ANNA UNIVERSITY CHENNAI: CHENNAI 600 025

UNIVERSITY DEPARTMENTS

CURRICULUM – 2009

PART TIME B.E.MANUFACTURING ENGINEERING

SEMESTER I

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PTMA9111	Applied Mathematics	3	0	0	3
2.	PTPH9111	Applied Physics	3	0	0	3
3.	PTCY9111	Applied Chemistry	3	0	0	3
4.	PTGE9112	Electrical Engineering	3	0	0	3
5.	PTGE9151	Fundamentals of Computing	3	0	0	3
		TOTAL	15	0	0	15

SEMESTER II

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PTMA9211	Mathematics II	3	0	0	3
2.	PTCE9213	Strength of Materials	3	0	0	3
3.	PTEE 9211	Electrical Drives and Control	3	0	0	3
4.	PTEC9161	Electronics Engineering	3	0	0	3
5.	PTMN9201	Manufacturing Processes-I	3	0	0	3
		TOTAL	15	0	0	15

SEMESTER III

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**PTMN9211**	Mechanics of Machines	3	0	0	3
2.	PTGE9621	Environmental Science and Engineering	3	0	0	3
3.	PTME9262	Thermodynamics	3	0	0	3
4.	**PTME9252**	Engineering Materials and Metallurgy	3	0	0	3
5.	PTMF9251	Manufacturing Processes-II	3	0	0	3
		TOTAL	15	0	0	15

SEMESTER IV

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PTMF9301	Casting and Welding Technology	3	0	0	3
2.	PTMF9304	Computer Aided Design	3	0	0	3
3.	PTME9261	Machine Design	3	0	0	3
4.	PTME9303	Hydraulics and Pneumatics	3	0	0	3
PRACTICAL						
5.	PTMF9308	CAD Laboratory	0	0	3	2
		TOTAL	12	0	3	14

SEMESTER V

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PTMF9252	Engineering Metrology	3	0	0	3
2.	**PTMF9253**	CNC Machines & Robotics	3	0	0	3
3.	PTMF9303	Precision Engineering	3	0	0	3
4.	PTMG9362	Industrial management	3	0	0	3
PRACTICAL						
5.	PTMF9306	CAM Laboratory	0	0	3	2
		TOTAL	12	0	3	14

SEMESTER VI

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	PTME9025	Design for Manufacturing	3	0	0	3
2.	PTMF9302	Metal Forming Technology	3	0	0	3
3.	PTMF9401	Operation Research	3	0	0	3
4.	PTGE9022	Total Quality Management	3	0	0	3
5.		Elective I	3	0	0	3
		TOTAL	15	0	0	15

SEMESTER VII

SL. NO.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	**PTME9402**	Mechatronics	3	0	0	3
2.	PTMF9351	Computer Integrated Production Management System	3	0	0	3
3.		Elective II	3	0	0	3
4.		Elective III	3	0	0	3
PRACTICAL						
5.	PTMF9451	Project work	0	0	6	6
		TOTAL	12	0	6	18

Total No. of Credits: 103

LIST OF ELECTIVES

S.NO.	CODE NO	COURSE TITLE	L	T	P	C
1.	PTMF9021	Product Design and Development	2	0	2	3
2.	PTMF9022	Non Destructive Testing	3	0	0	3
3.	PTMF9023	Rapid Prototyping	3	0	0	3
4.	PTMF9024	Computer Simulation	3	0	0	3
5.	PTMF9025	Quality Control and Reliability Engineering	3	0	0	3
6.	PTMF9026	Processes Planning and Cost Estimation	3	0	0	3
7.	PTMF9027	Processing of Plastics and Composite Materials	3	0	0	3
8.	PTMF9028	Nuclear Engineering	3	0	0	3
9.	PTMF9029	Total Productive Maintenance	3	0	0	3
10.	PTMF9030	Micromachining Processes	3	0	0	3
11.	PTMF9032	Artificial Intelligence	3	0	0	3
12.	PTMF9033	Mechanical Vibration and noise	3	0	0	3
13.	PTMF9034	Value Engineering and Reengineering	3	0	0	3
14.	PTMF9035	Electronics Manufacturing Technology	3	0	0	3
15.	PTML9254	Powder Metallurgy	3	0	0	3
16.	PTIE9035	Supply Chain Management	3	0	0	3
17.	PTME9022	New and Renewable Source of Energy	3	0	0	3
18.	PTME9032	Computational Fluid Dynamics	3	0	0	3
19.	PTGE9021	Professional Ethics in Engineering	3	0	0	3
20.	PTGE9023	Fundamentals of Nanoscience	3	0	0	3
21.	PTMG9072	Entrepreneurship Development	3	0	0	3

PTMA 9111 **APPLIED MATHEMATICS**
(Common to all branches of B.E / B.Tech (PT) Programmes)

L T P C
3 0 0 3

UNIT I MATRICES 9
Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley – Hamilton Theorem – Diagonalization of matrices - Reduction of a quadratic form to canonical form by orthogonal transformation – Nature of quadratic forms .

UNIT II FUNCTIONS OF SEVERAL VARIABLES 9
Partial derivatives – Homogeneous functions and Euler's theorem – Total derivative – Differentiation of implicit functions – Change of variables – Jacobians – Partial differentiation of implicit functions – Taylor's series for functions of two variables - Maxima and minima of functions of two variables.

UNIT III ANALYTIC FUNCTION 9
Analytic functions – Necessary and sufficient conditions for analyticity – Properties – Harmonic conjugates – Construction of analytic function – Conformal Mapping – Mapping by functions w = a + z , az, 1/z, **-** Bilinear transformation.

UNIT IV COMPLEX INTEGRATION 9
Line Integral – Cauchy's theorem and integral formula – Taylor's and Laurent's Series – Singularities – Residues – Residue theorem – Application of Residue theorem for evaluation of real integrals – Use of circular contour and semicircular contour with no pole on real axis.

UNIT V LAPLACE TRANSFORMS 9
Existence conditions – Transforms of elementary functions – Basic properties – Transforms of derivatives and integrals – Initial and Final value theorems – Inverse transforms – Convolution theorem – Transform of periodic functions – Application to solution of linear ordinary differential equations with constant coefficients.

TEXT BOOKS
1. Grewal B.S., Higher Engineering Mathematics (40th Edition), Khanna Publishers, Delhi (2007).
2. Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill Co. Ltd., New Delhi (2007).

REFERENCES
1. Glyn James, Advanced Modern Engineering Mathematics, Pearson Education (2007).
2. Veerarajan, T., Engineering Mathematics (For First Year), Tata McGraw-Hill Pub. Pvt Ltd., New Delhi (2006).

PTPH 9111　　　　　　　　　　**APPLIED PHYSICS**

L T P C
3 0 0 3

UNIT I　　ULTRASONICS　　　　　　　　　　　　　　　　　　9
Introduction – Production – magnetostriction effect - magnetostriction generator-piezoelectric effect - piezoelectric generator- Detection of ultrasonic waves properties – Cavitations - Velocity measurement – acoustic grating - Industrial applications – drilling, welding, soldering and cleaning – SONAR - Non Destructive Testing – pulse echo system through transmission and reflection modes - A, B and C –scan displays, Medical applications - Sonograms

UNIT II　　LASERS　　　　　　　　　　　　　　　　　　　9
Introduction – Principle of Spontaneous emission and stimulated emission. Population inversion, pumping. Einstein's A and B coefficients - derivation. Types of lasers – He-Ne, CO_2, Nd-YAG, Semiconductor lasers - homojunction and heterojunction (Qualitative)- Industrial Applications - Lasers in welding, heat treatment and cutting – Medical applications - Holography (construction and reconstruction).

UNIT III　　FIBER OPTICS & APPLICATIONS　　　　　　　9
Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – Double crucible technique of fibre drawing - Splicing, Loss in optical fibre – attenuation, dispersion, bending - Fibre optical communication system (Block diagram) - Light sources - Detectors - Fibre optic sensors – temperature and displacement - Endoscope.

UNIT IV　　QUANTUM PHYSICS　　　　　　　　　　　　9
Black body radiation – Planck's theory (derivation) – Deduction of Wien's displacement law and Rayleigh – Jeans' Law from Planck's theory – Compton effect - Theory and experimental verification – Matter waves – Schrödinger's wave equation – Time independent and time dependent equations – Physical significance of wave function – Particle in a one-dimensional box - Electron microscope - Scanning electron microscope - Transmission electron microscope.

UNIT V　　CRYSTAL PHYSICS　　　　　　　　　　　　　9
Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – 'd' spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – NaCl, ZnS, diamond and graphite structures – Polymorphism and allotropy - Crystal defects – point, line and surface defects- Burger vector.

TOTAL: 45 PERIODS

TEXT BOOKS:
1. Palanisamy, P.K., 'Engineering Physics' Scitech publications, Chennai, (2008).
2. Arumugam M.' Engineering Physics', Anuradha Publications, Kumbakonam, (2007)
3. Sankar B.N and Pillai S.O. 'A text book of Engineering Physics', New Age International Publishers, New Delhi, 2007.

REFERENCES:
1. R. K. Gaur and S.C. Gupta, 'Engineering Physics' Dhanpat Rai Publications, New Delhi (2003)
2. M.N. Avadhanulu and PG Kshirsagar, 'A Text book of Engineering Physics', S.Chand and company, Ltd., New Delhi, 2005.
3. Serway and Jewett, 'Physics for Scientists and Engineers with Modern Physics', 6th Edition, Thomson Brooks/Cole, Indian reprint (2007)

PTCY 9111   **APPLIED CHEMISTRY**

                                                              L T P C
                                                              3 0 0 3

UNIT I   WATER TREATMENT AND POLLUTION CONTROL   9
Treatment of water –impurities and disadvantages of hard water-Domestic and Industrial treatment - zeolite and ion exchange processes-Portable water-Boiler feed water – conditioning of boiler feed water. Scale and sludge formation –prevention –caustic embrittlement-boiler corrosion–priming and foaming Sewage treatment–Primary, secondary and tertiary treatment–significance of DO, BOD and COD-desalination – reverse osmosis. Control of water,air and land pollution.

UNIT II   FUELS   9
Classification of fuels-Proximate and ultimate analysis of coal- coke manufacture-Otto Hoffman by product method-cracking-thermal and catalytic (fixed bed and fluidized bed)-petroleum-refining-factions-composition and uses synthetic petrol-fischer drops methods- Bergius process- knocking-octane number and cetane number-Preparation, composition and uses of producer gas , water gas and natural gas. Flue gas analysis-Orsat apparatus- gross and net calorific values- calculation of minimum requirement of air(simple calculations)- Explosive range –spontaneous ignition temperature

UNIT III   THERMODYNAMICS AND SURFACE CHEMISTRY   9
Second law of thermodynamics-entropy and its significance- criteria for spontaneity- free energy-Gibbs, Helmholts and Gibbs-Helmholts equation-applications and problems – Adsorption –types of adsorption- adsorption of gases on solids- adsorption isotherm- Freundlich and Langmuir isotherms-adsorption of solutes from solutions- applications

UNIT IV   ELECTROCHEMISTRY - CORROSION AND CATALYSIS   9
Reversible and irreversible cells-electrode potentials-types of electrodes-cell reactions-Nernst equations- electrochemical and galvanic series-fuel cells and solar cells-corrosion-chemical and electrochemical-factors affecting corrosion-sacrifical anode-impressed current cathodic protection-surface treatment and protective coating-Catalysis –classification-characteristics of catalysis – auto catalysis- enzyme catalysis

UNIT V   POLYMERS-COMPOSITES AND NANOCHEMISTY   9
Polymers-definition-classification-thermoplastics and thermosetting plastics differences Preparation, properties and uses of polystyrene, bakelite, PET, polyurethane, Teflon, ureafromaldehyde, polycarbonates-Elastomers-Preparation, properties of Buna-S, nitrile, neoperene and butyl rubber, silicon rubber. Composites-FRP. Nanochemistry-introduction to nanochemistry- preparation and properties of nonmaterial-nano rods, nano wires-nanotubes-carbon nanotubes and their applications.

                                                    TOTAL PERIODS   45

TEXT BOOKS:
1. Dhara S S A text book of Engineering Chemistry, S.Chand & Co Ltd, New Delhi,2002
2. Jain. P.C and Monica Jain, Engineering Chemistry,Dhanpet Rai & Sons, New Delhi 2001

REFERENCES
1. Puri B R.,Sharma L R and Madhan S. Pathania, Principles of Physical Chemistry, Shoban Lal Nagin Chand & Co. Jalandar-2000.
2. G.B. Sergeev, Nanochemistry.Elsevier Science, New York,2006
3. V.R.Gowarikar, N.V.Viswanathan and Jayadev Sreedhar, Polymer Science, Wiley Eastern Limited, Madras (2006).

PTGE9112 **FUNDAMENTALS OF COMPUTING** **L T P C**
                                                      3 0 0 3

UNIT I   **9**
Computer systems – Exploring computers – Inside the system – processing data – CPUs – Types of storage devices - Operating systems basics – networking basics.

UNIT II   **9**
The internet and the WWW – Internet services – connecting to the internet - Working with applications software – productivity software – graphics and multimedia – Data base Management systems – Creating computer program.

UNIT III   **9**
C programming fundamentals – compilation process – variables – Data types – Expressions – looping – decisions.

UNIT IV   **9**
Arrays - Working with functions – structures – character strings – pre processor.

UNIT V   **9**
Pointers – Dynamic memory allocation – linked list - Applications

                                                          Total: 45

TEXT BOOKS:

1. Peter Norton,   "Introduction to Computers", Sixth Edition, Tata McGraw Hill, 2007.
2. Stephen G. Kochan, "Programming in C", Third Edition, Pearson Education, 2007.

REFERENCES:

1. B.W.Kernighan and D.M.Ritchie, "The C Programming language", Second Edition,
2. Pearson Education, 2006
3. Ashok N. Kamthane, "Computer programming", Pearson Education, 2007.
4. Kenneth A. Reek, "Pointers on C", Pearson Education, 2007.
5. R.G.Dromey, "How to solve it by Computer", Pearson Education, 2007.

PTGE9151 **ENGINEERING MECHANICS** **L T P C**
3 0 0 3

AIM:
To introduce the basic principles which help to understand motion and/or forces involved in engineering applications

OBJECTIVE:
At the end of this course the student should be able to understand the vectorial and scalar representation of forces and moments, static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions. Further, he should understand the principle of work and energy. He should be able to comprehend the effect of friction on equilibrium. The student should be able to understand the laws of motion, the kinematics of motion and the interrelationship. The student should also be able to write the dynamic equilibrium equation. All these should be achieved both conceptually and through solved examples.

UNIT- I **BASICS & STATICS** **9**
Introduction - UNITs and Dimensions - Laws of Mechanics – Lame's theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations on forces, dot product and cross product - Coplanar Forces – Resolution and Composition of forces – Equilibrium of a forces – Forces in space - Equilibrium in space - Equivalent systems of forces – Principle of transmissibility – Single equivalent force

UNIT- II **EQUILIBRIUM OF RIGID BODIES** **9**
Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem - Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

UNIT- III **PROPERTIES OF SURFACES AND SOLIDS** **9**
Determination of Areas and Volumes – First moment of area and the Centroid of standard sections – T section, I section, Angle section, Hollow section – second and product moments of plane area – Rectangle, triangle, circle - T section, I section, Angle section, Hollow section – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia - Mass moment of inertia – Derivation of mass moment of inertia for rectangular solids, prism, rods, sphere from first principle – Relation to area moments of inertia.

UNIT- IV **DYNAMICS OF PARTICLES** **9**
Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum

UNIT- V   CONTACT FRICTION & ELEMENTS OF RIGID BODY DYNAMICS   9
Frictional force – Laws of Coloumb friction – simple contact friction – Rolling friction – Belt friction Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion – Impact of elastic bodies

TOTAL: 45

TEXT BOOK:

1. Beer,F.P and Johnson Jr. E.R, "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, 2007.

REFERENCES:

1. Irving H. Shames, Engineering Mechanics - Statics and Dynamics, IV Edition – PHI / Pearson Education Asia Pvt. Ltd., 2003
2. Hibbeller, R.C., Engineering Mechanics, Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., 2000.
3. Ashok Gupta, Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM), Pearson Education Asia Pvt., Ltd., 2002
4. J.L. Meriam & L.G. Karige, Engineering Mechanics Vol. I & Vol. II, V edition, John Wiley & Sons, 2006.
5. P. Boresi & J. Schmidt, Engineering Mechanics Statics & Dynamics, Micro Print Pvt. Ltec., Chennai, 2004.

PTMA9211   **MATHEMATICS II**   **L T P C**
                                                                   3 0 0 3
(Common to all branches of BE / B.Tech (Part-Time) Programmes)
AIM:
To facilitate the understanding of the principles and to cultivate the art of formulating physical problems in the language of mathematics.

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

UNIT I   FOURIER SERIES   9
Dirichlet's conditions – General Fourier series – Odd and even functions – Half-range Sine and Cosine series – Complex form of Fourier series – Parseval's identity – Harmonic Analysis.

UNIT II   FOURIER TRANSFORM   9
Fourier integral theorem – Fourier transform pair-Sine and Cosine transforms – Properties – Transform of elementary functions – Convolution theorem – Parseval's identity.

UNIT III   PARTIAL DIFFERENTIAL EQUATIONS   9
Formation – Solutions of first order equations – Standard types and Equations reducible to standard types – Singular solutions – Lagrange's Linear equation – Integral surface passing through a given curve – Solution of linear equations of higher order with constant coefficients.

UNIT IV   APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS   9
Method of separation of Variables – Solutions of one dimensional wave equation and one-dimensional heat equation – Steady state solution of two-dimensional heat equation – Fourier series solutions in Cartesian coordinates.

UNIT V   Z – TRANSFORM AND DIFFERENCE EQUATIONS   9
Z-transform – Elementary properties – Inverse Z-transform – Convolution theorem – Initial and Final value theorems – Formation of difference equation – Solution of difference equation using Z-transform.

                                                            Total: 45 Periods

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

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

PTCE9213 **STRENGTH OF MATERIALS** **L T P C**
3 0 0 3

AIM:
To understand the stresses and strains for different types loads for various applications.
OBJECTIVES:
1. To understand the stresses developed in beams under transverse load
2. To understand the shear stress developed due to tensional load
3. To understand the stresses induced in cylinders and spheres due to internal pressure.

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

UNIT II TRANSEVERSE LOADING ON BEAMS AND STRESSES IN BEAMS **11**
Beams – types transverse loading on beams – Shear force and bending moment in beams – Cantilevers – Simply supported beams and over – hanging beams. Theory of simple bending - – bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams – Shear stress distribution.

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

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

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

TOTAL : 45

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

REFERENCES:
1. Egor. P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 1997
2. Subramanian R. "Strength Of Materials" Oxford University Press, Oxford Higher Education Series ,2007
3. Hibbeler , R.C, Mechanics Of Materials", Pearson Education, Low Price Edition,2007
4. Bansal, R.K. Strength Of Materials, Lakshmi Publications(P)Ltd, New Delhi
5. Ferdinand P Been, Russell Johnson,J.R. & John J Dewole Mechanics Of Materials, Tata Mcgraw Hill Publishing Co Ltd, New Delhi, 2006

PTEE9211   **ELECTRICAL DRIVES AND CONTROL**   **L T P C**
                                                                 3 0 0 3

AIM

To provide knowledge in the area of electrical dives and their control techniques

PREREQUISTE

Basic Electrical Engineering

OBJECTIVE

To impart knowledge on
 I. Basics of electric drives
 II. Different speed control methods
 III. Various motor starters and controllers
 IV. Applications

UNIT I   INTROUDCTION   9

Fundamentals of electric drives – advances of electric drive-characteristics of loads – different types of mechanical loads – choice of an electric drive – control circuit components: Fuses, switches, circuit breakers, contactors.   Relay – control transformers.

UNIT II   SPEED CONTROL OF DC MACHINES   9

DC shunt motors – Speed Torque characteristics - Ward Leonard method, DC series motor – series parallel control – solid state DC drives – Thyristor bridge rectifier circuits-chopper circuits.

UNIT III   SPEED CONTROL OF AC MACHINES   9

 Induction motor – Speed torque Characteristics – pole changing, stator frequency variation - slip-ring induction motor – stator voltage variation - Rotor resistance variation, slip power recovery – basic inverter circuits- variable voltage frequency control.

UNIT IV   MOTOR STARTERS AND CONTROLLERS   9

DC motor starters : using voltage sensing relays, current sensing relays and time delay relays - wound rotor induction motor starters – starters using frequency sensing relays - DOI -starter and auto transformers starter.

UNIT V   HEATING AND POWER RATING OF DRIVE MOTORS   9

Load diagram, over load capacity, insulating materials, heating and cooling of motors, service condition of electric drive – continuous, intermittent and short time – industrial application.

TOTAL: **45 PERIODS**

TEXT BOOKS
1. N.K De and P.K Sen 'Electric Drives' Prentice Hall of India Private Ltd,2002.
2. Vedam Subramaniam 'Electric Drives' Tata McGraw Hill ,New Delhi,2007
3. V.K Mehta and Rohit Mehta ' Principle of Electrical Engineering' S Chand & Company,2008

REFERENCES
1. S.K Bhattacharya Brinjinder Singh 'Control of Electrical Machines' New   Age International Publishers,2002.
2. John Bird 'Electrical Circuit theory and technology' Elsevier, First Indian Edition, 2006.

PTEC9161   **ELECTRONICS ENGINEERING**   **L T P C**

UNIT I SEMICONDUCTORS AND RECTIFIERS 8
Classification of solids based on energy band theory – Intrinsic Semiconductors-Extrinsic Semiconductors-P-Type & N-Type-P-N Junction-VI Characteristics Of PN Junction Diode-Zener Effects-Zener Diode-Zener Diode Characteristics-Zener Diode as a Regulator-Half & Full wave rectifiers.

UNIT II TRANSISTORS AND AMPLIFIERS 9
Bipolar junction transistors-CB, CE, CC configuration and characteristics-biasing circuits-Fixed Bias , Voltage Divider Bias-Concept of Feedback-Negative Feedback-Voltage series feedback amplifier-current series feedback amplifiers-principles of tuned amplifiers.

UNIT III POWER AND CONTROL ELECTRONIC DEVICES 9
FET-configuration and characteristics-FET amplifier-SCR, Diac, Triac, UJT-characteristics and simple applications.

UNIT IV SIGNAL GENERATORS AND LINEAR ICs 9
Sinusoidal oscillators-Positive feedback-RC phase shift, Hartley, Colpitts, Wein bridge oscillators-Multivibrators-Operational amplifier- Adder, Multipliers, Integrator and Differentiators.

UNIT V DIGITAL ELECTRONICS 7
Boolean algebra-Decoder, Encoder-Multiplexer, Demultiplexer-Half and Full Adders-Flip Flops-Digital to Analog and Analog to Digital Converters.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Malvino, 'Electronic principles', McGraw Book Co., 1993.

REFERENCES:

1. Grob. B and schultz. M.E., 'Basic Electronics', Tata Mcgraw Hill, 2003.
2. Thomas L. Floyd, 'Electronic Devices', Pearson Education, 2002.
3. Thomas L. Floyd, 'Digital Fundamentals', Pearson Education, 2003.

PTMN9211   **MECHANICS OF MACHINES**   **3 1 0 4**

OBJECTIVES:

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

1. KINEMATIC OF MECHANICS   **10**
Mechanisms – Terminology and definitions – kinematics inversions of 4 bar and slide crank chain – kinematics analysis in simple mechanisms – velocity and acceleration polygons – Analytical methods – computer approach – cams – classifications – displacement diagrams - layout of plate cam profiles – derivatives of followers motion – circular arc and tangent cams.

2. GEARS and GEAR TRAINS   **9**
Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

3. FRICTION   **8**
Sliding and Rolling Friction angle – friction in threads – Friction Drives – Friction clutches – Belt and rope drives – brakes – Tractive resistance.

4. FORCE ANALYSIS   **9**
Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members.

5. BALANCING AND VIBRATION   **9**
Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration solation.

TEXT BOOK

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

REFERENCES

1. Thomas Bevan, "Theory of Machines", CBS Publishers and Distributors, 1984.
2. Ghosh.A, and A.K.Mallick, "Theory and Machine", Affiliated East-West Pvt. Ltd., New Delhi, 1988.
3. Rao.J.S. and Dukkipatti R.V. "Mechanisms and Machines", Wiley-Eastern Ltd., New Delhi, 1992.
4. John Hannah and Stephens R.C., "Mechanics of Machines", Viva Low Prices Student Edition, 1999.
5. V.Ramamurthi, Mechanisms of Machine, Narosa Publishing House, 2002.
6. Robert L.Norton, Design of Machinery, McGraw-Hill, 2004.

STANDARDS

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

PTMN9201   **MANUFACTURING PROCESSES - I**   **L T P C**
                                                              3 0 0 3

AIM:

To provide the coverage of the breadth and depth of the field of manufacturing. So that students can become familiar with some of the basic metal cutting, and related machining process.

OBJECTIVE:

At the end of this course the student should be able to understand
1) Methods to solve problems on cutting forces, tool life and analytical methods of estimating cutting temperature.
2) Constructional features of lathe, drilling, shaper, planer, boring, broaching, and grinding machines, accessories and common operations performed on these machines.
3) Machine tool structures, erection and testing of machine tools
4) Concept of automation of machine tools.

UNIT I   FUNDAMENTALS OF METAL CUTTING   9
Tool geometry- Mechanics of orthogonal and oblique cutting - mechanism of chip formation- Types of chips produced in cutting -Cutting forces - Merchant's circle diagram – simple problems -Cutting temperature-causes, effects, measurement, estimation and control-Tool failure modes-wear mechanisms – tool life - simple problems- Machinability

-Surface finish and integrity of machined surfaces- Machining economics- cutting tool materials- Cutting tool reconditioning-Cutting fluids.

UNIT II   BASIC MACHINING PROCESSES   12
Lathe: Kinematic arrangement -Specification - Types - Mechanisms - work holding devices- Operations - Drilling: Specification - Types - Mechanism - Operations - Drill tool nomenclature –-Boring: Specification - Types - Operations - Boring tool - Jig Boring machine – Reamer and tap Milling: Specification – Types - Cutter nomenclature - Types of cutter - mounting of cutters Operations - Indexing - Cam and thread milling- Shaper: Specification - Types – Mechanism- Planer: Specification - Types - Mechanism - Broaching: Specification - Types - Tool nomenclature - Broaching process.

UNIT III   GRINDING AND FINISHING OPERATIONS   8
Grinding: Types of grinding machine - Designation and selection of grinding wheel - Abrasives- Bonds -bonded abrasives - Reconditioning of grinding wheel - grinding operations and machines   wheel grinding -Design Considerations for grinding-economics of grinding- finishing operation. - deburring - lapping, honing, burnishing - super finishing operations.

UNIT IV   GEAR CUTTING   8
Gear cutting methods-Kinematics of gear shaping and gear hobbing – template gear cutting methods-Gear generation principles specifications - Bevel gear generator - Gear finishing methods-gear grinding -lapping

UNIT V   MACHINE TOOL STRUCTURE AND AUTOMATION   8
Classification Machine tool structures-Vibration and chatters in machining-erecting and testing of machine tools-Automation: Cam controlled automats, single spindle and multi spindle automats - Swiss type, automatic screw mechanism - Feeding mechanism - Transfer mechanism, Tracer controller mechanism.

TOTAL : 45 PERIODS

TEXT BOOK:

1. Geoffrey Boothroyd, Winston A. Knight, "Fundamentals of metal machining and machine tools ", CRC , 2nd edition, 1988.
2. 2.P.C.PANDY,C.K.SINGH,"Production Engineering and Science", Standard Publishers distributors, New Delgi,2003

REFERENCES:

1. S.K. HAJRA CHOUDRY, S.K.BOSE, A.K. HAJRA CHOUDRY " Elements of Workshop Technology Vol II: Machine tools", Media promoters and Publishers Pvt Ltd, 2002
2. P.C.SHARMA, A Text book of Production Technology, S.Chand and Co., Ltd., 1999.
3. KRAR, OSWARD, Technology of Machine Tools, McGraw Hill International Editions,1991.
4. ROY A LINDBERG, Fourth Edition, Process and Materials of Manufacture, Prentice-Hall of India, 1994.
5. E.PAUL DeGARMA, J.T.BLACK and RONALD A.KOSHER, Eighth Edition, Materials and Processes in Manufacturing Prentice-Hall of India, 1997.

PTGE9261 ENVIRONMENTAL SCIENCE AND ENGINEERING   **L T P C**
    (Common to all branches)   **3 0 0 3**

AIM:
The AIM: of this course is to create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make them sensitive to the environment problems in every professional endeavour that they participates.

OBJECTIVE:
At the end of this course the student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment and useful environment for the future generations and how to maintain ecological balance and preserve bio-diversity. The role of government and non-government organization in environment managements.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY   **14**
Definition, scope and importance of environment – need for public awareness - concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers – energy flow in the ecosystem – ecological succession – food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.
Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION   **8**
Definition – causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Soil pollution (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards – soil waste management: causes, effects and control measures of municipal solid wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.
Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES   **10**

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion

and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles.

Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT   7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air (Prevention and Control of Pollution) act – Water (Prevention and control of Pollution) act – Wildlife protection act – Forest conservation act – enforcement machinery involved in environmental legislation- central and state pollution control boards- Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT   6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare – role of information technology in environment and human health – Case studies.

TOTAL : 45

TEXT BOOKS:
1.   Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).
  2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2006).

REFERENCES:

 1.   R.K. Trivedi, 'Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards', Vol. I and II, Enviro Media.
2.   Cunningham, W.P. Cooper, T.H. Gorhani, 'Environmental Encyclopedia', Jaico Publ., House, Mumbai, 2001.
3.   Dharmendra S. Sengar, 'Environmental law', Prentice hall of India PVT LTD, New Delhi, 2007.
4.   Rajagopalan, R, 'Environmental Studies-From Crisis to Cure', Oxford University Press (2005)

PTME 9262   **THERMODYNAMICS**   **L T P C**
                                                                3 0 0 3

AIM:
To impart the importance of thermal science aspects in the field of manufacturing engineering.

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

UNIT I   BASIC CONCEPTS OF THERMODYNAMICS   9
Thermodynamics and Energy – Systems – Types and properties - State and Equilibrium - Processes and Cycles – Forms of Energy – Temperature and Zeroth law of Thermodynamics – Pure substances – Phase change processes of pure substances – Property diagrams – Internal energy – Enthalpy – Energy transfer by Heat, Work and Mass – Applications.

UNIT II   FIRST AND SECOND LAW OF THERMODYNAMICS   9
First law of thermodynamics – Energy balance for closed systems and steady flow systems – Applications of First law of Thermodynamics – Energy balance for Unsteady flow processes – Second law of Thermodynamics – Entropy – Carnot principles – Change in Entropy – Entropy and irreversibility -Applications.

UNIT III   HEAT ENGINES   15
Internal Combustion Engines – C.I and S.I Engines – Four Stroke and Two Stroke Engines – Gas Turbines - Boilers – Fire Tube Boiler & Water Tube Boilers , Boiler Accessories and Components. Turbines – Impulse Turbine and Reaction Turbine , Turbine Components - Refrigeration Cycle – Vapour Compression & Vapour Absorption System ,Gas Refrigeration System – Environmental friendly Refrigerants – Air Conditioning.

UNIT IV   GASES AND VAPOUR MIXTURES   9
Ideal and Real gases – Vander waals equations – Reduced property – Compressibility chart -Properties of mixture of gases – Dalton's law and Gibbs – Dalton law – Internal energy, Enthalpy and specific heats of gas mixtures.

UNIT V   HEAT TRANSFER   9
Conduction – Plane Wall, Cylinder system, Composite Walls – Critical insulation thickness – Simple, fins convection – Free convection and forced convection – Flow over Flat plates and Flow through Pipes – Radiation – Black Body, Grey Body Radiation.

                                            Total   : 60 Periods

TEXT BOOKS
   1. "Thermodynamics an Engineering Approach" Yunus A. Cenegal and Michael A.Boles, Tata McGraw hill, Fourth edition, 2004.
   2. "Fundamentals of Engineering Thermodynamics" Michael J.Moran, Howard N.Shapiro, John wiley &Sons, Fourth editon,2000.

REFERENCES
   1. "A Text book of Engineering Thermodynamics" R.K.Rajput , Laxmi puplication(P) Ltd. ,Third Edition, 2007.
   2. "Engineering Thermodynamics" P.K.Nag, Tata McGraw hill, Third edition, 2005
   3."A course in Thermal engineering" S.Domkundwar, C.P.Kothandaraman ,
    Dhanpat rai & co (p) Ltd, Fifth edition, 2000.

PTME9252   ENGINEERING MATERIALS AND METALLURGY   **L T P C**
                                                        3 0 0 3

OBJECTIVE
To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

UNIT I   CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS   9
Constitution of alloys – Solid solutions, substitutional and interstitials – Phase diagrams and microstructure development: Isomorphous, eutectic, peritectic, eutectoid and peritectroid alloy systems. Iron-Iron carbide equilibrium diagram, Development of microstructures in Iron- carbon alloys.

UNIT II   HEAT TREATMENT   9
Full annealing-stress relief, Recrystalisation- Spheroidizing, Normalising, Hardening and tempering of steel. Isothermal transformation diagrams- TTT– CCT cooling curves - Hardenability, Jominy end quench test – Austempering, martempering – case hardening, carburizing, nitriding, cyaniding, carbonotriding –flame and induction hardening – vacuum and plasma hardening – current trends- thermo-mechanical treatments- elementary ideas on sintering.

UNIT III   FERROUS AND NON FERROUS METALS   9
Effect of alloying additions on steel (Mn, Si, Cr, Mo, V, Ti & W)- classification of steels (tool steel, stainless)– cast irons – alloy cast irons- Copper and Copper alloys – Aluminum and its alloys- Magnesium and its alloys– Titanium and its alloys- Nickel and Cobalt alloys, properties and applications of these materials.

UNIT IV   NON-METALLIC MATERIALS   9
Types, properties and applications: Polymers, Ceramics and Composites– Super conductors- nanomaterials and their properties.

UNIT V   MECHANICAL PROPERTIES AND TESTING   9
Crystal imperfections- Dislocations- Strengthening mechanisms- Elastic, anelastic and viscoelastic behaviour – modulus of elasticity- plastic deformation- Mechancial tests- tension, compression, impact, hardness- effect of temperature, grain size , solutes and precipitates on dislocation dynamics – Mechancism of Fracture - mechanism of creep- creep resistant materials- creep tests- fracture toughness- ductile-brittle transition – deformation mechanism maps- fatigue fracture-fatigue test.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Raghavan. V. "Materials Science and Engineering", Prentice Hall of India Pvt. Ltd, 5th edition, 2007.
2. Williams D Callister, "Material Science and Engineering" Wiley India Pvt Ltd, Revised Indian edition 2007.

REFERENCES

1. George E. Dieter, "Mechanical Metallurgy", McGraw Hill, 2007.
2. Syndney H Avn er, "Introduction to Physical Metallurgy", 2/E Tata McGraw Hill Book Company, 2007.
3. Kenneth G. Budinski and Michael K. Budinski "Engineering Materials", PHI / Pearson Educations, 8th Edition, 2007.
4. G.S. Upadhay and Anish Upadhay, "Materials Science and Engineering", Viva Books Pvt. Ltd, 2006.
5. James F. Shackelford and Madanpalli K. Muralidhara, "Introduction to Materials Science for Engineers", Pearson Education, 6th edition, 2007.

PTMF9251   **MANUFACTURING PROCESSES – II**   **L T P C**
                                                                   3 0 0 3

AIM:

To give the insight, principles of basic forming, casting and joining processes to the student. So that they will be able to analyze the merits and limitations of each processes while making process selection.

OBJECTIVE:

At the end of this course the student should be able to understand
   3) The tools, equipment and principle of operation of primary and secondary manufacturing processes.
   4) Defects, causes and their remedies of welding, casting and metal forming operations.
   5) Processing of plastics and fabrication of various types composite material.
   6) Equipment, principle of operation of non traditional machining and forming processes.

UNIT I   CASTING PROCESSES   9

Casting Terminology – Pattern – Types of Patterns – Pattern allowances – Moulds – Moulding Tools – Machines and Materials – Core – Core Making – Sand Moulding methods – Melting furnaces – fluxing – Inoculation – Die-casting processes-Cleaning, Inspection and repairing of castings.

UNIT II   METAL FORMING PROCESSES   9

Hot working & Cold working of metals – Forging Machines - Forging operations– Rolling-Types of Rolling mills – Rolling operations – Extrusion – Extrusion processes– Rod, wire and tube drawing - Bending – Principle & types- Deep drawing – Principle & Types Sheet metal forming operations such as squeezing, spinning, peen ,stretch forming and super plastic forming.

UNIT III   FABRICATIOIN PROCESSES   9

Welding – Classification of welding – Electric Arc Welding- Equipment – Consumables – processes – Gas Welding – Equipment – Processes – Resistance welding – Types of Resistance welding – Soldering & Brazing – Adhesive bonding – Welding Inspection – Defects, Causes & Remedies.

UNIT IV   PROCESSING OF PLASTICS AND COMPOSITES   9

Types of plastics – Processing of thermo plastics – Extrusion, Inspection blow, Rotatromal moulding processes – Calendaring, Film blowing, Thermo forming – Processing of thermosets - Compression, Transfer, Jet Moulding processes – Bonding of thermoplastics- Laminated plastic –– Composites- types- Fabrication Methods – advantages ,limitations and applications.

UNIT V   UNCONVENTIONAL METHODS OF MANUFACTURING   9

Introduction – Need –classification -Electro-Discharge Machining – Electro-Chemical Machining – Laser Beam Machining – Abrasive Jet Machining –Water jet Cutting – Ultrasonic Machining –– High Velocity Forming of Metals – Explosive Fabrication – Hydro forming – Electro-hydraulic Forming – Magnetic pulse Forming – Electron Beam Machining.

TOTAL : 45 PERIODS

TEXT BOOK:

1. S.Gowri, P.Hariharan, A.Suresh Babu "Manufacturing Technology-I",Pearson Education, 2008
2. P.C.SHARMA, A Text book of Production Technology, S.Chand and Co., Ltd., 1999.

REFERENCES

1. R.K.Rajput, "Manufacturing Technology (Manufacturing Processes), Latmi Publications Ltd., New Delhi,2007
2. D.K.Singh, "Fundamentals of Manufacturing Engineering", Ane Books India, New Delhi,2008
3. R.B.Gupta, "Foundry Engineering", Sataya Prakasham, New Delhi,2002
4. R.S.Parmar, "Welding Processes and Technology", Khanna Publishers, New Delhi,2003

PTMF9301　　　　**CASTING AND WELDING TECHNOLOGY**　　　**L T P C**
　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　　3 0 0 3

AIM:

To impart knowledge on fundamentals of welding technology , cast design and advanced welding and casting processes.

OBJECTIVE:

At the end of this course the student should be able to understand
1. Melting procedure of various materials
2. Design principles of welding and casting
3. Principles of advanced welding and casting processes
4. Automation of welding and casting plant

UNIT I　　　MELTING AND POURING　　　　　　　　　　　　8

Principles of melting practice-fluxing- Degasification and inoculation- types of furnaces-Crucibles, Cupola, Oil fired furnaces – Electric arc and induction furnaces –Melting practice of cast iron, SG iron, steel, aluminum and copper alloys.

UNIT II　　　CASTING DESIGN　　　　　　　　　　　　　10

Solidification of pure metals and alloys-shrinkage in cast metals-design of sprue, runner ,gate and risers-problems in design and manufacture of thin and unequal sections-designing for directional solidification, minimum distortion and for overall economy-design problems of L,T,V,X and Y junctions.

UNIT III　　　WELD DESIGN AND WELDING METALLURGY　　　10

Design of welded components-symbolic representation of welds on drawings- welding classes-residual stresses in welds-weld distortions-design consideration-strength consideration of welded joints-analysis of statistically loaded welded joints-welded structures subjected to fatigue loads.

UNIT IV　　　SPECIAL CASTING AND WELDING PROCESSES　　　8

Evaporative pattern casting-ceramic mould casting –electro magnetic moulding-squeeze casting –investment casting-shell moulding- PAW-electron beam welding-laser beam welding- friction welding-ultrasonic welding – diffusion welding-high velocity oxy fuel processes

UNIT V　　　QUALITY CONTROL AND AUTOMATION　　　　　9

Cleaning and inspection of castings – Casting defect and remedies – foundry automations-moulding machines-Automation of sand plant, moulding and fettling sections of foundry-Dust and fume control-Welding defects –causes and remedies – Non destructive tests – arc welding using robots-weld positioner and manipulators –weld seam tracking-vision system-arc sensing Welding

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TEXT BOOKS

1. PARMAR,R.S., Welding Processes and Technology, Khanna Publishers, 1997
2. JAIN,P.L., Principles of Foundry Technology, Tata McGraw Hill, 2003.

REFERENCES

1. A.S.M Hand book, vol 15,casting,ASM international,1988
2. KLAS WEMAN, welding processes hand book, CRC press,2003
3. CARY and HOWARD,B., Modern Welding Technology, Prentice-Hall, 1989.
4. HEINE, R.W., LOPER.L.R., and ROSENTHAL,C, Principles of Metal Casting, Tata McGraw Hill, 1986.
5. MINKOFF,J., solidification and cast structure,wiley.1986
6. DAVIES, A.C., Welding (10th Edition), Cambridge University Press, 1996.

PTMF9304   **COMPUTER AIDED DESIGN**   **L T P C**
                                                                      3 0 0 3

AIM:
To impart knowledge in the theoretical principles of Computer Aided Design

OBJECTIVE:
To familiarize the student with computer hardware and peripheral
Devices, mathematics of computer graphics, geometric modeling, CAD standards
And to impart fundamental knowledge in Finite Element Analysis

UNIT I   INTRODUCTION   5
Product Cycle – Design Process – CAD Hardware – Mainframe, Mini, Workstation and
Micro computer Based Systems, Input and Output Devices – Software – Operating
System, Geometric Modeling capabilities – hardware Integration and Networking.

UNIT II   COMPUTER GRAPHICS   9
Two dimensional transformations – Transformation of Straight Lines – Rotation –
Reflection – Scaling – Combined Transformations – Translations and homogeneous co
ordinates – Three dimensional transformations – Scaling – Rotation – Reflection –
Translation – Projections – Orthographic and Isometric Projections – Clipping – Hidden
Line and Surface Removal.

UNIT III   GEOMETRIC MODELLING   9
Geometrical Modeling – wire frame, models – entities – surface models – entities – solid
models – Entities – Boundary Representation (B-Rep) – Constructive Solid
Geometric (CSG) – Sweep and Analytical Solid Modeling.

UNIT IV   CAD STANDARDS   11
Graphical Kernel System (GKS) Programmers Hierarchical Interface for Graphics
(PHIGS), Initial Graphics Exchange Specification (IGES), Standard for Exchange of
product Model Data (STEP), Drawing Exchange Format (DXF), Dimensional
Measurement Interface Specification (DMIS) – Introduction to Drafting and Modeling
Systems.

UNIT V   FINITE ELEMENT ANALYSIS   11
Introduction – Procedures – Element types – Nodal approximation – Element matrices,
vectors and equations – Global connectivity – Assembly – Boundary conditions –
Solutions techniques – Interfaces to CAD – Introduction to packages, Case Studies –
Applications.

                                                          TOTAL : 45   PERIODS
TEXT BOOKS
1. Ibrahim Zeid, "CAD-CAM Theory and Practice", Tata McGraw Hill Publishing Co.
   Ltd., 1991
2. D.F.Rogers and J.A.Adams, "Mathematical Elements in Computer Graphics",
   McGraw–Hill Book Company, New York, 1976.

REFERENCES
1. P.Radhakrishnan and C.P.Kothandaraman, "Computer Graphics and Design",
   Dhanpat Rai and Sons, New Delhi, 1991.
2. E.Dieter George, "Engineering Design", McGraw-Hill International Edition, 1991.
3. P.Radhakrishnan and S.Subramanyam, "CAD/CAM/CIM", Wiley Eastern Ltd.,
   New Age International Ltd., 1994.

OBJECTIVE:

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

**UNIT III   STEADY STRESSES AND VARIABLE STRESSES IN MACHINE
      MEMBERS   9**
Introduction to the design process – factor influencing machine design, selection of materials based on mechanical properties – Preferred numbers, fits and tolerances – Direct, Bending and torsional stress equations – impact and shock loading – calculation of principle stresses for various load combinations, eccentric loading – Design of curved beams – crane hook and 'C' frame – Factor of safety – theories of failure – stress concentration – design for variable loading – Soderberg, Goodman and Gerber relations.

UNIT III   DESIGN OF SHAFTS AND COUPLINGS   10

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

UNIT III   DESIGN OF TEMPORARY AND PERMANENT JOINTS   9

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

UNIT IV   DESIGN OF ENERGY STORING ELEMENTS   8

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

UNIT V   DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 9

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

                        TOTAL : 60 PERIODS

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

TEXT BOOKS

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

REFERENCES

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

STANDARDS

IS 10260 : Part I : 1982 Terms, definitions and classification of Plain bearings Part 1 : Construction.
IS10260 : Part I : 1982 Terms, definitions and classification of Plain bearings Part 2 : Friction and Wear.
IS 10260 : Part I : 1982 Terms, definitions and classification of Plain bearings Part 3 : Lubrication.

PTME9303   **HYDRAULICS AND PNEUMATICS**   **L T P C**
                                                          3 0 0 3

OBJECTIVE:
This course will give an appreciation of the fundamental principles, design and operation of hydraulic and pneumatic machines, components and systems and their application in recent automation revolution.

UNIT I   FLUID POWER PRINCIPLES AND FUNDEMENTALS (REVIEW)   3
Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids- Properties of fluids Basics of Hydraulics – Pascal's Law- Principles of flow – Work, Power and Torque. Properties of air– Perfect Gas Laws.

UNIT II   HYDRAULIC SYSTEM AND COMPONENTS   13
Sources of Hydraulic power: Pumping Theory – Pump Classification- Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary- Fixed and Variable displacement pumps, Hydraulic Actuators: Cylinders – Types and construction, Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves- Types, Construction and Operation- Applications – Types of actuation. Accessories: Reservoirs, Accumulators, Intensifiers, Pressure Switches- Applications- Fluid Power ANSI Symbol.

UNIT III   HYDRAULIC CIRCUITS   9
Industrial hydraulic circuits- Regenerative, Pump Unloading, Double-pump, Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Accumulators, Electro hydraulic circuits, Mechanical Hydraulic servo systems.

UNIT IV   PNEUMATIC SYSTEM   8
Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves, Quick Exhaust valves, Pneumatic actuators, Servo systems. Introduction to Fluidics, Pneumatic logic circuits.

UNIT V   DESIGN OF HYDRALIC AND PNEMATIC CIRCUITS   12
Designing the components of hydraulic system for Drilling, Planning, Shaping, Punching, Press. – Selection, fault finding and maintenance of hydraulic components- Sequential circuit design for simple application using cascade method, Electro pneumatic circuits. Selection criteria of pneumatic components – Installation fault finding and maintenance of pneumatic components. Microprocessor and PLC- Applications in Hydraulic and Pneumatics- Low cost Automation – Hydraulic and Pneumatic power packs- case studies.

TOTAL: 45 PERIODS

TEXT BOOK
   1. Anthony Esposito," Fluid Power with Applications", PHI / Pearson Education, 2005.

REFRENCES
   1. Shanmugasundaram.K, "Hydraulic and Pneumatic controls", Chand & Co, 2006.
   2. Majumdar, S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw Hill, 2001
   3. Majumdar, S.R., "Pneumatic Systems – Principles and Maintenance", Tata McGraw Hill, 2007.
   4. Micheal J, Pinches and Ashby, J.G., "Power Hydraulics", Prentice Hall, 1989.
   5. Dudelyt, A Pease and John J Pippenger, "Basic Fluid Power", Prentice Hall, 1987.

PTMF9308   **CAD LABORATORY**   **L T P C**

OBJECTIVE:

To impart hands on experience to students in Geometric Modeling, Assembly and Engineering Drafting.

1. SKETCHER

Introduction- Basic sketch, Constraints – Geometry & Dimensional.

2. SOLID MODELING

Extrude, Revolve, Sweep, Loft, Datum plane creation etc.

3. SURFACE MODELING

Extrude & Revolve surfacing, Advance surfacing technique – Ruled & Loft surfacing, Mesh of curves, Free form surfaces, Surface operations – trium, merge, intersect, etc.

4. FEATURE MANIPULATION

Copy, Edit, Pattern, Suppress, History operations etc.

5. ASSEMBLY

Constraints, Patterns, exploded Views, Interference check, creating components from assembly, mass property calculations, BOM generations and assembly cut sections.

6. DRAFTING

Standard view, Sectional views and Detailing, BOM and Balloon creation.

PTMF9252   **ENGINEERING METROLOGY**   **L T P C**
                                                                             3 0 0 3

AIM:
To give a thorough knowledge of measurement and instrumentation of increasing importance in industry. The student will be knowledgeable in various standards and proliferation of computerized and automated inspecting techniques along with the classical metrology.

OBJECTIVE:
To teach the students basic concepts in various methods of engineering measurement techniques and applications, understand the importance of measurement and inspection in manufacturing industries. Expose the students to various modern metrological instruments and the procedure used to operate these instruments.

UNIT I   BASIC CONCEPTS OF MEASUREMENTS   8
Need for measurement – Dimensional and Form tolerances – Precision and Accuracy – Errors in Measurements – Causes – Types – Handling of measuring instruments – Maintenance of Instruments – Standards and Practice – Metrology lab – Environment and conditions.

UNIT II   INEAR AND ANGULAR MEASUREMENTS   9
Measurement of Engineering Components – Comparators, Slip gauges, Rollers, Limit gauges – Design and Applications – Angle dekkor – Alignment telescope – Sine bar – Bevel protractors – Types – Principle – Applications.

UNIT III   FORM MEASUREMENTS   9
Measurement of Screw thread and gears – Radius measurement – Surface finish measurement – Auto collimator – Straightness, Flatness and roundness measurements – Principles – Application.

UNIT IV   OPTICAL MEASUREMENTS   10
Optical microscope, interference microscope, Tool makers microscope, Vision systems, Precision instrument based on Laser – Use of Lasers – Principle – Laser Interferometer – Application in Linear and Angular measurements – Testing of machine tools using Laser Interferometer.

UNIT V   ADVANCES IN METROLOGY   9
Co-ordinate measuring machine – Constructional features – Types – Applications of CMM – CNC CMM applications – Computer Aided Inspection – Machine Vision – Applications in Metrology.
Nanometrology – Introduction – Principles – Nanometer metrology systems – Methods of measuring length and surfaces to nano scale result with interferometers and other devices

TOTAL:45 PERIODS

TEXT BOOKS:
1. Gaylor, Shotbolt and Sharp, "Metrology for Engineers", O.R.Cassel, London, 5th Edition, 1993.
2. R.K.Jain, "Engineering Metrology", Khanna Publishers, 19th Edition, 2005

REFERENCES:
1. Thomas, "Engineering Metrology", Butthinson & Co., 1984.
2. Industrial Metrology, Graham T. Smith, Springer-Verlag London Ltd 2002
3. White house, D. J, "Handbook of Surface & Nanometrology", The institute of Physics, London, 1994.
4. M.Mahajan, "A text-Book of Metrology", Dhanpat Rai & Co. (P) Ltd. 2006

PTMF   **CNC MACHINES AND ROBOTICS**   **L T P C**
                                                                      3 0 0 3

AIM:

To provide knowledge on constructional features, programming, tooling and workholding devices in CNC machine tools

To impart knowledge on construction of Robotics, its programming and applications

OBJECTIVE:

Upon completion of this subject, student will be able to:
1. Describe constructional features of CNC machine tools
2. Write simple programs for CNC turning and machining centres
3. Generate CNC programs for popular CNC controllers
4. Describe tooling and work holding devices for CNC machine tools
5. Understand robot construction
6. Describe robot programming and applications

UNIT I   STRUCTURE OF CNC MACHINE TOOL   9

Evolution of CNC Technology, principles, features, advantages, applications, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of control systems, CNC controllers, characteristics, interpolators– Computer Aided Inspection, CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and other types of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings.

UNIT II   CNC PROGRAMMING   9

Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and tool nose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well known controllers such as Fanuc, Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages.

UNIT III   DRIVES, CONTROLS AND TOOLING AND WORK HOLDING   9

Spindle drives, feed drives, Open loop and closed loop control, Axis measuring system – synchro, synchro-resolver, gratings, moiré fringe gratings, encoders, inductosyn, laser interferometer. cutting tool materials – HSS, Carbides, Ceramics, CBN, PCD–inserts classification- PMK, NSH, qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.

UNIT IV   ROBOTICS TECHNOLOGY   9

Robot anatomy, common robot configurations, specifications, accuracy, repeatability, drive system, control system, kinematics- direct and inverse, end effectors-types, sensors –tactile, proximity and range sensors, machine vision

UNIT V   ROBOT PROGRAMMING AND APPLICATIONS   9

Methods of robot programming, Lead-through programming, Robot languages, simulation and Offline programming, work cell control,

Types of robot applications, material handling, material processing, assembly and inspection, other applications.

                                              TOTAL : 45 PERIODS

TEXT BOOKS

1. HMT, "Mechatronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
2. Mikell P. Groover, Industrial Robotics – Technology, Programming & Applications, McGraw-Hill International, 1996

REFERENCES

1. James Madison, "CNC Machining Hand Book", Industrial Press Inc., 1996.
2. Ken Evans, John Polywka & Stanley Gabrel, "Programming of CNC Machines", Second Edition – Industrial Press Inc, New York, 2002
3. Deb S.R., "Robotics Technology and Flexible Automation", Tata McGraw-Hill Publishing Company Limited, New Delhi, 1994
4. Berry Leathan – Jones, "Introduction to Computer Numerical Control", Pitman, London, 1987.
5. Radhakrishnan P "Computer Numerical Control Machines", New Central Book Agency, 2002.
6. Rao P.N., CAD/CAM, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2002.

PTMG9362 INDUSTRIAL MANAGEMENT   **L T P C**
                                                                             3 0 0 3

OBJECTIVE
To provide a clear understanding of basic management principles that leads to corporate building. Industrial Management deals with not only functions of management but also organizational structure and dynamics and includes modern concepts of Industrial Management

UNIT I INTRODUCTION (9)
Technology Management - Definition – Functions – Evolution of Modern Management – Scientific Management Development of Management Thought. Approaches to the study of Management, Forms of Organization – Individual Ownership – Partnership – Joint Stock Companies – Co-operative Enterprises – Public Sector Undertakings, Corporate Frame Work – Share Holders – Board of Directors – Committees – Chief Executive – Line and Functional Managers, Constraints – Environmental – Financial – Legal – Trade Union–

UNIT II FUNCTIONS OF MANAGEMENT (9)
Planning – Nature and Purpose – Objectives – Strategies – Policies and Planning Premises – Decision Making – Organizing – Nature and Process – Premises – Departmentalization – Line and staff – Decentralization – Organizational culture, Staffing - selection and training – Placement – Performance appraisal – Career Strategy – Organizational Development. Leading – Managing human factor – Leadership – Communication, Controlling - Process of Controlling – Controlling techniques, productivity and operations management – Preventive control, Industrial Safety.

UNIT III ORGANIZATIONAL BEHAVIOUR (9)
Definition – Organization – Managerial Role and functions – Organizational approaches, Individual behaviour – causes – Environmental Effect – Behaviour and Performance, Perception – Organizational Implications. Personality – Contributing factors – Dimension – Need Theories – Process Theories – Job Satisfaction, Learning and Behaviour – Learning Curves, Work Design and approaches.

UNIT IV GROUP DYNAMICS (9)
Group Behaviour – Groups – Contributing factors – Group Norms, Communication – Process – Barriers to communication – Effective communication, leadership – formal and informal characteristics – Managerial Grid – Leadership styles – Group Decision Making – Leadership Role in Group Decision, Group Conflicts – Types –Causes – Conflict Resolution – Inter group relations and conflict, Organization centralization and decentralization – Formal and informal – Organizational Structures – Organizational Change and Development – Change Process – Resistance to Change – Culture and Ethics.

UNIT V MODERN CONCEPTS **(9)**

Management by Objectives (MBO) –, Management by Exception (MBE), Strategic Management - Planning for Future direction – SWOT Analysis – Evolving development strategies, information technology in management – Decisions support system – Management Games – Business Process Re-engineering(BPR) – Enterprises Resource Planning (ERP) – Supply Chain Management (SCM) – Activity Based Management (ABM) – Global Perspective - Principles and Steps – Advantages and disadvantages

TOTAL : 45

TEXT BOOK:

1. Herald Knottz and Heinz Weihrich, 'Essentials of Management', McGraw Hill Publishing Company, Singapore International Edition, 1980.

REFERENCES:
1. S.Chandran, Organizational Behaviours, Vikas Publishing House Pvt.1994
2. Ties, AF, Stoner and R.Edward Freeman, 'Management' Prentice Hall of India Pvt. Ltd. New Delhi 110011, 1992
3. Joseph J, Massie, 'Essentials of Management' Prentice Hall of India Pvt. Ltd. 1985

PTMF9401   OPERATIONS RESEARCH

L T P C
3 0 0 3

OBJECTIVE
To create an awareness about the optimization of resources.
To understand and apply the operations research techniques in industrial operations.

UNIT I   LINEAR PROGRAMMING PROBLEMS   9
OR-Definition - Phases – models, LP model – formulation - solutions: Graphical- simplex method, Duality in LP – Dual simplex method – Revised simplex method – Sensitivity analysis.

UNIT II   TRANSPORTATION AND NETWORK MODELS   10
Transportation problems- Assignment problems – Traveling salesman problems, Project management: Network logic – Fulkerson's rule – AON diagram – CPM and PERT techniques, sequencing models.

UNIT III   INVENTORY CONTROL   8
Types of inventory- Inventory cost – EOQ – Deterministic inventory problems – EOQ with price breaks – Stochastic inventory problems – Multi product problems – Systems of inventory control – Selective inventory control techniques.

UNIT IV   QUEUING THEORY   9
Queuing system – Characteristics – symbols – Poisson process and exponential distribution – Single server queuing models – Multiserver queuing models, Simulation – Monte Carlo technique – Inventory & Queuing problems.

UNIT V   DECISION MODELS   9
Theory of Games – Two person zero sum games – pure strategies – Mixed strategies – Principle of dominance – Graphical solutions – Algebraic solutions – LP solutions. Replacement models – types of failures – replacement of items: Efficiency deteriorates with time, sudden failures.

Total: 45

TEXT BOOKS
1. Wayne.L.Winston, Operations research applications and algorithms, 4th edition 2007, Thomson learning.
2. Hamdy.A.Taha, Operations research an introduction, 8th edition 2007, PHI / Pearson education.

REFERENCES
   1. G.Srinivasan, Operations research principles and applications, EEE 2007, PHI.
   2. R.Pannerselvam, Operations research, 2nd edition 2007, PHI
   3. Frederick. S. Hiller and Gerald.J.Lieberman, Operations research concepts and cases, 8th edition (SIE),TMH.
   4. Ravindran, Phillips and Solberg, Operations research principles and practice, 2nd edition 2007, Wiley India.
   5. J.K.Sharma, Operations research theory and aplications, 3rd edition 2007, Macmillan India.
   6. Prem kumar Gupta and D.S.Hira, Problems in Operations research, S.Chand.

PTME9025   **DESIGN FOR MANUFACTURING**   **L T P C**
                                                         3 0 0 3

AIM:

OBJECTIVE:

UNIT I   DESIGN FOR MANUFACTURING APPROACH AND PROCESS   9
Methodologies and tools, design axioms, design for assembly and evaluation, minimum part assessment. Taguchi method, robustness assessment, manufacturing process rules, designer's tool kit, Computer Aided group Technology, failure mode effective analysis, Value Analysis. Design for minimum number of parts, development of modular design, minimizing part variations, design of parts to be multi-functional, multi-use, ease of fabrication, Poka Yoke principles.

UNIT II   GEOMETRIC ANALYSIS   9
Surface finish, review of relationship between attainable tolerance grades and difference machining processes. Analysis of tapers, screw threads, applying probability to tolerances.

UNIT III   FORM DESIGN OF CASTINGS AND WELDMENTS   9
Redesign of castings based on parting line considerations, minimising core requirements, redesigning cast members using weldments, use of welding symbols.

UNIT IV   MECHANICAL ASSEMBLY   9
Selective assembly, deciding the number of groups, control of axial play, examples, grouped datum systems - different types, geometric analysis and applications - design features to facilitate automated assembly.

UNIT V   TRUE POSITION THEORY   9
Virtual size concept, floating and fixed fasteners, projected tolerance zone, assembly with gasket, zero true position tolerance, functional gauges, paper layout gauging, examples. Operation sequence for typical shaft type of components. Preparation of process drawings for different operations, tolerance worksheets and centrality analysis, examples.

TOTAL : 45 PERIODS

TEXT BOOKS :

1. Harry Peck, "Designing for Manufacture", Pitman Publications, 1983.

2. Matousek, "Engineering Design, - A Systematic Approach" - Blackie & Son Ltd., London, 1974.

REFERENCES :

1. Spotts M.F., "Dimensioning and Tolerance for Quantity Production, Prentice Hall Inc., 1983.

2. Oliver R. Wade, "Tolerance Control in Design and Manufacturing", Industrial Press Inc. New York Publications, 1967.

3. James G. Bralla, "Hand Book of Product Design for Manufacturing" McGraw Hill Publications, 1983.

4. Trucks H.E., "Design for Economic Production", Society of Manufacturing Engineers, michigan, 2nd edition, 1987.

PTGE9022 TOTAL QUALITY MANAGEMENT   **L T P C**
                                               3 0 0 3

UNIT I INTRODUCTION   9
Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM.

UNIT II TQM PRINCIPLES   9
Leadership – Strategic quality planning, Quality statements - Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS & TECHNIQUES I   9
The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV TQM TOOLS & TECHNIQUES II   9
Quality circles – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Cost of Quality – Performance measures.

UNIT V QUALITY SYSTEMS   9
Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT.

Total : 45

TEXT BOOK:

1. Dale H.Besterfiled, et at., "Total Quality Management", Pearson Education Asia, III Ed, Indian Reprint (2006).

REFERENCES:

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

PTME9402   **MECHATRONICS**

L T P C
3   0   0 3

OBJECTIVE
This syllabus is formed to create knowledge in Mechatronic systems and impart the source of concepts and techniques, which have recently been applied in practical situation. It gives a framework of knowledge that allows engineers and technicians to develop an interdisciplinary understanding and integrated approach to engineering.

UNIT I INTRODUCTION   **5**
Introduction to Mechatronics - Systems - Concepts of Mechatronics approach - Need for Mechatronics - Emerging area of Mechatronics - Classification of Mechatronics.

UNIT II SENSORS AND TRANSDUCERS   **12**
Introduction - Performance Terminology – Potentiometers - LVDT - Capacitance sensors - Strain gauges - Eddy current sensor - Hall effect sensor - Temperature sensors - Light sensors - Selection of sensors - Signal processing.

UNIT III MICROPROCESSOR AND INTERFACING   **13**
Introduction - Architecture - Pin configuration - Instruction set - Programming of Microprocessors using 8085 instructions - Interfacing input and output devices - Interfacing D/A converters and A/D converters - Applications - Temperature control - Stepper motor control - Traffic light controller.

UNIT IV PROGRAMMABLE LOGIC CONTROLLERS   **8**
Introduction - Basic structure - Input and output processing - Programming - Mnemonics-Timers, counters and internal relays - Data handling - Selection of PLC.

UNIT V DESIGN AND MECHATRONICS   **7**
Design process - stages of design process - Traditional and Mechatronics design concepts - Case studies of Mechatronics systems - Pick and place Robot - Engine Management system - Automatic car park barrier.

Total: 45

TEXT BOOK:
1. Bolton.W, "Mechatronics" , Pearson education, second edition, fifth Indian Reprint, 2003

REFERENCES:
1. Devadas Shetty and Richard A.Kolk, "Mechatronics systems design", PWS Publishing Company, 2007.
2. Smaili.A and Mrad.F , "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008
3. Godfrey C. Onwubolu, "Mechatronics Principles and Applications", Elsevier, 2006
4. Nitaigour Premchand Mahalik, "Mechatronics Principles, Concepts and Applicatlions" Tata McGraw-Hill Publishing company Limited, 2003.
5. Michael B.Histand and Davis G.Alciatore," Introduction to Mechatronics and Measurement systems". McGraw Hill International edition, 1999.
6. Bradley D.A, Dawson.D, Buru N.C and Loader A.J, "Mechatronics" Nelson Thornes ltd, Eswar press, Indian print, 2004.
7. Lawrence J.Kamm, "Understanding Electro-Mechanical Engineering – An Introduction to Mechatronics", Prentice Hall of India Pvt Ltd, 2000.
8. Dan Necsulescu, "Mechatronics", Pearson education, 2002.
9. Newton C.Braga, "Mechatronics Sourcebook", Thomson Delmar Learning, Eswar Press, 2003.

PTMF9351   COMPUTER INTEGRATED PRODUCTION MANAGEMENT SYSTEM

L T P C
3 0 0 3

AIM:
To enable the students to understand the importance of Computer Integrated Production Management System and related topics.

OBJECTIVE:
The course provides basic concepts of production planning and control, its bottlenecks, material requirement planning, shop floor control and different approaches to computer aided process planning in manufacturing sector.

UNIT I   PRODUCTION PLANNING AND CONTROL   10
Basic concepts – Types of production System - Functions of production planning and control – problems with Production Planning and Control – Computer Integrated Production Management System– Forecasting – Purpose and methods of forecasting – Single and Double Moving average methods – Single and Double exponential smoothing methods – Simple regression method of forecasting – errors in forecasting.

UNIT II   MATERIAL REQUIREMENT PLANNING   10
Basic MRP Concepts – Inputs to the MRP System – Master production Schedule – Bill of Materials, Inventory Record File – MRP Logic – Gross requirements, net requirements, lot sizing - MRP reports – Capacity Planning – Benefits of MRP – Manufacturing Resource Planning (MRP II).

UNIT III   SHOP FLOOR CONTROL   7
Functions of shop floor control – order scheduling – order progress – Data logging and acquisition – Automated data collection – Control types – Sensor Technology.

UNIT IV   COMPUTER AIDED PROCESS PLANNING   8
Need for process planning – Functions of process planning – Future trend of CAPP – Expert process planning system – case studies.

UNIT V   APPROACHES TO CAPP   10
Variant process planning – part family search – Generative method of CAPP – Forward and Backward planning – input format – part description methods – CAD Models – Decision Logic – Artificial Intelligence – Knowledge Representation – Databases and Algorithms – Automatic Process Planning – Programming Practice using C, C++ for Computer Integrated Production Management System Applications

TOTAL : 45 PERIODS

TEXT BOOKS
1. Mikell P.Groover, "Automation, Production Systems and Computer Integrated Manufacturing", Prentice Hall of India, 2004.
2. S.Kant Vajpayee, Principles of Computer Integrated Manufacturing, Prentice Hall of India, 2006

REFERENCES
1. Mikell P.Groover M.P., Emory W. Zimmers, "CAD/CAM, Computer Aided Design and Manufacturing", Prentice Hall of India, 2006..
2. Gideonha and Roland D.Well, "Principles of process planning", Chapman and Hall, 1995.
3. T.C.Chand, "Expert process planning for manufacturing", Addison Wesley publishing company, 1990.

PTMF9451   PROJECT WORK   **L T P C**
                                                                        0 0 6 6

The objective of project work is to enable the students, to work in convenient groups of not more than four members in a group, on a project involving some design and fabrication work or theoretical and experimental studies related to the respective engineering discipline.

Every project work shall have a guide who is a member of the faculty of the University. Twelve periods per week shall be allotted in the Time Table for this important activity and the students to receive directions from the guide, on library reading, laboratory work, and computer analysis, shall utilize this time. Or fieldwork as assigned by the guide and also to present in periodical seminars or viva to review the progress made in the project.

Each student shall finally produce a comprehensive report covering background information, literature-survey, problem statement, project work details, estimation of cost and conclusion. This final report shall be in typewritten form as specified in the guidelines.

The continuous assessment and semester evaluation may be carried out as specified in the guidelines to be issued from time to time.

PTMF9021 PRODUCT DESIGN AND DEVELOPMENT   **L T P C**

                                                                      3 0 0 3

AIM:

OBJECTIVE:

To impart knowledge on principles and practices of product design considering the customer wants and needs.

UNIT I
                                                                            9
Product Development process – Product development organizations, Gather raw data – Interpret raw data- organize the needs into a hierarchy – Relative importance of the needs.

UNIT II
                                                                            9
Establishing the product specifications,– Target specifications – Refining specifications, concept generation-Clarify the problem – Search internally – Search externally – Explore systematically.

UNIT III
                                                                            9
Concept selection- Screening – scoring, Product architecture – Implication of architecture – Establishing the architecture – Related system level design issues.

UNIT IV
                                                                            9
Need for industrial design – Impact of industrial design – Industrial design process – Management of industrial design process – Assessing the quality of industrial design, design for manufacturing- cost considerations, Impact of DFM decisions on other factors.

UNIT V
                                                                            9
Principles of prototyping – Planning for prototypes, economics of product development projects, Elements of economic analysis – Base – Case financial model – Sensitivity analysis – Influence of the quantitative factors.

                                                             TOTAL 45

TEXT BOOK:
1. Karal, T.Ulrich steven D.Eppinger, Product Design and Development, McGraw Hill, International Editions, 2003.

REFERENCES:
1. S.Rosenthal, Effective Product Design and Development, Irwin, 1992.
2. Charles Gevirtz Developing New products with TQM, McGraw Hill International Editions, 1994.

PTMF9022 NON DESTRUCTIVE TESTING　　　　　　　　**L T P C**

　　　　　　　　　　　　　　　　　　　　　　　　　　3 0 0 3

UNIT I　　　　　LIQUID PENETRANT AND MAGNETIC PARTICLE INSPECTION

　　　　　　　　　　　　　　　　　　　　　　　　　　　9

Liquid penetrant systems - processing cycles - inspection of surface defects - Generation of Magnetic fields - Magnetic particle inspection equipments - Demagnetization - Applications and limitations.

UNIT II　　　　RADIOGRAPHY　　　　　　　　　　　　11

Production of x-rays - Characteristic rays and white ray - Tube current and Voltage - Sources of 8 rays - Half life period - Penetrating power - Absorption of x and y rays - Radiation contrast and film contrast - exposure charts - pentameters and sensitivity - Safety.

UNIT III　　　　EDDY CURRENT INSPECTION　　　　　　7

Eddy current production - Impedance concepts - inspection of magnetic materials - inspection of non magnetic materials - influences of various parameters - Advantages and limitations.

UNIT IV　　　　ULTRASONIC TESTING　　　　　　　　10

Production of ultrasonic waves - Different types of waves - Normal beam inspection - Angle beam inspection - thickness measurements - Applications.

UNIT V　　　　RECENT TECHNIQUES　　　　　　　　8

Principles of acoustic emission - instrumentation for non destructive testing - Principles of holography - Applications of holographic techniques non destructive inspection - advantages and limitations - Other techniques.

　　　　　　　　　　　　　　　　　　　　　　　　L = 45

TEXT BOOK :

 1.　 Barry Hull and Vernon John, "Non Destructive Testing", Mac Millan, 1988.

REFERENCES :

 1.　Americal Society of Metals, Metals Hand Book, 9th Edition, Volume 11, (1980)
 2.　Birchan.D,Non Destructive Testing", Oxford University Press, 1977
 3.　Proceedings of the 10th International Acoustic Emission Symposium, Japanese Society for Non Destructive Inspection, Sendai, 1990.
 4.　Holler,P., "New Procedures in Non Destructive Testing" Springer Verlag , 1983.

PTMF9023 RAPID PROTOTYPING   **L T P C**
                                                                 3 0 0 3

UNIT I   INTRODUCTION :   **8**
Need – Principle – Impact of RP on Product Development – Benefits – Applications: Medical, Art, Engineering analysis, Functional.

UNIT II   POPULAR RAPID PROTOTYPING PROCESSES   10
Classification – Stereolithography – Selective Laser Sintering – Fused Deposition Modelling – Laminated Object Manufacturing, Solid Ground Curing, Working Principles, Applications, Advantages and Limitations.

UNIT III   OTHER SYSTEMS: **10**
Three dimensional Printing – Shape Deposition Manufacturing – Laser Engineering Net shaping (LENS) – Materials for Rapid Prototyping.

UNIT IV   CAD PROCESSES: **10**
Introduction – Data requirements – geometric modeling techniques – wireframe, surface and solid modeling – Data formats, Part orientation, Support structure slicing – Information work flow.

UNIT V   RECENT TRENDS: **7**
Microstereolithography,   Rapid Tooling – Rapid Manufacturing,Reverse Engineering: orthopedic,dental and related medical areas- cases and applications

                                                              L=45

TEXT BOOK :

1. KAI .C.C and FAI .L.K, Rapid Prototyping: Principles and Applications in Manufacturing, Wiley (Asia) Pte Ltd, Singapore , 1997.

REFERENCES :

1. Paul . f. Jacobs, Rapid Prototyping and Manufacturing, "Fundamentals of Stereolithography", McGraw Hill 1992.
2. Ibrahim Zeid, "CAD/CAM theory and practice", TATAMcGraw Hill, 1998.
3. D.T Pham and S.S.Dimov, "Rapid Manufacturing", Springer – verlog 2001.

PTMF9024 COMPUTER SIMULATION   **L T P C**
                                                                   3 0 0 3

UNIT I   INTRODUCTION   5

Concept of simulation - simulation as a decision making tool - Monte Carlo simulation.

UNIT II   RANDOM NUMBERS/VARIATES   9

Pseudo random numbers - methods of generating random variates – random variates for uniform, normal, binomial, poisson, exponential distributions.

UNIT III   DESIGN OF SIMULATION EXPERIMENTS   15

Problem formulation - data collection and reduction - logic developments - initial conditions - run length, tabular method of simulation – development of models using higher level languages for systems like queuing, production, inventory and maintenance - output analysis and interpretation, validation.

UNIT IV   DISCRETE SYSTEM SIMULATION LANGUAGES   8

Need for simulation language - Comparison of simulation languages: SIMSCRIPT, GASP, SIMULA, GPSS, PROMODEL, etc…- study of any one of the simulation language.

UNIT V   CASE STUDIES USING SIMULATION LANGUAGES   8

Development of simulation models using the simulation language studied for systems like, queuing systems, production systems, inventory systems, maintenance and replacement systems, investment analysis and network.

                                                                   L : 45

REFERENCES :
1. Jerry Banks and John S.Carson, Barry L Nelson, David M.Nicol, "Discrete event system simulation", Prentice Hall, India, 2000.
5. Shannon, R.E. "Systems simulation -The art and Science", Prentice Hall, 1975.
6. Thomas J.Schriber, "Simulation using GPSS", John Wiley, 1991.
7. Gordon .G, "Systems Simulation", Prentice Hall, 1987.

PTMF9025 QUALITY CONTROL AND RELIABILITY ENGINEERING   **L T P C**
                                                               3 0 0 3

UNIT I   STATISTICAL QUALITY CONTROL   9

Methods and Philosophy of Statistical Process Control - Control Charts for Variables and Attributes -Cumulative sum and Exponentially weighted moving average control charts - Other SPC Techniques – Process - Capability Analysis - Six sigma accuracy.

UNIT II   ACCEPTANCE SAMPLING   9

Acceptance Sampling Problem - Single sampling plans for attributes - double, multiple and sequential sampling -Military standards - The Dodge Roming sampling plans.

UNIT III   INTRODUCTION   9

Reliability function - MTBF - MTTF - mortality curve - availability - Maintainability.

UNIT IV   FAILURE DATA ANALYSIS   9

Repair time distributions - exponential, normal, log normal, gamma, and Weibull - reliability data requirements - Graphical evaluation.

UNIT V   RELIABILITY PREDICTION AND MANAGEMENT   9

Failure rate estimates - Effect of environment and stress - Series and Parallel systems - RDB analysis – Standby Systems - Complex Systems - Reliability demonstration testing - Reliability growth testing - Duane curve -Risk assessment - FMEA, Fault tree.

REFERENCES :
1. Mohamed Zairi, " Total Quality Management for Engineers ", Woodhead Publishing Limited 1991.
2. Harvid Noori and Russel, " Production and Operations mangament - Total Quality and Responsiveness ", McGraw-Hill Inc, 1995.
3. Suresh Dalela and Saurabh, ISO 9000 " A Manual for Total Quality Management ", S.Chand and Company Ltd., 1997.
4. John Bank, " The Essence of Total Quality Management ", Prentice Hall of India Pvt.Ltd., 1995.
5. Douglus C. Montgomery, " Introduction to Statistical Quality Control ", 2nd Edition, John Wiley and Sons, 1991.
6. Grant E.L and Leavensworth, " Statistical Quality Control ", McGraw-Hill, 1984.

PTMF9026   PROCESS PLANNING AND COST ESTIMATION   **L T P C**
                                                               3 0 0 3

UNIT I   PROCESS PLANNING   9

Types of Production - Standardization, Simplification - Production design and selection - Process planning, selection and analysis - Process planning, selection and analysis – Steps involved in manual experience based planning and computer aided process planning - Retrieval, generative - Selection of processes analysis - Breakeven analysis.

UNIT II   ESTIMATING AND COSTING   5

Importance and aims of Cost estimation - Functions of estimation - Costing - Importance and aims of Costing - Difference between costing and estimation - Importance of realistic estimates - Estimation procedure.

UNIT III   ELEMENT OF COST   12

Introduction - Material Cost - Determination of Material Cost Labour Cost - Determination of Direct Labour Cost - Expenses - Cost of Product (Ladder of cost) - Illustrative examples. Analysis of overhead expenses - Factory expenses - Depreciation - Causes of depreciation - Methods of depreciation - Administrative expenses - Selling and Distributing expenses - Allocation of overhead expenses.

UNIT IV   PRODUCT COST ESTIMATION   10

Estimation in forging shop - Losses in forging - Forging cost - Illustrative examples. Estimation in welding shop - Gas cutting - Electric welding - illustrative examples. Estimation in foundry shop - Estimation of pattern cost and casting cost - Illustrative examples.

UNIT V   ESTIMATION OF MACHINING TIME   9

Estimation of machining time for Lathe operations - Estimation of machining time for drilling, boring, shaping, planning, milling and grinding operations - Illustrative examples.
                                                               L= 45
TEXT BOOKS :
1. M.Adithan and B.S. Pabla, " Estimating and Costing ", Konark Publishers Pvt. Ltd., 1989.
2. A.K. Chitale and R.C. Gupta, " Product Design and Manufacturing ", Prentice Hall Pvt. Ltd., 1997.

REFERENCES :

1. Nanua Singh, " System approach to Computer Integrated Design and Manufacturing ",John Wiley & Sons, Inc., 1996.
2. Joseph G. Monks, " Operations Management, Theory & Problems ", McGraw Hill Book Company, 1982.
3. G.B.S. Narang and V.Kumar, " Production and Costing ", Khanna Publishers, 1995.
4. T.R. Banga and S.C. Sharma, " Estimating and Costing ", Khanna Publishers, 1986.

PTMF9027 PROCESSING OF PLASTICS AND COMPOSITE MATERIALS   L T P C
3 0 0 3

UNIT I   INTRODUCTION TO PLASTICS AND COMPOSITES   7

Chemistry and Classification of Polymers - Properties of Thermo Plastics - Properties of Thermosetting Plastics - Applications - Merits and Disadvantages. Fibres - Glass, Boron, Carbon, Organic, Ceramic and Metallic Fibers - Matrix Materials - Polymers, Metals and Ceramics.

UNIT II   PROCESSING OF PLASTICS   9
Extrusion - Injection Moulding - Blow Moulding - Compression and Transfer Moulding - Casting – Thermo Forming.

UNIT III   MACHINING AND JOINING OF PLASTICS   7
General Machining properties of Plastics - Machining Parameters and their effect - Joining of Plastics - Mechanical Fasteners - Thermal bonding - Press Fitting.

UNIT IV   PROCESSING OF POLYMER MATRIX COMPOSITES   13
Open Mould Processes, Bag Moulding, Compression Moulding with BMC and SMC - Filament winding - Pultrusion - Centrifugal Casting - Injection Moulding - Application of PMC's.

UNIT V   PROCESSING OF METAL MATRIX COMPOSITES   9
Solid State Fabrication Techniques - Diffusion Bonding - Powder Metallurgy Techniques - Plasma Spray, Chemical and Physical Vapour Deposition of Matrix on Fibres - Liquid State Fabrication Methods - Infiltration -Squeeze Casting - Rheo Casting - Compocasting - Application of MMCS.

L= 45

REFERENCES :

1. Harold Belofsky, Plastics : " Product Design and Process Engineering, Hanser Publishers, 1995.
2. Bera, E and Moet, A, " High Performance Polymers ", Hanser Publishers, 1991.
3. Hensen, F, " Plastics Extrusion technology ", Hanser Publishers, 1988.
4. Johannaber F, " Injection Moulding Machines ", Hanser Publishers, 1983.
5. Rauwendaal, C, " Polymer extrusion ", Hanser Publishers, 1990.
6. Rosatao, D.V., " Blow Moulding Handbook, Hanser Publisher, 1989.
7. Seamour,E.B., " Modern Plastics Moulding ", John Wiley.
8. John Dalmonte, " Plastics Moulding ", John Wiley.
9. Akira Kobyashi, " Machining of Plastics ", Mc-Graw Hill.
10. Kishan K.Chawla, " Composite Materials science and Engineering ", Springer-Verlag, 1987.
11. Agarwal. D. and Broutman L.J., " Analysis and Performance of Fiber Composites ", Wiley, 1990.
12. Mallick, P.K. and Newman, S. " Composite Materials Technology ", Hanser Publishers, 1990.

WEB REFERENCE :
1. www.innotech.ch/unsere-leistungen/gruppen/mec/Fvwo2_e.htm.

PTMF9028 NUCLEAR ENGINEERING **L T P C**
3 0 0 3

AIM:
To impart fundamental knowledge of nuclear power plants

OBJECTIVE:
To gain some fundamental knowledge about nuclear physics, nuclear reactor, nuclear fuels, reactors and safe disposal of nuclear wastes.

UNIT I NUCLEAR PHYSICS **9**
Nuclear model of an atom-Equivalence of mass and energy-binding- radio activity-half life-neutron interactions-cross sections.

UNIT II NUCLEAR REACTIONS AND REACTION MATERIALS **9**
Mechanism of nuclear fission and fusion- radio activity- chain reactions-critical mass and composition-nuclear fuel cycles and its characteristics-uranium production and purification-Zirconium, thorium, beryllium.

UNIT III REPROCESSING **9**
Reprocessing: nuclear fuel cycles-spent fuel characteristics-role of solvent extraction in reprocessing-solvent extraction equipment.

UNIT IV NUCLEAR REACTOR **9**
Nuclear reactors: types of fast breeding reactors-design and construction of fast breeding reactors-heat transfer techniques in nuclear reactors- reactor shielding. Fusion reactors.

UNIT V SAFETY AND DISPOSAL **9**
Safety and disposal: Nuclear plant safety-safety systems-changes and consequences of accident-criteria for safety-nuclear waste-types of waste and its disposal-radiation hazards and their prevention-weapons proliferation.

TOTAL : 45

TEXT BOOKS:

1. Thomas J.Cannoly, "Fundamentals of nuclear Engineering" John Wiley 1978.

REFERENCES:
1. Collier J.G., and Hewitt G.F, "Introduction to Nuclear power", Hemisphere publishing, New York. 1987
2. Wakil M.M.El., "Power Plant Technology" – McGraw-Hill International, 1984.

PTMF9029 TOTAL PRODUCTIVE MAINTENANCE L T P C
3 0 0 3

UNIT I MAINTENANCE CONCEPTS 6
Objectives and functions – Tero technology – Reliability Centered Maintenance (RCM) – maintainability prediction – availability and system effectiveness- maintenance costs – maintenance organization

UNIT II MAINTENANCE MODELS 9
Minimal repair – AGAN policy – maintenance types – balancing PM and breakdown maintenance- PM schedules: deviations on both sides of target values – PM schedules: functional characteristics – replacement models

UNIT III TOTAL PRODUCTIVE MAINTENANCE 12
Zero breakdowns – ZD and TPM – maximizing equipment effectiveness – Autonomous maintenance program – five pillars of TPM – TPM small group activities – TPM organization – Management Decision – Educational campaign – Creation of Organizations – Establishment of basic policies and goals – Formation of master plan. - TPM implementation

UNIT IV MAINTENANCE LOGISTICS 9
Human factors in maintenance – maintenance manuals – maintenance staffing methods – queuing applications – simulation – spare parts management – maintenance planning and scheduling

UNIT V ONLINE MONITORING 9
Condition monitoring – corrosion control – vibration monitoring, signature analysis – Wear Debris Monitoring (WDM) – MMIS - expert systems.

TOTAL : 45

TEXT BOOK :
    1.Seiichi Nakajima, "Introduction to TPM", Productivity Press, Chennai, 1992.

REFERENCES :
    1. Fumiu Goto, "Equipment planning for TPM Maintenance Prevention Design", Productivity Press, 1992.
    2. Kunio Shirose, "Total Productive Maintenance for Workshop Leaders", Productivity Press, 1992.
    3. Kunio Shirose, "TPM for Operators", Productivity Press, 1996.
    4. T. Suzuki, "New Directions for TPM", Productivity Press, 1993.
    5. Kelly .A, "Maintenance planning and control", Butterworths, London, 1991.

PTMF9030 MICRO-MACHINING PROCESSES   **L T P C**
                                                         3 0 0 3

UNIT I INTRODUCTION   8
Introduction to Micro system design. Material properties, micro fabrication technologies, structural behavior, sensing methods, fluid flow, micro scale transport, noise, amplifiers feedback systems.

UNIT II BASIC MICRO- FABRICATION AND MACHINING   10
Bulk Processes - Surface Processes - Sacrificial Processes and Bonding Processes Micro-machining processes for Microsystems – Tool for micro fabrication Micro-machining based on conventional machining processes - Special machining Laser beam micro machining - Electrical Discharge Machining - Ultrasonic Machining- Electro chemical Machining. Electron beam Machining.

UNIT III MICROMECHANICS   9
Microstructure of materials, its connection to molecular structure and its consequences on macroscopic properties- Phase transformations in crystalline solids including martensite, ferroelectric, and diffusional phase transformations, twinning and domain patterns, active materials.

UNIT IV INTEGRATION   9
Process Integration – CMOS transistor fabrication – bipolar Technology – multi level metallization, MEMS process integration processing on Non - Si substrates

UNIT V ELECTRICAL MANUFACTURING   9
Clean room – yield model – wafer IC manufacturing – feature micro fabrication technologies – PSM – IC industry – New Materials – Bonding and layer transfer - devices – micro fabrication industries.

                                                                L=45
TEXT BOOK :
1. Sami Franssile, "Introduction to Micro Fabrication", John Wiley & Sons Ltd., UK, 2004

REFERENCE :
1. Madore Mar J, "Fundamental of Micro Fabrication", CRC Press, 2002

PTMF9032 ARTIFICIAL INTELLIGENCE   **L T P C**
                                                3 0 0 3

UNIT I   INTRODUCTION   10

Definition - Pattern recognition - Criteria of Success - Production Systems - Control Strategies - Heuristic Search - Problem Characteristics - Production System Characteristics - Forward and backward reasoning – Matching Indexing - Heuristic Functions - Search Algorithms.

UNIT II   GAME PLAYING   8

Overview - Minimax search procedure - Adding Alpha - Beta cutoffs - Waiting for Quiescence – Secondary search - Using book moves.

UNIT III   KNOWLEDGE REPRESENTATION   10

Use of Predicate logic - Introduction to representation - representing simple facts in logic - augmenting the representation - resolution - Conversion to clause from - The basis of resolution-Unification of algorithm - Question answering - Natural Deduction.

UNIT IV   KNOWLEDGE REPRESENTATION USING OTHER LOGICS   8

Non-monotonic reasoning - Statistical and Probabilistic reasoning - Techniques for dealing with a random world and deterministic world - rule based system.

UNIT V   STRUCTURAL REPRESENTATIONS OF KNOWLEDGE   9

Common knowledge structures-Level of representation - Right structures - Declarative representations - Semantic nets - Conceptual dependency - Frames - Scripts - Procedural representation - Natural language understanding - Perception - learning - Implementation A.I. Systems

                                                         L=45

TEXT BOOK :
1.   Elaine Rich, "Artificial Intelligence", McGraw Hill Book Company.

REFERENCES :
   1. M.W.Richaugh, "Artificial Intelligence, A.Knowledge Based Apprach", PWS Rent Publishing, Boston.
   2. Charniac, E And M.C.Dermott, "Introduction to Artificial Intelligence", Addison Wesley Publishing Company.

PTMF9033 MECHANICAL VIBRATIONS AND NOISE　　　　**L T P C**
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AIM:

To impart the knowledge of effects of vibrations and noise, and the methods to control them in engineering applications.

OBJECTIVES:

(i) To understand the Fundamentals of Vibration and Noise and its practical applications.
(ii) To understand the working principle and operations of various vibrations and noise measuring instruments
(iii) To understand the various Vibration and Noise control strategies

UNIT I FUNDAMENTALS OF VIBRATION　　　　　　　　　　　　**9**
Introduction -Sources of vibration-Mathematical models-Types of vibration. Review of Single degree freedom systems with and without damping –Types of Damping-Dynamics of rotating and reciprocating engines– Critical speed of industrial rotors with specific reference to rigid and flexible rotors – Influence of type of bearings – Vibration isolation – Nonmetallic isolators

UNIT II TWO DEGREE FREEDOM SYSTEM　　　　　　　　　　　**8**
 Introduction- Free vibration of Undamped and damped system. Torsional system-Spring coupled system – mass coupled system – Vibration of two degree freedom system – Forced vibration with harmonic Excitation – Dynamic Vibration Absorber – Torsional Vibration Absorber-Vibration control.

UNIT III MULTI-DEGREE FREEDOM SYSTEM　　　　　　　　　**8**
Longitudinal, Transverse, Torsional systems, Geared systems Complexities - Normal mode of vibration – Flexibility Matrix and Stiffness matrix – Eigen values and eigen vectors – Orthogonal properties – Energy methods of Rayleigh, Ritz and Dunkerley

UNIT IV EXPERIMENTAL VIBRATION ANALYSIS　　　　　　　　**10**
Need for the experimental methods in Vibration analysis. Vibration Measuring Devices: seismometer, accelerometer and velometers-Vibration exciters: mechanical, hydraulic, electromagnetic and electrodynamic –Frequency measuring instruments: single reed, multi reed and stroboscope. Vibration meters and sound level meter. Signal conditioning devices: Filters, Amplifiers　 , Modulators/Demodulators, ADC/DAC. Signal analysis devices. Vibration recording and display devices. Experimental modal analysis. System Identification from frequency response

UNIT V ENGINEERING NOISE AND ITS CONTROL　　　　　　　**10**
Introduction-Sound Power, Sound Intensity and Sound pressure level. Sound spectra. The decibel scale-Decibel addition, subtraction and averaging- Loudness, Weighting networks, Equivalent sound level. Noise: Effects, Ratings and Regulations. Noise: Sources, Isolation and control-Industrial noise sources-Industrial noise control strategies-Noise control at the source, along the path and at the receiver.

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TEXT BOOKS:

1. Ambekar.A.G. "Mechanical Vibrations and Noise Engineering", Prentice Hall of India, New Delhi,2006
2. Rao, S.S.," Mechanical Vibrations," Addison Wesley Longman, 1995.

REFERENCES:

1. Thomson, W.T. – "Theory of Vibration with Applications", CBS Publishers and Distributors, New Delhi, 1990.
2. Den Hartog, J.P, "Mechanical Vibrations," Dover Publications, 1990.
3. Ramamurti. V, "Mechanical Vibration Practice with Basic Theory", Narosa, New Delhi, 2000.

PTMF9034   VALUE ENGINEERING AND REENGINEERING   **L T P C**
                                                        3 0 0 3

UNIT I   FUNDAMENTALS OF VALUE ENGINEERING   8
Value- Types –How to add value-Job plan – techniques employed- Who will do value engineering- Organizing the value engineering study-Benefits.

UNIT II   STEP BY STEP APPLICATION OF JOB PLAN   10
Selection of project and team members – general phase – information phase – function phase – creative phase – evaluation phase – Investigation phase – implementation phase - Audit

UNIT III   WORK SHEETS AND GUIDE LINES   9
Preparation of worksheets – general and information phase – Function Classification, relationship and summary- Meaningful costs- Cost analysis- Idea listing and Comparison – Feasibility ranking – Investigator phase, study summary – guidelines for writing value engineering proposal – Financial aspects – Life cycle cost analysis – Oral presentation – Audit – Case studies and Discussion.

UNIT IV   REENGINEERING PRINCIPLES   10
The 6 R's of organizational transformation and reengineering – process reengineering - preparing the workforce – Methodology – PMI leadership expectation – Production and service improvement model – Process improvement.

UNIT V   IMPLEMENTATION OF REENGINEERING   8
Process analysis techniques – Work flow analysis – Value analysis approach – Nominal group technique – Fish bone diagram – Pareto analysis – team building – Force fields analysis – Implementation.

                                                                L=45

TEXT BOOKS :

1. S.S.Iyer, "Value Engineering", New Age Information, 1996.
2. Del L. Younker, "Value Engineering" Marcel Dekker, Inc. 2003
3. M.S.Jayaraman and Ganesh Natarajan, "Business Process Reengineering", Tata McGraw Hill, 1994.

REFERENCES :

1. Dr.Johnson, A.Edosomwan, "Organizational Transformation and Process reengineering", British Library Cataloguing in publication data, 1996.

PTMF9035   ELECTRONICS MANUFACTURING TECHNOLOGY   L T P C
                                                           3 0 0 3

OBJECTIVE:

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

UNIT I   INTRODUCTION TO ELECTRONICS MANUFACTURING   8

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

UNIT II   COMPONENTS AND PACKAGING   9

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

UNIT III   SURFACE MOUNT TECHNOLOGY PROCESS   12

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

UNIT IV   INSPECTION AND TESTING   9

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

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

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

Total: 45

TEXT BOOKS

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

REFERENCES

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

PTIE9035 SUPPLY CHAIN MANAGEMENT　　　　　　　　　　　　**L T P C**
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OBJECTIVE:
To cover the basics of supply chain concepts, associated networks, tools and techniques required for evaluating various supply chain processes .

UNIT I　　　　STRATEGIC FRAMEWORK　　　　　　　　　　　　　　5
Objective, decision phases, process views, examples, strategic fit, supply chain drivers and metrics

UNIT II　　　　SUPPLY CHAIN NETWORKS　　　　　　　　　　　　10
Distribution networks, Facility networks and design options, Factors influencing, Models for facility location and capacity allocation, Transportation networks and design options, Evaluating network design decisions

UNIT III　　　MANAGING DEMAND AND SUPPLY IN A SUPPLY CHAIN　　10
Predictable variability in a supply chain, Economies of scale and uncertainty in a supply chain – Cycle and safety Inventory, Optimum level of product availability, Forward Buying, Multi-echelon cycle inventory

UNIT IV　　　SOURCING AND PRICING IN A SUPPLY CHAIN　　　　10
Cross-Functional drivers, Role of sourcing in a supply chain, Logistics providers, Procurement process, Supplier selection, Design collaboration, Role of Pricing and Revenue Management in a supply chain

UNIT V　　　　INFORMATION TECHNOLOGY AND COORDINATION IN A SUPPLY
**　　　　　　　　　CHAIN　　　　　　　　　　　　　　　　　　　　10**
The role of IT in supply chain, The supply chain IT frame work, Customer Relationship Management, Supplier relationship management, Future of IT in supply chain, E-Business in supply chain, Bullwhip effect – Effect of lack of co-ordination in supply chain, Building strategic partnerships, CPFR

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TEXT BOOK
1. Sunil Chopra and Peter meindl, "Supply Chain Management , Strategy, Planning, and operation", PHI, Third edition,2007

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

PTME9022   NEW AND RENEWABLE SOURCES OF ENERGY   L T P C
3 0 0 3

AIM:
To instruct the importance of renewable energy and its utilization for the thermal and electrical energy needs and also the environmental aspects of theses resources.

OBJECTIVE:
At the end of the course, the student expected to do Understand and analyze the pattern of renewable energy resources Suggest methodologies / technologies for its utilization Economics of the utilization and environmental merits

UNIT I SOLAR ENERGY   9
Solar Radiation – Measurements of solar Radiation and sunshine – Solar Thermal Collectors – Flat Plate and Concentrating Collectors – Solar Applications – fundamentals of photo Voltaic Conversion – solar Cells – PV Systems – PV Applications.

UNIT II WIND ENERGY   9
Wind Data and Energy Estimation – wind Energy Conversion Systems – Wind Energy generators and its performance – Wind Energy Storage – Applications – Hybrid systems.

UNIT III BIO - ENERGY   9
Biomass, Biogas, Source, Composition, Technology for utilization – Biomass direct combustion – Biomass gasifier – Biogas plant – Digesters – Ethanol production – Bio diesel production and economics.

UNIT IV OTEC, TIDAL, GEOTHERMAL AND HYDEL ENERGY   9
Tidal energy – Wave energy – Data, Technology options – Open and closed OTEC Cycles – Small hydro, turbines – Geothermal energy sources, power plant and environmental issues.

UNIT V NEW ENERGY SOURCES   9
Hydrogen, generation, storage, transport and utilisation, Applications : power generation, transport – Fuel cells – technologies, types – economics and the power generation
Total 45

TEXT BOOKS:
1. G.D. Rai, Non Conventional Energy Sources, Khanna Publishers, New Delhi, 1999.
2. S.P. Sukhatme, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

REFERENCES:

1. Godfrey Boyle, Renewable Energy, Power for a Sustainable Future, Oxford University Press, U.K., 1996.
2. Twidell, J.W. & Weir, A., Renewable Energy Sources, EFN Spon Ltd., UK, 1986.
3. G.N. Tiwari, solar Energy – Fundamentals Design, Modelling & applications, Narosa Publishing House, New Delhi, 2002.
4. L.L. Freris, Wind Energy Conversion systems, Prentice Hall, UK, 1990.

PTME9032   **COMPUTATIONAL FLUID DYNAMICS**   **L T P C**
                                                                       3 0 0 3

AIM:

To impart the knowledge of numerical techniques to the solution of fluid dynamics and heat transfer problems.

OBJECTIVE:

To introduce Governing Equations of vicous fluid flows
- i)   To introduce numerical modeling and its role in the field of fluid flow and heat transfer
- ii)   To enable the students to understand the various discretization methods, solution procedures and turbulence modeling.
- iii)   To create confidence to solve complex problems in the field of fluid flow and heat transfer by using high speed computers.

PREREQUISITE :   Fundamental Knowledge of partial differential equations, Heat Transfer and Fluid Mechanics

UNIT I GOVERNING EQUATIONS AND BOUNDARY CONDITIONS   8

Basics of computational fluid dynamics – Governing equations of fluid dynamics – Continuity, Momentum and Energy equations – Chemical species transport – Physical boundary conditions – Time-averaged equations for Turbulent Flow – Turbulent–Kinetic Energy Equations – Mathematical behaviour of PDEs on CFD - Elliptic, Parabolic and Hyperbolic equations.

UNIT II FINITE DIFFERENCE METHOD   9

Derivation of finite difference equations – Simple Methods – General Methods for first and second order accuracy – solution methods for finite difference equations – Elliptic equations – Iterative solution Methods – Parabolic equations – Explicit and Implicit schemes – Example problems on elliptic and parabolic equations.

UNIT III FINITE VOLUME METHOD (FVM) FOR DIFFUSION   9
Finite volume formulation for steady state One, Two and Three -dimensional diffusion problems.   One dimensional unsteady heat conduction through Explicit, Crank – Nicolson and fully implicit schemes.

UNIT IV FINITE VOLUME METHOD FOR CONVECTION DIFFUSION   10
Steady one-dimensional convection and diffusion – Central, upwind differencing schemes-properties of discretization schemes – Conservativeness, Boundedness, Trasnportiveness, Hybrid, Power-law, QUICK Schemes.

UNIT V CALCULATION FLOW FIELD BY FVM   9
Representation of the pressure gradient term and continuity equation – Staggered grid – Momentum equations – Pressure and Velocity corrections – Pressure   Correction equation, SIMPLE algorithm and its variants. Turbulence models, mixing length model, two equation (k-Є) models – High and low Reynolds number models
                                                                       TOTAL : 45

TEXT BOOKS:

1. T.J. Chung, Computational Fluid Dynamics, Cambridge University, Press, 2002.
2. Versteeg, H.K., and Malalasekera, W., An Introduction to Computational Fluid Dynamics: The finite volume Method, Longman, 1998.
3. Ghoshdastidar , P.S., computer Simulation of flow and heat transfer, Tata McGraw Hill Publishing Company Ltd., 1998.

REFERENCES:

1. Patankar, S.V. Numerical Heat Transfer and Fluid Flow, Hemisphere Publishing Corporation, 2004.
2. Muralidhar, K., and Sundararajan, T., computationsl Fluid Flow and Heat Transfer, Narosa Publishing House, NewDelhi, 1995.
3. Ghoshdastidar P.S., Heat Transfer, Oxford Unversity Press, 2005.
4. Prodip Niyogi, Chakrabarty .S.K., Laha .M.K. Introduction to Computational Fluid Dynamics, Pearson Education, 2005.
5. Introduction to Computational Fluid Dynamics Anil W. Date Cambridge University Press, 2005.

PTGE9021   **PROFESSIONAL ETHICS IN ENGINEERING**   **L T P C**
                                                                3 0 0 3

AIM:

OBJECTIVE:

UNIT I ENGINEERING ETHICS   **9**
Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION   **9**
Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY   **9**
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal

UNIT IV RESPONSIBILITIES AND RIGHTS   **9**
Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

UNIT V GLOBAL ISSUES   **9**
Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct

                                                                    Total : 45

TEXT BOOKS:

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

REFERENCES:

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

PTGE9023   **FUNDAMENTALS OF NANOSCIENCE**

AIM:

OBJECTIVE:

UNIT I INTRODUCTION 10

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

UNIT II PREPARATION METHODS 10

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

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 5

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

UNIT IV PREPARATION ENVIRONMENTS 10

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

UNIT V CHARECTERISATION TECHNIQUES 10

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

TOTAL 45

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

REFERENCES:

1. G Timp (Editor), "Nanotechnology", AIP press/Springer, 1999
2. Akhlesh Lakhtakia (Editor), "The Hand Book of Nano Technology,Nanometer Structure", Theory, Modeling and Simulations", Prentice-Hall of India (P) Ltd, New Delhi, 2007.

PTMG9072   **ENTREPRENEURSHIP DEVELOPMENT**

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AIM:
To provide an understanding of the scope of an entrepreneur.

OBJECTIVE:
To develop confidence on financial assistance by the institutions, methods of taxation and tax benefits, etc.

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

UNIT II MOTIVATION   **9**
Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Entrepreneurial skills - Self Rating, Business Game, Thematic Appreciation Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.

UNIT III BUSINESS   **9**
Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.

UNIT IV FINANCING AND ACCOUNTING   **9**
Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital, Costing, Break Even Analysis, Network Analysis Techniques of PERT / CPM – Taxation – Income Tax, Excise Duty – Sales Tax.

UNIT V SUPPORT TO ENTREPRENEURS   **9**
Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion, Diversification, Joint Venture, Merger and Sub Contracting.

Total : 45

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

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