. Arc of contact, Contact ratio of spur, helical, bevel and worm gears, Interference in involute gears. Methods of avoiding interference, Back lash. Comparison of involute and cycloidal teeth. Profile Modification.

07 Hours

UNIT - 8

Gear Trains: Simple gear trains, Compound gear trains for large speed. reduction, Epicyclic gear trains, Algebraic and tabular methods of finding velocity ratio of epicyclic gear trains. Tooth load and torque calculations in epicyclic gear trains.

07 Hours

<u>**TEXT BOOKS:**</u>

1. **Theory of Machines**: Sadhu Singh, Pearson Education, 2nd edition, 2007.
2. **Theory of Machines**: Rattan S.S. Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition, 2006.

<u>**REFERENCE BOOKS:**</u>

1. **Theory of Machines,** Thomas Bevan, CBS Publication 1984.
2. **Design of Machinery,** Robert L. Norton, McGraw Hill, 2001.
3. **Mechanisms and Dynamics of Machinery,** J. Srinivas, Scitech Publications, Chennai, 2002.

METROLOGY & MECHANICAL MEASUREMENTS

Sub Code	: 06MT51	IA Marks	: 25
Hrs/week	: 04	Exam Hours	: 03
Total Lecture Hrs	: 52	Exam Marks:	100

PART- A

UNIT-1:

Standards of measurement: Definition and Objectives of metrology, Standards of length-International prototype meter, Imperial standard yard, Wave length standard, subdivision of standards, line and end standard, calibration of end bars (Numerical), Slip gauges, Wringing phenomena, Indian Standards (M-81, M-12), Numerical problems on building of slip gauges.

06 Hours

UNIT-2:

System of Limits, Fits, Tolerance and Gauging: Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS919-1963), geometrical tolerance, positional-tolerances, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials.

07 Hours

UNIT-3:

Comparators and Angular measurement: Introduction to comparators, characteristics, classification of comparators, mechanical comparators-Johnson Mikrokator, sigma comparators, dial indicator, optical comparators-principles, Zeiss ultra optimeter, electric and electronic comparators-principles, LVDT, pneumatic comparators, back pressure gauges, solex comparators. Angular measurements, bevel protractor, sine principle and use of sine bars, sine centre, use of angle gauges (numericals on building of angles), clinometers.

07 Hours

UNIT-4:

Interferometer and screw thread, gear measurement: Interferometer, interferemetry, autocollimator. Optical flats. Terminology of screw threads, measurementof major diameter, minor diameter, pitch, angle and effective diameter of screw threadsby 2-wire and 3-wire methods, best size wire. Tool maker's microscope, gear to., terminology, use of gear tooth vernier caliper and micrometer.

06 Hours

PART-B

UNIT-5:
Measurements and measurement systems: Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysterisis, repeatability, linearity, loading effect, system response-times delay. Errors in measurement, classification of errors. Transducers, transfer efficiency, primary and secondary transducers, <u>electrical, mechanical, electronic</u> transducers, advantages of each type transducers.

07 Hours

UNIT-6:
Intermediate modifying and terminating devices: Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, ballast circuit, electronic amplifiers and telemetry. Terminating devices, mechanical, cathode ray oscilloscope, oscillographs, X-Y plotters.

06 Hours

UNIT-7:
Measurement of force, torque and pressure: Principle, analytical balance, platform balance, proving ring. Torque measurement, Prony brake, hydraulic dynamometer. Pressure measurements, principle, use of elastic merijbers, Bridgeman gauge, Mcloed gauge, Pirani gauge.

06 Hours

I
UNIT-8:
Temperature and strain measurement: Resistance thermometers, thermocouple, law of thermo couple, materials used for construction, pyrometer, optical pyrometer. Strain measurements, strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement.

07 Hours

TEXT BOOKS:
1. **Mechanical Measurements,** Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. **Engineering Metrology,** R.K. Jain, Khanna Publishers, 1994.

REFERENCE BOOKS:
1. **Engineering Metrology,** I.C. Gupta, Dhapat Rai Publications, Delhi.
2. **Mechanical Measurements,** R.K. Jain
3. **Industrial Instrumentation,** Alsutko, Jerry. D. Faulk, Thompson Asia Pvt. Ltd.2002.
4. **Measurement Systems Applications and Design,** Ernest O. Doblin, McGraw Hill Book Co.

COMPUTER GRAPHICS

Subject Code	:	**06MT52**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

PART - A

UNIT - 1
Scan Conversion and Clipping Representation of points, lines, Line Drawing Algorithms: DDA algorithm, Bresenham's integer line algorithm, Bresenham's circle algorithm, mid point line and circle, Polygon filling algorithms: scan conversion, seed filling, scan line algorithm. Viewing transformation, Clipping –points, lines, text, polygon, Cohen-Sutherland line clipping, Sutherland-Hodgmen algorithm.

07 Hours

UNIT - 2
Two Dimensional Transformations Representation of points, Transformations: Rotation, Reflection, Scaling, Combined Transformations, Translations and Homogeneous Coordinates, A geometric interpretation of homogeneous coordinates, Over all scaling, Points at infinity, rotation about an arbitrary point, Reflection through an arbitrary line.

06 Hours

UNIT - 3
Three Dimensional Transformations and Projections 3D Transformation matrix: general matrix, Translation, scaling, Shearing, Rotation, Reflection, Multiple transformations, Rotation about an axis parallel to coordinate axis, Rotation about an arbitrary axis in space, Reflection through an arbitrary plane, Orthographic, Parallel projection Transformations, one, Perspective projections- one point, two point and three point.

06 Hours

UNIT - 4
Plane and Space Curves Curve representation, Nonparametric curves, parametric curves, parametric representation and generation of line, circle, ellipse, parabola, hyperbola, generation of circle, ellipse, parabola, hyperbola, Cubic spline, normalized cubic splines, Bezier curves: blending function, properties, generation, B-spline curves- Cox-deBoor recursive formula,properties,open uniform basis functions, Non-uniform basis functions, periodic B-spline curve.

07 Hours

PART - B

UNIT - 5
Types and Mathematical Representation of Solids, Solid Models, Solid entities, Solid representation, Solid modeling- set theory, regularized set operations, set membership classification, Half spaces, Half spaces of plane, cylinder, sphere, conical half-space, Boundary representation, Constructive Solid Geometry- basic elements, Building operations.

07 Hours

UNIT - 6
VISUAL REALISM-I: Introduction, hidden line removal- visibility of object views, Visibility techniques: minimax test, containment test, surface test, Silhouttes, Homogeneity test, Sorting, Coherence, Hidden line priority algorithm, Hidden surface removal- Z-buffer algorithm, Warnock's algorithm, Hidden solid removal- ray tracing algorithm.

06 Hours

UNIT - 7
VISUAL REALISM-II: Shading, shading models- diffuse reflection, specular reflection, ambient light, Shading surfaces- constant shading, gourmand shading, Phong shading, Shading enhancements, Shading Solids- Ray tracing for CSG, z- buffer algorithm for B-rep and CSG, octree encoded objects, Colouring- RGB, CMY, HSV, HSL colour models.

07 Hours

UNIT - 8
COMPUTER ANIMATION: Introduction, Conventional animation-key frame, Inbetweening, Line testing, Painting, Filming, Computer animation- entertainment and engineering animation, Animation system hardware, software architecture, Animation types- frame buffer, colour table, zoom-pan-scroll, cross bar, real time play back, Animation techniques- key frame, skelton. Path of motion and p-curves.

06 Hours

<u>**TEXT BOOKS:**</u>

1 **CAD/CAM-Theory and Practice,** Ibraham Zeid, McGraw Hill, 2006

2 **Mathematical Elements for Computer Graphics**, Rogoer's Adams, McGraw Hill. 1990

<u>**REFERENCE BOOKS:**</u>

1. **Computer Graphics**, Xiang z, Plastock, R. A., Schaums outlines, McGraw Hill. 2007.

2. **Computer Graphics, principles and practice,** .Foley, Van- Damn, Finner and Hughes, Addison Wesley. 2000

3. **Computer Graphics,** Sinha A. N., Udai A. D., Tata McGraw Hill, 2008.

4. **Computer Graphics,** C Version- Doneld Heran, M. Pauline Baker, 2nd Edition, Pearson.

HYDRAULICS AND PNEUMATICS

Sub Code	: 06MT53	IA Marks	: 25
Hrs/Week	: 04	Exam Hours	: 03
Total Hrs	: 52	Exam Marks	: 100

PART - A

UNIT -1

Introduction to Hydraulic Power: Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law.

The source of Hydraulic Power: Pumps Classification pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics, pump Selection factors, problems on pumps.

07 Hours

UNIT -2

Hydraulic Actuators and Motors: Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, cushioning, special types of cylinders, problems on cylinders, construction and working of rotary actuators such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors).

06 Hours

UNIT - 3

Control Components in Hydraulic Systems: Classification of control valves, Directional Control Valves- Symbolic representation, constructional features of poppet, sliding spool, rotary type valves solenoid and pilot operated DCV, shuttle valve, check valves, Pressure control valves - types, direct operated types and pilot operated types. Flow Control Valves - compensated and non-compensated FCV, needle valve, temperature compensated, pressure compensated, pressure and temperature compensated FCV, symbolic representation.

07 Hours

UNIT - 4

Hydraulic Circuit Design And Analysis: Control of Single and Double Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Hydraulic circuit for force multiplication, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits.

06 Hours

PART – B

UNIT - 5

Maintenance of Hydraulic System: Hydraulic Oils - Desirable properties, general type of Fluids, Sealing Devices, Reservoir System, Filters and Strainers, wear of Moving Parts due to solid -particle Contamination, temperature control (heat exchangers), Pressure switches, trouble shooting.

06 Hours

UNIT - 6

Introduction to Pneumatic Control: Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System, fluid conditioners and FRL unit.

Pneumatic Actuators: Linear cylinder - Types, Conventional type of cylinder- working, End position cushioning, seals, mounting arrangements- Applications. Rod - Less cylinders types, working, advantages, Rotary cylinders- types construction and application, symbols.

07 Hours

UNIT-7

Pneumatic Control Valves: DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. 3Hrs Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders - supply air throttling and Exhaust air throttling and Exhaust air throttling.
Signal Processing Elements: Use of Logic gates - OR and AND gates in pneumatic applications. Practical Examples involving the use of logic gates, Pressure dependant controls- types - construction - practical applications, Time dependent controls principle. Construction, practical applications.

07 Hours

UNIT-8

Multi- Cylinder Application: Coordinated and sequential motion control, Motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves).
Electro- Pneumatic Control: Principles - signal input and out put, pilot assisted solenoid control of directional control valves, Use of relay and contactors. Control circuitry for simple signal cylinder application.

06 Hours

Compressed Air: Production of compressed air- Compressors Preparation of compressed air-Driers, Filters, Regulators, Lubricators, Distribution of compressed air - Piping layout.

TEXT BOOKS:

1. **"Fluid Power with Applications",** Anthony Esposito**,** Sixth edition, Pearson Education, Inc, 2000.

2. **'Pneumatics and Hydraulics',** Andrew Parr, Jaico Publilishing Co

REFERENCE BOOKS:

1. **'Oil Hydraulic systems', Principles and Maintenance** S. R. Majurr, Tata Mc Graw Hill Publishing Company Ltd. - 2001

2. **'Industrial Hydraulics', Pippenger, Hicks''** McGraw Hill, New York

3. **'Hydraulic & Pneumatic Power for Production'**, Harry L. Stewart

4. **'Pneumatic Systems',** S. R. Majumdar, Tata Mc Graw Hill Publish 1995

5. **Power Hydraulics'** Michael J Pinches & John G Ashby, Prentice Hall

METROLOGY AND MEASUREMENT LABORATORY

Subject Code	:	**06MT57**	IA Marks	:	25
No. of Practical Hrs./ Week	:	03	Exam Hours	:	03
Total No. of Practical Hrs.	:	42	Exam Marks	:	50

PART - A

1. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)
2. Balancing of rotating masses.
3. Determination of critical speed of a rotating shaft.
4. Determination of Fringe constant of Photoelastic material using.
   - a) Circular disc subjected to diametral compression.
   - b) Pure bending specimen (four point bending)
5. Determination of stress concentration using Photoelasticity for simple components like plate with a hole under tension or bending, circular disk with circular hole under compression, 2D Crane hook.

PART - B

6. Determination of equilibrium speed, sensitiveness, power and effort of Porter/Prowel /Hartnel Governor. (only one or more)
7. Determination of Pressure distribution in Journal bearing.
8. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes.
9. Determination of stresses in Curved beam using strain gauge.
10. Experiments on Gyroscope (Demonstration only)

Scheme of Examination:

One question from Part A	-	20 Marks (05 Write up +15)
One question from Part B	-	20 Marks (05 Write up +15)
Viva - Voce	-	10 Marks

Total:		**50 Marks**

MANAGEMENT AND ENTERPRENEURSHIP

Subject Code	**: 06AL51**	**IA Marks**	**: 25**
No. of Lecture Hrs./ Week	**: 04**	**Exam Hours**	**: 03**
Total No. of Lecture Hrs.	**: 52**	**Exam Marks**	**: 100**

PART – A

MANAGEMENT

UNIT - 1
MANAGEMENT: Introduction – Meaning – nature and characteristics of Management, Scope and Functional areas of management – Management as a science, art of profession – Management & Administration – Roles of Management, Levels of Management, Development of Management Thought
– early management approaches – Modern management approaches.

7 Hours

UNIT – 2

PLANNING: Nature, importance and purpose of planning process – Objectives – Types of plans (Meaning Only) – Decision making – Importance of planning – steps in planning & planning premises – Hierarchy
of plans.

6 Hours

UNIT – 3

ORGANIZING AND STAFFING : Nature and purpose of organization – Principles of organization – Types of organization – Departmentation – Committees- Centralization Vs Decentralization of authority and responsibility – Span of control – MBO and MBE (Meaning Only) Nature and importance of staffing–Process of Selection & Recruitment (in brief).

6 Hours

UNIT – 4

DIRECTING & CONTROLLING: Meaning and nature of directing – Leadership styles, Motivation Theories, Communication – Meaning and importance – coordination, meaning and importance and Techniques of Co – Ordination. Meaning and steps in controlling – Essentials of a sound control system – Methods of establishing control (in brief).

7 Hours

PART – B

ENTREPRENEURSHIP

UNIT – 5

ENTREPRENEUR: Meaning of Entrepreneur; Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Intrapreneur - an emerging Class. Concept of Entrepreneurship – Evolution of
Entrepreneurship, Development of Entrepreneurship; Stages in entrepreneurial process; Role of entrepreneurs in Economic Development; Entrepreneurship in India; Entrepreneurship – its Barriers.

6 Hours

UNIT – 6

SMALL SCALE INDUSTRIES: Definition; Characteristics; Need and rationale; Objectives; Scope; role of SSI in Economic Development. Advantages of SSI Steps to start and SSI – Government policy towards SSI; Different Policies of SSI; Government Support for SSI during 5 year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GATT Supporting Agencies of Government for SSI, Meaning, Nature of support; Objectives; Functions; Types of Help; Ancillary Industry and Tiny Industry (Definition Only)

7 Hours

UNIT – 7

INSTITUTIONAL SUPPORT: Different Schemes; TECKSOK; KIADB; KSSIDC; KSIMC; DIC Single Window Agency; SISI; NSIC; SIDBI; KSFC.

7 Hours

UNIT – 8

PREPARATION OF PROJECT: Meaning of Project; Project Identification; Project Selection; Project Report; Need and Significance of Report; Contents; Formulation; Guidelines by Planning Commission for
Project report; Network Analysis; Errors of Project Report; Project Appraisal. **Identification of business opportunities:** Market Feasibility Study; Technical Feasibility Study; Financial Feasibility Study & Social Feasibility Study.

7 Hours

TEXT BOOKS:

1. **Principles of Management** – P.C.Tripathi, P.N.Reddy – Tata McGraw Hill,
2. **Dynamics of Entrepreneurial Development & Management** – Vasant Desai – Himalaya Publishing House
3. **Entrepreneurship Development** – Poornima.M.Charantimath – Small Business Enterprises – Pearson Education – 2006 (2 & 4).

REFERENCE BOOKS:

1. **Management Fundamentals** – Concepts, Application, Skill Development – Robers Lusier – Thomson –
2. **Entrepreneurship Development** – S.S.Khanka – S.Chand & Co.
3. **Management** – Stephen Robbins – Pearson Education/PHI – 17th Edition, 2003.

MODELLING AND SIMULATION

Subject Code   : 06MT62   **l A Marks**   : 25

No. of Lecture Hrs./ Week   : 04   **Exam Hours :** 03

Total No. of Lecture Hrs.   : 52   **Exam Marks : 100**

UNIT I

System and System Environment: Component of a System – Continuous and discrete systems – Types of model; Steps in Simulation study; Simulation of an event occurrence using random number table – Single server queue –two server queue – inventory system.

7 Hours

UNIT 2

Random number generation: Properties of random numbers – Generation of Pseudo – random numbers – techniques of generating pseudo random numbers; Test for random numbers: the Chisquare test-the kolmogrov Smirnov test – Runs test – Gap test – poker test.

7 Hours

UNIT 3

Random – Variate Generation: Inverse transform technique for Exponential, Uniform, triangular, weibull, empirical, uniform and discrete distribution, Acceptance rejection method for Poisson and gamma distribution; Direct Transformation for normal distribution.

6 Hours

UNIT 4

Analysis of simulated Data – Data collection, identifying the distribution, Parameter estimation, goodness of fit tests, verification and validation of simulation models.

6 Hours

PART B

UNIT 5

Comparison and selection of GPSS, SIMSCRIPT, SLAM; Arena simulation languages: Development of simulation models using Arena simulation package for queuing system, Production system, inventory system, maintenance system.

6 Hours

TEXT BOOK

1.   Banks J., Carson J.S. and Nelson B.L., "Discrete – Event System Simulation", 3rd Edition, Pearson Education, Inc 2004 (ISBN 81-7808-505-4).

REFERENCES
1.   Geoffrey Gorden, "System Simulation", Prentice Hall of India, 2003.
2.   Narsingh Deo., "System Simulation with Digital Computer", Prentice Hall of India, 2003.

MICRO AND SMART SYSTEMS TECHNOLOGY

Subject Code	: 06MT63	**l A Marks** : 25
No. of Lecture Hrs./ Week	: 04	**Exam Hours :** 03
Total No. of Lecture Hrs.	: 52	**Exam Marks :** 100

PART - A

UNIT - 1

INTRODUCTION TO MICRO AND SMART SYSTEMS:
a) What are smart-material systems? Evolution of smart materials, structures and systems. Components of a smart system. Application areas. Commercial products.
b) What are microsystems? Feynman's vision. Micromachined transducers. Evolution of micro-manufacturing. Multi-disciplinary aspects. Applications areas. Commercial products.

5 Hours

UNIT - 2

MICRO AND SMART DEVICES AND SYSTEMS: PRINCIPLES AND MATERIALS:
a) Definitions and salient features of sensors, actuators, and systems. b) Sensors: silicon capacitive accelerometer, piezo-resistive pressure sensor, blood analyzer, conductometric gas sensor, fiber-optic gyroscope and surface-acoustic-wave based wireless strain sensor.
c) Actuators: silicon micro-mirror arrays, piezo-electric based inkjet printhead, electrostatic comb-drive and micromotor, magnetic micro relay, shapememory- alloy based actuator, electro-thermal actuator
d) Systems: micro gas turbine, portable clinical analyzer, active noise control in a helicopter cabin

8 Hours

UNIT - 3

MICROMANUFACTURING AND MATERIAL PROCESSING:
a) Silicon wafer processing, lithography, thin-film deposition, etching (wet and dry), wafer-bonding, and metallization.
b) Silicon micromachining: surface, bulk, moulding, bonding based process flows.
c) Thick-film processing:
d) Smart material processing:
e) Processing of other materials: ceramics, polymers and metals
f) Emerging trends

7 Hours

UNIT - 4

MODELING:

a) Scaling issues.
b) Elastic deformation and stress analysis of beams and plates. Residual stresses and stress gradients. Thermal loading. Heat transfer issues. Basic fluids issues.
c) Electrostatics. Coupled electromechanics. Electromagnetic actuation. Capillary electrophoresis. Piezoresistive modeling. Piezoelectric modeling. Magnetostrictive actuators.

6 Hours

PART - B

UNIT - 5

COMPUTER-AIDED SIMULATION AND DESIGN:
Background to the finite element element method. Coupled-domain simulations using Matlab. Commercial software.

8 Hours

UNIT - 6

ELECTRONICS, CIRCUITS AND CONTROL:
Carrier concentrations, semiconductor diodes, transistors, MOSFET amplifiers, operational amplifiers. Basic Op-Amp circuits. Charge-measuring circuits. Examples from microsystems. Transfer function, state-space modeling, stability, PID controllers, and model order reduction. Examples from smart systems and micromachined accelerometer or a thermal cycler.

8 Hours

UNIT - 7

**INTEGRATION AND PACKAGING OF MICROELECTRO
MECHANICAL SYSTEMS:**
Integration of microelectronics and micro devices at wafer and chip levels. Microelectronic packaging: wire and ball bonding, flip-chip. Lowtemperature- cofired-ceramic (LTCC) multi-chip-module technology.
Microsystem packaging examples.

6 Hours

UNIT - 8

CASE STUDIES:
BEL pressure sensor, thermal cycler for DNA amplification, and active vibration control of a beam.

TEXT BOOKS AND A CD-SUPPLEMENT:

1. A course-pack with matter taken from the following books including some newly written material. (This is until the textbook is ready. Chapter-wise resource material is indicated below.)
2. **MEMS & Microsystems: Design and Manufacture,** Tai-Ran Tsu, Tata Mc-Graw-Hill.

REFERENCE BOOKS:

1. **Animations of working principles, process flows and processing techniques, A CD-supplement with Matlab codes, photographs and movie clips of processing machinery and working devices.**
3. **Microsystems Design,** S. D. Senturia, 2001, Kluwer Academic Publishers, Boston, USA. ISBN 0-7923-7246-8.
4. **Analysis and Design Principles of MEMS Devices,** Minhang Bao, Elsevier, Amsterdam, The Netherlands, ISBN 0-444-51616-6.
5. **Design and Development Methodologies,** Smart Material Systems and MEMS: V. Varadan, K. J. Vinoy, S. Gopalakrishnan, Wiley.
6. **MEMS-** Nitaigour Premchand Mahalik, TMH 2007

MICRO AND SMART SYSTEMS TECHNOLOGY LABORATORY

Subject Code   **: 06MT67**   **l A Marks   : 25**
No. of Lecture Hrs./ Week   : 03   **Exam Hours : 03**
Total No. of Lecture Hrs.   : 42   **Exam Marks : 50**

PART A

a) CAD lab (coupled field simulation of electrostatic-elastic actuation with fluid effect)

b) BEL pressure sensor

c) Thermal-cycler for PCR

d) Active control of a cantilever beam

THERMODYNAMICS & HEAT TRANSFER

Sub Code   : 06MT71   IA Marks   : 25
Hrs/week   : 04   Exam Hours   : 03
Total Lecture Hrs : 52   Exam Marks: 100

PART-A
(THERMODYNAMICS)

UNIT - 1

Fndamental Concepts & Definitions: Thermodynamis; definition and scope, Microscopic and Macroscopic approaches. Engineering thermodynamics; definition, some practical applications of engineering thermodynamic. System (Closed system) and Control Volume (open system); Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive and extensive properties. Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic preesses; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics, Temperature; concepts, scales, measurement. Internal fixed points.

07 Hours

UNIT - 2

Work and Heat: Mechancis, defintion of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; at part of a system boundary, at whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention, what heat is not.

06 Hours

UNIT - 3

First Law of Thermodynamics: Joules expriments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, pure substance; definition, two-property rule, Specific heat at constant volume, enthalpy, specific heat constant pressure. Extension of the First law to control volume; steady state-steady flow energy equation, important applications, analysis of unsteady processes such as filmg and evacuation of vessels with and without heat transfer.

06 Hours

UNIT - 4

Second Law of Thermodynamics: Devices converting heat to work; (a) in a thermodynacmic cycle, (b) in a mechanical cycle. Thermal reservoir. Direct heat engine; schematic representation and efficiency. Devices converting work to heat in a theromodynamic cycle; reserved heat engine, schematic representation, coefficients of performace. Keivin - Planck statement of the Secnd law of Thermodynamics; PMM II and PMM I, Clasius statement of Second law of Thermodynamics,Equivalence of the two statements; Reversible and irrevesible processes; factors that make a process irreversible, reversible heat engines, Carnot cycle, Carnot principles. Thermodynamic temperature scale.

07 Hours

PART – B
(HEAT TRANSFER)

UNIT - 5
INTRODUCTORY CONCEPTS AND DEFINITIONS: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer; combined heat transfer mechanism. Boundry conditions of 1st, 2nd and 3rd Kind

CONDUCTION: Derivation of general three dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation). One dimensional conduction equations in rectangular, cylindrical and spherical coordinates for plane and composite walls. Overall heat transfer coefficient. Thermal contact resistance.

07 Hours

UNIT - 6
VARIABLE THERMAL CONDUCTIVITY: Derivation for heat flow and temperature distribution in plane wall. Critical thickness of insulation without heat generation, Thermal resistance concept & its importance. Heat transfer in extended surfaces of uniform cross-section without heat generation, Long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and effectiveness. Numerical problems.

06 Hours

UNIT - 7
CONCEPTS AND BASIC RELATIONS IN BOUNDARY LAYERS: Flow over a body velocity boundary layer; critical Reynolds number; general expressions for drag coefficient and drag force; thermal boundary layer; general expression for local heat transfer coefficient; Average heat transfer coefficient; Nusselt number. Flow inside a duct- velocity boundary layer, hydrodynamic entrance length and hydro dynamically developed flow; flow through tubes (internal flow discussion only). Numericals based on empirical relation given in data handbook.

FREE OR NATURAL CONVECTION: Application of dimensional analysis for free convection- physical significance of Grashoff number; use of correlations of free convection in vertical, horizontal and inclined flat plates, vertical and horizontal cylinders and spheres, Numerical problems.

07 Hours

UNIT - 8
RADIATION HEAT TRANSFER: Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle; Lambert's law; radiation heat exchange between two finite surfaces-configuration factor or view factor. Numerical problems.

06 Hours

TEXT BOOKS:

1. **Basic and Applied Thermodynamics,** P.K.Nag, Tata McGraw Hul Pub. 2002

2. **Heat & Mass transfer,** Tirumaleshwar, Pearson education 2006

REFERENCE BOOKS:

1. **Engineering Thermodynamics**, J.B.Jones and G.A.Hawkins, John Wiley and Sons..
2. **K.A.Venkatesh Basic Engineering Thermodynomics,** Thermodynomic data hand book by B.T. Nijaguna. (To be supplied in the examination)
3. **Thermodynamcis**, An Engineering Approach, Yunus A.Cenegal and Michael A.Boles, Tata McGraw Hill publications, 2002
4. **Heat transfer-A basic approach,** Ozisik, Tata Mc Graw Hill 2002
5. **Heat transfer,** P.K. Nag, Tata Mc Graw Hill 2002.
6. **Heat transfer, a practical approach,** Yunus A- Cengel Tata Mc Graw Hill

ROBOTICS & MACHINE VISION SYSTEM

Subject Code   : 06MT72   **IA Marks   : 25**
No. of Lecture Hrs.l Week : 04   **Exam Hours : 03**
Total No. of Lecture Hrs.   : 52   **Exam Marks : 100**

PART - A

UNIT - 1

Introduction and Mathematical Representation of Robots: History of Robots, Types of Robots, Notation, Position and Orientation of a Rigid Body, Some Properties of Rotation Matrices, Successive Rotations, Euler Angles For fixed frames X- Y -Z and moving frame ZYZ. Transformation between coordinate system, Homogeneous coordinates, Properties of A/BT, Types of Joints: Rotary, Prismatic joint, Cylindrical joint, Spherical joint, Representation of Links using Denvit - Hartenberg Parameters: Link parameters for intermediate, first and last links, Link transformation matrices, Transformation matrices of 3R manipulator, PUMA560 manipulator, SCARA manipulator   **07 Hours**

UNIT - 2

Kinematics of Serial Manipulators: Direct kinematics of 2R, 3R, RRP, RPR manipulator, puma560 manipulator, SCARA manipulator, Stanford arm, Inverse kinematics of 2R, 3R manipulator, puma560 manipulator.

06 Hours

UNIT - 3

Velocity and Static's of Manipulators: Differential relationships, Jacobian, Differential motions of a frame (translation and rotation), Linear and angular velocity of a rigid body, Linear and angular velocities of links in serial manipulators, 2R, 3R manipulators, Jacobian of serial manipulator, Velocity ellipse of 2R manipulator, Singularities of 2R manipulators, Statics of serial manipulators, Static force and torque analysis of 3R manipulator, Singularity in force domain.

07 Hours

UNIT - 4

Dynamics of Manipulators: Kinetic energy, Potential energy, Equation of motion using Lagrangian, Equation of motions of one and two degree freedom spring mass damper systems using Lagrangian formulation, Inertia of a link, Recursive formulation of Dynamics using Newton Euler equation, Equation of motion of 2R manipulator using Lagrangian Newton-Euler formulation.

06 Hours

PART-B

UNIT - 5

Trajectory Planning: Joint space schemes, cubic trajectory, Joint space schemes with via points, Cubic trajectory with a via point, Third order polynomial trajectory planning, Linear segments with parabolic blends, Cartesian space schemes, Cartesian straight line and circular motion planning

07 Hours

UNIT - 6

Control: Feedback control of a single link manipulator- first order, second order system, PID control, PID control of multi link manipulator, Force control of manipulator, force control of single mass, Partitioning a task for force and position control- lever, peg in hole Hybrid force and position controller.

08 Hours

UNIT - 7

Actuators: Types, Characteristics of actuating system: weight, power-to-weight ratio, operating pressure, stiffness vs. compliance, Use of reduction gears, comparision of hydraulic, electric, pneumatic actuators, Hydraulic actuators, proportional feedback control, Electric motors: DC motors, Reversible AC motors, Brushles DC motors, Stepper motors- structure and principle of operation, stepper motor speed-torque characteristics

06 Hours

UNIT - 8

Sensors: Sensor characteristics, Position sensors- potentiometers, Encoders, LVDT, Resolvers, Displacement sensor, Velocity sensor-encoders, tachometers, Acceleration sensors, Force and Pressure sensors piezoelectric, force sensing resistor, Torque sensors, Touch and tactile sensor, Proximity sensors-magnetic, optical, ultrasonic, inductive, capacitive, eddy-current proximity sensors.

05 Hours

TEXT BOOKS:

1. **Fundamental Concepts and Analysis,** Ghosal A., Robotics, Oxford,2006

2. **Introduction to Robotics Analysis, Systems, Applications**, Niku, S. B., Pearso Education, 2008

REFERENCE BOOKS:

1. **Introduction to Robotics: Mechanica and Control,** Craig, J. J., 2nd Edition, Addison-Welsey, 1989.

2. **Fundamentals of Robotics, Analysis and Control**, Schilling R. J., PHI, 2006

3. **Industrial Robotics –** Technology, Programming and Applications, M.P. Groover McGraw-Hill, USA, 1986.
4. **Machine Vision,** Ramesh Jam, Rangachari Kasturi, Brain G. Schunck, Tata McGraw-Hill, 1991.
5. **Robotics for Engineers,** Yoremkoren, McGraw-Hill, USA, 1987.
6. **Robotics and Image Processing,** P.A. Janaki Raman, Tata McGraw-Hill, 1991.

ROBOTICS & MACHINE VISION LABORATORY

Subject Code	**: 06MT77**	**IA Marks**	**: 25**
No. of Lecture Hrs.l Week	**: 03**	**Exam Hours**	**: 03**
Total No. of Lecture Hrs.	**: 42**	**Exam Marks**	**: 50**

LIST OF EXPERIMENTS

1. Study of different types of robots based on configuration and application.
2. Study of different type of links and joints used in robots
3. Study of components of robots with drive system and end effectors.
4. Determination of maximum and minimum position of links.
5. Verification of transformation (Position and orientation) with respect to gripper and world coordinate system
6. Estimation of accuracy, repeatability and resolution.
7. Robot programming exercises
   (Point-to-point and continuous path programming)

LIST OF EQUIPMENT

SL.No	Name of the Equipment/components	No. of Items
1	Any one type of robot configuration with at least five degree of freedom.	1 set
2	Robot programming software inclusive of computer system.	10 licenses
3	Models of different types of end effectors drive systems Links and Joints.	5 each
4	Models of different configuration robots	5 each

ELECTIVE - II
SMART MATERIALS

Subject Code	:	**06MT751**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

PART - A

UNIT - 1

INTRODUCTION: Characteristics of composites and ceramics materials, Dynamics and controls, concepts, Electro-magnetic materials and shape memory alloys-processing and characteristics

06 Hours

UNIT - 2

SENSING AND ACTUATION: Principals of electromagnetic, acoustics, chemical and mechanical sensing and actuation, Types of sensors and their applications, their compatibility writer conventional and advanced materials, signal processing, principals and characterization.

07 Hours

UNIT - 3

CONTROL DESIGN: Design of shape memory alloys, Types of MR fluids, Characteristics and application, principals of MR fluid value designs, Magnetic circuit design, MR Dampers, Design issues.

06 Hours

UNIT - 4

OPTICS AND ELECTROMAGNETIC: Principals of optical fiber technology, characteristics of active and adaptive optical system and components, design and manufacturing principles.

07 Hours

PART - B

UNIT - 5

STRUCTURES: Principles of drag and turbulence control through smart skins, applications in environment such as aerospace and transportation vehicles, manufacturing, repair and maintainability aspects.

07 Hours

UNIT - 6

Controls: Principles of structural acoustic control, distributed, amalog and digital feed back controls, Dimensional implications for structural control.

06 Hours

UNIT - 7

PRINCIPLES OF VIBRATION AND MODAL ANALYSIS: PZT Actuators, MEMS, Magnetic shape Memory Alloys, Characteristics and Applications.

07 Hours

UNIT - 8

INFORMATION PROCESSING: Neural Network, Data Processing, Data Visualisation and Reliability – Principals and Application domains.

06 Hours

TEST BOOKS:

1. **Analysis and Design',** A. V. Srinivasan, 'Smart Structures –Cambridge University Press, New York, 2001, (ISBN : 0521650267)

2. **'Smart Materials and Structures',** M V Gandhi and B S Thompson Chapmen & Hall, London, 1992 (ISBN : 0412370107)

REFERENCE BOOKS:

1. **'Smart Materials and Structures',** Banks HT, RC Smith, Y Wang, Massow S A, Paris 1996

2. **G P Gibss'Adaptive Structres',** Clark R L, W R Saunolers, Jhon Wiles and Sons, New York, 1998

3. **An introduction for scientists and Engineers',** Esic Udd, Optic Sensors : Jhon Wiley & Sons, New York, 1991 (ISBN : 0471830070)

MANAGEMENT INFORMATION SYSTEM

Subject Code	:	**06MT752**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

PART - A

UNIT - 1

The Information Age: An Overview: The purpose, data, information, and information systems and their types, ethical and societal issues, information systems in business functions, web empowered enterprises.

05 Hours

UNIT - 2

Strategic Uses of Information Systems: Strategies and Strategic moves, Achieving a competitive advantage, creating and maintaining strategic information systems, Business Functions and Supply Chains – effectivenss and efficiency, accounting, finance, engineering, supply chain management, Human resource management, Enterprise resource planning.

05 Hours

UNIT - 3

Information Technology: Business Hardware – components, classification of computers, output devices, storage media, and purchasing,, Business Software – programming languages and software development tools, language translation, compilers and interpreters, system software, open source software, software licensing, ethical issues,

08 Hours

UNIT - 4

Business Networks and Telecommunication: Telecommunication in Business and Daily Use, Bandwiths and Media, networks, protocols, internet networking services, Telecommuting – pros and cons, Future of Networking Technologies.

08 Hours

PART - B

UNIT - 5

Web Enabled Commerce: Web enabled enterprises – web business and technologies, web enabled business, Challenges of Global Information Systems – Multinational organizations, international commerce, ethical issues.

07 hours

UNIT - 6

Decision Support and Business intelligence: Decision support and expert systems – decision support and decision making process, structured and unstructured problems, decision support systems, expert systems, geographical systems, Business Intelligence and Knowledge Mangement – Date Mining and online analysis, knowledge management,

06 Hours

UNIT - 7

Planning, Acquisition, and Control: Systems Planning and Development –Planning Information sytems, systems development life cycle, agile methods, systems integration, ethical issues – IS professionals certification.

07 Hours

UNIT - 8

Choices in Systems Acquisition: Options and Priorities, outsourcing, licensing applications, software as a service, user application development, ethical issues-computer use policies for employees.

06 Hours

TEXT BOOK

1. **Management Information Systems**, Effy Oz, Cengage Learning, INDIA EDITION, 2009.

2. **Management Information Systems**, James A O'Brien, Irwin McGraw Hill, Fifth Edition.

REFERENCE BOOKS:

1. **Mangement Information Systems,** Laudon & Laudon, PHI 1998 Ed. ISBN 81-203-1282-1

2. **Managaement Information systems,** S.Sadagopan, Prentice Hall of India, 1998 Ed. ISBN 81-203-1180-9

3. **Information sytems for Modern managaement** G.R.Murdick PHI 2002.

ARTIFICIAL INTELLIGENCE

Subject Code	: **06MT753**	IA Marks	:	25
No. of Lecture Hrs./ Week	: 04	Exam Hours	:	03
Total No. of Lecture Hrs.	: 52	Exam Marks	:	100

PART - A

UNIT - 1
ARTIFICIAL INTELLIGENCE: Introduction, definition, underlying assumption, importance f A1, AI and related fields.

06 Hours

UNIT - 2
SPACE REPRESENTATION: Defining a problem. Production systems and its characteristics, Search and Control strategies – Generate and Test, Hill Climbing, Best – first Search, Problem reduction, Constraint Satisfaction, Means – Ends Analysis.

07 Hours

UNIT - 3
KNOWLEDGE REPRESENTATION ISSUES: Representations and Mappings, Types of knowledge – Procedural Vs Declarative, Logic programming. Forward Vs Backward reasoning, Matching.

07 Hours

UNIT - 4
USE OF PREDICATE LOGIC: Representing simple facts, Instance and Isa relationships, Syntax and Semantics for Prepositional logic, FQPL and properties of Wffs, Conversion to Clausal form, Resolution, Natural deduction.

06 Hours

PART - B

UNIT - 5
STATISTICAL AND PROBABILISTIC REASONING: Symbolic reasoning under uncertainty, Probability and Bayes' theorem, Certainity factors and Rule based systems, Bayesian Networks, Shafer Theory, Fuzzy Logic.

07 Hours

UNIT - 6
EXPERT SYSTEMS: Structure and uses, Representing and using domain knowledge, Expert System Shells. Pattern recognition Learning classification patterns, recognizing and understanding speech. Introduction to knowledge Acquisition, Types of Learning.

07 Hours

UNIT - 7
TYPICAL EXPERT SYSTEMS: MYCIN, Variants of MYCIN, PROSPECTOR, DENDRAL, PUFF, ETC.

06 Hours

UNIT - 8
INTRODUCTION TO MACHINE LEARNING: Perceptrons, Checker Playing Examples, Learning Automata, Genetic Algorithms, Intelligent Editors.
06 Hours

TEXT BOOKS:

1. **Artificial Intelligence,** Elaine Rich & Kevin Knight, M/H 1983.

2. **Introduction to AI & ES,** Dan W. Patterson, Prentice Hall of India, 1999.

REFERENCE BOOKS:

1. **Principles of Artificial Intelligence**, Springer Verlag, Berlin, 1981.

2. **Artificial Intelligence in business, Science & Industry**, Wendy B. Ranch

3. **A guide to expert systems,** Waterman, D.A., Addison – Wesley inc. 1986

4. **Building expert systems,** Hayes, Roth, Waterman, D.A. Addison – Wesley, 1983

MECHANICAL VIBRATIONS

Subject Code	**: 06ME754**	**I.A. Marks**	**: 25**
No. of Lecture Hrs./ Week	**: 04**	**Exam Hrs.**	**: 03**
Total No. of Lecture Hrs.	**: 52**	**Exam Marks: 100**	

PART- A

Unit - 1
Introduction: Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Work done by harmonic force, Principle of super position applied to SHM, Beats, Fourier theorem and problems.
06 Hours

Unit -2
Undamped (Single Degree of Freedom) Free Vibrations: Derivations for spring mass systems, Methods of Analysis, Natural frequencies of simple systems, Springs in series and parallel, Torsional and transverse vibrations, Effect of mass of spring and Problems.
07 Hours

Unit - 3
Damped free vibrations (1DOF): Types of damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.
06 Hours

Unit - 4
Forced Vibrations (1DOF): Introduction, Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Energy dissipated due to damping and Problems.
07 Hours

PART – B

Unit – 5
Vibration Measuring Instruments and Whirling of shafts: Seismic Instruments – Vibrometers, Accelerometer, Frequency measuring instruments and Problems. Whirling of shafts with and without damping, discussion of speeds above and below critical speeds and Problems.
06 Hours

Unit – 6
Systems with two degrees of Freedom: Principle modes of vibrations, Normal mode and natural frequencies of systems (without damping) – Simple spring mass systems, masses on tightly stretched strings, double pendulum, torsional systems, combined rectilinear and angular systems, geared systems and Problems. Undamped dynamic vibration absorber and Problems.
06 Hours

Unit - 7
Numerical Methods for multi degree freedom of systems: Introduction, Maxwell's reciprocal theorem, Influence coefficients, Rayleigh's method, Dunkerley's method, Stodola method, Holzer's method, Orthogonality of principal modes, method of matrix iteration and Problems.

09 Hours

Unit – 8
Modal analysis and Condition Monitoring: Signal analysis, dynamic testing of machines and structures, Experimental modal analysis, Machine condition monitoring and diagnosis**.**

05 Hours

TEXT BOOKS:

1. **Mechanical Vibrations,** S. S. Rao, Pearson Education Inc, 4th edition, 2003.

2. **Mechanical Vibrations,** V. P. Singh, Dhanpat Rai & Company, 3rd edition, 2006.

REFERENCE BOOKS:

1. **Theory of Vibration with Applications,** W. T. Thomson, M. D. Dahleh and C. Padmanabhan, Pearson Education Inc, 5th edition, 2008.

2. **Mechanical Vibrations:** S. Graham Kelly, Schaum's outline Series, Tata McGraw Hill, Special Indian Edition, 2007.

3. **Theory and Practice of Mechanical Vibrations:** J. S. Rao & K. Gupta, New Age International Publications, New Delhi, 2001.

4. **Mechanical Vibrations,** G. K.Grover, Nem Chand and Bros, 6th edition, 1996.

OPERATION RESEARCH

Subject Code	: **06MT755**	IA Marks	:	25
No. of Lecture Hrs./ Week	: 04	Exam Hours	:	03
Total No. of Lecture Hrs.	: 52	Exam Marks	:	100

PART- A

UNIT -1

INTRODUCTION: Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem-formulation and solution by graphical method.

04 Hours

UNIT -2

SOLUTION OF Linear Programming PROBLEMS: The simplex method-canonical and standard form of an LP problem, slack, surplus and artificial variables, big M method and concept of duality, dual simplex method.

08 Hours

UNIT -3

TRANSPORTATION PROBLEM: Formulation of transportation problem, types, initial basic feasible solution using different methods, optimal solution by MODI method, degeneracy in transportation problems, application of transportation problem concept for maximization cases. Assignment Problem-formulation, types, application to maximization cases and travelling salesman problem.

08 Hours

UNIT -4

INTEGER PROGRAMMING: Pure and mixed integer programming problems, solution of
Integer programming problems-Gomory's all integer cutting plane method and mixed integer method, branch and bound method, Zero-One programming.

06 Hours

PART- B

UNIT -5

PERT-CPM TECHNIQUES: Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.

08 Hours

UNIT -6

QUEUING THEORY: Queuing systems and their characteristics, Pure-birth and Pure-death models (only equations), empirical queuing models – M/M/1 and M/M/C models and their steady state performance analysis.

06 Hours

UNIT -7

GAME THEORY: Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games.

06 Hours

UNIT -8

SEQUENCING: Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule-'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method.

06 Hours

TEXT BOOKS

1. **Operations Research,** P K Gupta and D S Hira, Chand Publications, New Delhi - 2007
2. **Operations Research,** Taha H A, Pearson Education

REFERNCE BOOKS

1. **Operations Research,** A P Verma, S K Kataria &Sons, 2008
2. **Operations Research,** Paneerselvan, PHI
3. **Operations Research,** A M Natarajan, P Balasubramani, Pearson Education, 2005
4. **Introduction to Operations Research,** Hiller and Liberman, McGraw Hill
5. **Operations Research** S.D. Sharma, Ledarnath Ramanath & Co, 2002

RAPID PROTOTYPING

Subject Code	:	**06MT81**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

PART - A

UNIT - 1
INTRODUCTION: Need for the compression in product development, history of RP systems, Survey of applications, Growth of RP industry, and classification of RP systems.
STEREO LITHOGRAPHY SYSTEMS: Principle, Process parameter, Process details, Data preparation, data files and machine details, Application.
07 Hours

UNIT - 2
SELECTIVE LASER SINTERING: Type of machine, Principle of operation, process parameters, Data preparation for SLS, Applications.
FUSION DEPOSITION MODELLING: Principle, Process parameter, Path generation, Applications.
07 Hours

UNIT - 3
SOLID GROUND CURING: Principle of operation, Machine details, Applications. Laminated Object Manufacturing: Principle of operation, LOM materials. Process details, application.
06 Hours

UNIT - 4
CONCEPTS MODELERS: Principle, Thermal jet printer, Sander's model market, 3-D printer. Genisys Xs printer HP system 5, object Quadra systems.
06 Hours

PART - B

UNIT - 5
RAPID TOOLING: Indirect Rapid tooling, Silicone rubber tooling, Aluminum filled epoxy tooling, Spray metal tooling, Cast kirksite, 3Q keltool, etc. Direct Rapid Tooling Direct. AIM.
06 Hours

UNIT - 6
RAPID TOOLING: Quick cast process, Copper polyamide, Rapid Tool, DMILS, Prometal, Sand casting tooling, Laminate tooling soft Tooling vs. hard tooling.
06 Hours

UNIT - 7
SOFTWARE FOR RP: STL files, Overview of Solid view, magics, imics, magic communicator, etc. Internet based software, Collaboration tools.
06 Hours

UNIT - 8
RAPID MANUFACTURING PROCESS OPTIMIZATION: factors influencing accuracy. Data preparation errors, Part building errors, Error in finishing, influence of build orientation.

08 Hours

<u>**TEXT BOOKS:**</u>

1. **Stereo Lithography and other RP & M Technologies,** Paul F. Jacobs: SME, NY 1996.

2. **Rapid Manufacturing,** Flham D.T & Dinjoy S.S Verlog London 2001.

<u>**REFERENCE BOOKS:**</u>

1. **Rapid Prototyping,** Terry Wohlers Wohler's Report 2000" Wohler's Association 2000.

2. **Rapid Prototyping Materials,** Gurumurthi, IISc Bangalore.

3. **Rapid Automated,** Lament wood. Indus press New York

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ELECTIVE - IV
NANOTECHNOLOGY

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Subject Code	:	**06MT831**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

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PART - A

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UNIT - 1
AN OVERVIEW OF NANOSCIENCE & NANOTECHNOLOGY – historical background – nature, scope and content of the subject – multidisciplinary aspects – industrial, economic and societal implications.

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05 Hours

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UNIT - 2
EXPERIMENTAL TECHNIQUES AND METHODS for investigating and manipulating materials in the nano scale – electron microscope – scanning probe microscope – optical and other microscopes – light scattering – x-ray diffraction.

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07 Hours

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UNIT - 3
FULLERENES – discovery, synthesis and purification – chemistry of fullerenes in the condensed phase – orientational ordering – pressure effects – conductivity and superconductivity – ferromagnetism – optical properties.
Carbon Nanotubes – synthesis and purification – filling of nanotubes – mechanism of growth – electronic structure – transport properties – mechanical and physical properties – applications.

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07 Hours

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UNIT - 4
SELF-ASSEMBLED MONOLAYERS – monolayers on gold – growth process – phase transitions – patterning monolayers – mixed monolayers – applications.
GAS PHASE CLUSTERS – history of cluster science – formation and growth – detection and analysis – type and properties of clusters – bonding in clusters.

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07 Hours

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PART - B

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UNIT - 5
SEMICONDUCTOR QUANTUM DOTS – synthesis – electronic structure of nanocrystals – how quantum dots are studied – correlation of properties with size – uses.

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05 Hours

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UNIT - 6
MONOLAYER-PROTECTED METAL NANOPARTICLES – method of preparation–characterization – functionalized metal nanoparticles – applications – superlattices.
CORE-SHELL NANOPARTICLES – types – characterization – properties – applications.
NANOSHELLS – types – characterization – properties – applications.

<div align="right">

08 Hours

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UNIT - 7
NANOBIOLOGY – interaction between biomolecules and nanoparticle surfaces – materials used for synthesis of hybrid nano-bio assemblies – biological applications – nanoprobes for analytical applications – nanobiotechnology – future perspectives.
Nanosensors – what make them possible – nanoscale organization for sensors – characterization – nanosensors based on optical properties – nanosensors based on quantum size effects – electrochemical sensors – sensors based on physical properties – nanobiosensors – sensors of the future.
NANOMEDICINES – approach to development – nanotechnology in diagnostic and therapeutic applications.

08 Hours

UNIT - 8
MOLECULAR NANOMACHINES – covalent and non-covalent approaches – molecular motors and machines – other molecular devices – single molecular devices – practical problems involved.
NANOTRIBOLOGY – studying tribology on the nanoscale – applications.

05 Hours

TEXT BOOKS:

1. **NANO: The Essentials – Understanding Nanoscience and Nanotechnology;** T Pradeep (Professor, IIT Madras); Tata McGraw-Hill India (2007)

2. **Nanotechnology:** Richard Booker & Earl Boysen; Wiley (2005).

REFERENCE BOOKS:

1. **Introduction to Nanoscale Science and Technology [Series: Nanostructure Science and Technology],** Di Ventra, et al (Ed); Springer (2004)

2. **Nanotechnology Demystified,** Linda Williams & Wade Adams; McGraw-Hill (2007)

3. **Introduction to Nanotechnology,** Charles P Poole Jr, Frank J Owens, Wiley India Pvt. Ltd., New Delhi, 2007.

DATABASE MANAGEMENT SYSTEM

Subject Code	:	**06MT832**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

PART - A

UNIT - 1

DATABASE AND DATABASE USERS: Introduction, characteristics of database approach, intended uses of a DBMS, advantages and implementation of database approach.

06 Hours

UNIT - 2

DATABASE SYSTEMS CONCEPTS AND ARCHITECTURE: Data models, schemes and instances, DBMS architecture and data independence, database languages and interfaces, database system environment, classification of database management systems.

06 Hours

UNIT - 3

DATA MODELING: High level conceptual data models for database design. Entity types, entity sets, attributes and keys, Relationships, relationship types, roles and structural constraints. Weak entity types, ER diagram and design issue.

08 Hours

UNIT - 4

RECORD STORAGE AND PRIMARY FILE ORGANIZATIONS: Secondary storage devices, buffering of the blocks, placing file records on the disk, operations on files, heap files and sorted files, hashing techniques.

06 Hours

PART - B

UNIT - 5

RELATIONAL DATA MODEL AND RELATIONAL ALGEBRA: Brief discussion on code rules, relational model concepts, constraints and schemas. Update operation on relations, basic and additional relational algebra operations, queries in relational algebra.

07 Hours

UNIT - 6

STRUCTURAL QUERY LANGUAGE (SQL): Data definition etc., in SQL2. Basic and complex queries in SQL, Inser, Delete; Update statements, and views in SQKL, embedded SQL.

07 Hours

UNIT - 7

DATABASE DESIGN: Design guidelines for relational schemas, functional dependencies, normalization 1st, 2nd, 3rd, 4th and 5th; normal forms. Database design process, factors influencing physical database design guidelines, and guidelines for relational systems.

07 Hours

UNIT - 8
SYSTEM IMPLEMENTATION: System catalogue for RDBMSs, transaction processing, and system concepts, properties of transaction, brief discussion on concurrency control and recovery techniques, database security and authorization.

05 Hours

TEXT BOOKS:

1. **Fundamentals of Database Systems,** Ramez Elmasri and Shanmkanth B. Navathe, 3rd Edition, Addison Pearson.

2. **Database Management System,** Raghu Ramakrishnan, Tata Mc Graw Hill, 3rd Edn. 2002.

REFERENCE BOOKS:

1. **Database Management and Design,** Gray W.hansen and James V. Hansen, 2nd Edn. Printice Hall India Pvt. Ltd., 2002.

2. **Database Management Systems,** Designing and Building business applications by Gerald V. Post, 3rd Edition, Tata Mc Graw Hill Publishing company Ltd.,- 2005

3. **Project Mangment with PERT and CPM,** Moder Joseph J and Phillips cerel, R., VAN Noserand, Reinhold, 2nd Edn., 1976.

DESIGN OF EXPERIMENTS

Subject Code	:	**06MT833**	IA Marks	:	25
No. of Lecture Hrs./ Week	:	04	Exam Hours	:	03
Total No. of Lecture Hrs.	:	52	Exam Marks	:	100

PART - A

UNIT - 1
INTRODUCTION: Strategy of Experimentation, Typical applications of Experimental design, Basic Principles, Guidelines for Designing Experiments.

05 Hours

UNIT - 2
BASIC STATISTICAL CONCEPTS: Concepts of random variable, probability, density function cumulative distribution function. Sample and population, Measure of Central tendency; Mean median and mode, Measures of Variability, Concept of confidence level. Statistical Distributions: Normal, Log Normal & Weibull distributions. Hypothesis testing, Probability plots, choice of sample size. Illustration through Numerical examples.

07 Hours

UNIT - 3
EXPERIMENTAL DESIGN: Classical Experiments: Factorial Experiments: Terminology: factors, levels, interactions, treatment combination, randomization, Two-level experimental designs for two factors and three factors. Three-level experimental designs for two factors and three factors, Factor effects, Factor interactions, Fractional factorial design, Saturated Designs, Central composite designs. Illustration through Numerical examples.

07 Hours

UNIT - 4
ANALYSIS AND INTERPRETATION METHODS: Measures of variability, Ranking method, Column effect method & Plotting method, Analysis of variance (ANOVA) in Factorial Experiments: YATE's algorithm for ANOVA, Regression analysis, Mathematical models from experimental data. Illustration through Numerical examples.

07 Hours

PART - B

UNIT - 5
QUALITY BY EXPERIMENTAL DESIGN: Quality, Western and Taguchi's quality philosophy, elements of cost, Noise factors causes of variation. Quadratic loss function & variations of quadratic loss function. Robust Design: Steps in Robust Design: Parameter design and Tolerance Design. Reliability Improvement through experiments, Illustration through Numerical examples.

06 Hours

UNIT - 6
EXPERIMENT DESIGN USING TAGUCHI'S ORTHOGONAL ARRAYS: Types of Orthogonal Arrays, selection of standard orthogonal arrays, Linear graphs and

Interaction assignment, Dummy level Technique, Compound factor method, Modification of linear graphs. Illustration through Numerical examples.

08 Hours

UNIT - 7
SIGNAL TO NOISE RATIO: Evaluation of sensitivity to noise. Signal to Noise ratios for static problems: Smaller-the-better type, Nominal-the –better-type, Larger-the-better type. Signal to Noise ratios for Dynamic problems. Illustration through Numerical examples.

06 Hours

UNIT - 8
PARAMETER AND TOLERANCE DESIGN: Parameter and tolerance design concepts, Taguchi's inner and outer arrays, parameter design strategy, tolerance design strategy. Illustration through Numerical examples.

06 Hours

TEXT BOOKS:
1. **Design and Analysis of Experiments,** Douglas C. Montgomery, 5th Edition Wiley India Pvt. Ltd. 2007

2. **Quality Engineering using Robust Design,** Madhav S. Phadke, Prentice Hall PTR, Englewood Cliffs, New Jersy 07632, 1989.

REFERENCE BOOK:
1. **Quality by Experimental Design,** Thomas B. Barker, Marcel Dekker, Inc ASQC Quality Press.1985.

2. **Experiments Planning, analysis, and parameter Design optimization,** C.F. Jeff Wu Michael Hamada, John Wiley Editions. 2002.

3. **Reliability Improvement by Experiments,** W.L. Condra, Marcel Dekker, Inc ASQC Quality Press.1985.

4. **Taguchi Techniques for Quality Engineering,** Phillip J. Ross, 2nd Edn. McGraw Hill International Editions, 1996.

FINITE ELEMENT ANALYSIS

Subject Code	**: 06MT834**	**l A Marks**	**: 25**
No. of Lecture Hrs./ Week	**: 04**	**Exam Hours :**	**03**
Total No. of Lecture Hrs.	**: 52**	**Exam Marks :**	**100**

PART-A

UNIT-1
Introduction: Equilibrium equations in elasticity subjected to body force, traction forces, and stress-strain relations for plane stress and plane strains. General description of Finite Element Method, Application and limitations. Types of elements based on geometry. Node numbering, Half band width.

07 Hrs

UNIT-2
Basic Procedure: Euler - Lagrauge equation for bar, beam (cantilever / simply supported fixed) Principle of virtual work, principle of minimum potential energy, Raleigh's Ritz method. Direct approach for stiffness matrix formulation of bar element. Galerkin's method.

07 Hrs

UNIT-3
Interpolation Models: Interpolation polynomials- Linear, quadratic and cubic. Simplex complex and multiplex elements. 2D PASCAL's triangle. CST elements-Shape functions and Nodal load vector, Strain displacement matrix and Jacobian for triangular and rectangular element.

07 Hrs

UNIT-4
Solution of 1-D Bars: Solutions of bars and stepped bars for displacements, reactions and stresses by using penalty approach and elimination approach. Guass-elimination technique.

06 Hrs

PART-B

UNIT-5
Higher Order Elements: Langrange's interpolation, Higher order one dimensional elements-Quadratic and cubic element and their shape functions. Shape function of 2-D quadrilateral element-linear, quadric element Iso-parametric, Sub parametric and Super parametric elements. numerical integration : 1, 2 and 3 gauge point for 1D and 2D cases.

06 Hrs

UNIT-6
Trusses: Stiffness matrix of Truss element. Numerical problems.

06 Hrs

UNIT-7

Beams: Hermite shape functions for beam element, Derivation of stiffness matrix. Numerical problems of beams carrying concentrated, UDL and linearly varying loads.

06 Hrs

UNIT-8

Heat Transfer: Steady state heat transfer, 1D heat conduction governing equations. Functional approach for heat conduction. Galerkin's approach for heat conduction. 1D heat transfer in thin fins.

07 Hrs

TEXT BOOKS:

1. **Finite Elements in Engineering**, T.R.Chandrupatla, A.D Belegunde, 3rd Ed PHI.

2. **Finite Element Method in Engineering**, S.S. Rao, 4th Edition, Elsevier, 2006.

REFERENCE BOOKS:

1. **"Finite Element Methods for Engineers"** U.S. Dixit, Cengage Learning, 2009

2. **Concepts and applications of Finite Element Analysis**, R.D. Cook D.S Maltus, M.E Plesha, R.J.Witt, Wiley 4th Ed, 2009

3. **Finite Element Methods**, Daryl. L. Logon, Thomson Learning 3rd edition, 2001.

4. **Finite Element Method**, J.N.Reddy, McGraw -Hill International Edition.

INDUSTRIAL ENGINEERING AND ERGONOMICS

Subject Code   : **06MT835**   IA Marks   : 25
No. of Lecture Hrs./ Week : 04   Exam Hours   : 03
Total No. of Lecture Hrs.   : 52   Exam Marks   : 100

PART - A

UNIT - 1

PRODUCTIVITY & WORK STUDY: Definition of productivity, factors affecting productivity, definition, objective & scope of work study, human factors in work study, work study & management, work study & supervisor, work study &worker.

6 Hours

UNIT – 2

METHOD STUDY: Definition, objective & scope, charts to record movements in shop, process charts, flow process charts, Multiple activity charts, two handed process charts, SIMO chart, principles of motion economy.

8 Hours

UNIT – 3

WORK MEASUREMENT: Definition, objectives, techniques of work measurement, work sampling, need of confidence levels, sample size determination, random observation with simple problems

6 Hours

UNIT – 4

TIME STUDY: Definition, time study equipments, selection of jobs, steps in time study, breaking jobs into elements, recording information, rating, standard performance, scales of rating, factors affecting rate of working, allowances, standard time determination.

6 Hours

PART – B

UNIT - 5

INTRODUCTION TO INDUSTRIAL DESIGN: elements of design structure for industrial design in engineering application in modern manufacturing systems. Ergonomics and Industrial Design: Introduction, general approach to the man-machine relationship, workstation design-working position.

UNIT – 6

VISUAL EFFECTS OF LINE AND FORM: The mechanics of seeingpsychology of seeing general influences of line and form.

6 Hours

UNIT – 7

COLOR MODELS: RGB, CMY, HSV, Color and light, color and objectscolor and the eye-color consistency-color terms reactions to color and color continuation-color on engineering equipments.

6 Hours

UNIT – 8

AESTHETIC CONCEPTS: Concept of unity-concept of order with varietyconcept of purpose style and environment –Aesthetic expressions. Style – components of style house style, observation style in capital goods, case study.

6 Hours

TEXT BOOKS:

1. **Work study,** ILO, 3rd edition, 2006
2. **Human Factor Engineering**: Sanders & McCormick McGraw Hill Publications.

REFERENCE BOOKS:

1. **Applied Ergonomics Hand Book,** Brain Shakel, Butterworth Scientific, London 1988
2. **Introduction to Ergonomics,** R. C. Bridger, McGraw Hill Publications.
3. **Industrial Design for Engineers,** Mayall W. H. London Hffee Books Ltd., 1988
4. **Work Study & Ergonomics,** Suresh Dalela & Saurabh, standard publishers & distributors, 1999