ANNA UNIVERSITY : : CHENNAI – 600 025

UNIVERSITY DEPARTMENTS

R – 2008

B.TECH. RUBBER & PLASTICS TECHNOLOGY

III – VIII SEMESTERS CURRICULUM AND SYLLABI

SEMESTER – III

CODE NO	THEORY	L	T	P	C
THEORY					
MA 9211	Mathematics III	3	1	0	4
AE 9201	Engineering Fluid Mechanics	3	1	0	4
EI 9211	Electronics and Instrumentation	3	0	0	3
RP 9201	Physical and Organic Chemistry	3	0	0	3
AU 9201	Thermodynamics & Thermal Engineering	3	1	0	4
AU 9202	Solid Mechanics	3	1	0	4
PRACTICAL					
PR 9202	Computer Aided Parts & Assembly Drawing	0	0	3	2
PR 9203	Mechanical Sciences Laboratory	0	0	3	2
	TOTAL	**18**	**4**	**6**	**26**

SEMESTER – IV

CODE NO	THEORY	L	T	P	C
THEORY					
MA 9262	Numerical Methods	3	1	0	4
PR 9251	Theory of Machines	3	1	0	4
RP 9251	Basics of Polymers	3	0	0	3
RP 9252	Rubber Materials	3	0	0	3
RP 9253	Fundamentals of Chemical Engg. Operation	3	0	0	3
RP 9254	Polymer Physics	3	0	0	3
PRACTICALS					
EI 9261	Electrical and Electronics Engineering Lab	0	0	3	2
RP 9261	Polymer Science Lab	0	0	3	2
	TOTAL	**18**	**2**	**6**	**24**

SEMESTER – V

CODE NO	THEORY	L	T	P	C
THEORY					
PR 9303	Machine Design	3	1	0	4
RP 9301	Plastics Materials	4	0	0	4
RP 9302	Rubber Processing and Machinery	3	0	0	3
RP 9303	Rubber Compounding	3	0	0	3
RP 9304	Latex Technology	3	0	0	3
	Elective – 1	3	0	0	3
PRACTICALS					
RP 9305	Rubber Processing Lab	0	0	3	2
RP 9306	Rubber Materials Lab	0	0	3	2
RP 9307	Technical Seminar	0	0	2	1
PR 9306	Computer Aided Design Lab	0	0	3	2
	TOTAL	**19**	**1**	**11**	**27**

SEMESTER VI

CODE NO	THEORY	L	T	P	C
THEORY					
RP 9351	Testing of Rubber and Plastics	4	0	0	4
RP 9352	Plastics Processing and Machinery	3	0	0	3
RP 9353	Product Design & Engg. Application of Polymers	4	0	0	4
RP 9354	Polymer Characterization Techniques	3	0	0	3
	Elective II	3	0	0	3
	Elective III	3	0	0	3
PRACTICAL					
GE 9371	Communication Skills and Soft Skills Lab	0	0	2	1
RP 9355	Plastics Processing Lab	0	0	3	2
RP 9356	Rubber Testing Lab	0	0	3	2
RP 9357	Design & Drawing of Moulds and Dies Lab	0	0	3	2
	TOTAL	**20**	**0**	**11**	**27**

SEMESTER – VII

CODE NO	THEORY	L	T	P	C
THEORY					
RP 9401	Polymer Composites	3	0	0	3
RP 9402	Technology of Tyres and Tubes	3	0	0	3
RP 9403	Polymer Recycling	3	0	0	3
	Elective IV	3	0	0	3
	Elective V	3	0	0	3
PRACTICALS					
RP 9404	Design Project	0	0	4	2
RP 9405	Industrial Training *	-	-	-	2
RP 9406	Plastics Testing Lab	0	0	3	2
RP 9407	Comprehension and Seminar	0	0	4	2
	TOTAL	**15**	**0**	**11**	**23**

* Four weeks of training during 6th semester Vacation

SEMESTER – VIII

SL.NO	CODE NO	THEORY	L	T	P	C
THEORY						
1.		Elective – VI	3	0	0	3
PRACTICAL						
1.	RP 9451	Project Work	-	-	12	6
		TOTAL	**3**	**0**	**12**	**9**

LIST OF ELECTIVES

FOR B.TECH. RUBBER AND PLASTICS TECHNOLOGY

CODE .NO	COURSE TITLE	L	T	P	C
AE 9306	Experimental Stress Analysis	3	0	0	3
AE 9354	Finite Element Method	3	0	0	3
IE 9311	Principles of Management	3	0	0	3
GE 9021	Professional Ethics in Engineering	3	0	0	3
GE 9022	Total Quality Management	3	0	0	3
GE 9023	Fundamentals of Nano Science	3	0	0	3
RP 9021	Adhesives and Surface Coatings	3	0	0	3
RP 9022	Multi phase polymer systems	3	0	0	3
RP 9023	Fibres and Engineering Materials in Polymer Products	3	0	0	3
RP 9024	Footwear Technology	3	0	0	3
RP 9026	Product Design and Cost Estimation	3	0	0	3
PR 9402	Engineering Management	3	0	0	3
RP 9029	Polymer Components in Automotive Applications	3	0	0	3
RP 9030	Rubber Machinery	3	0	0	3
RP 9031	Plastics Machinery	3	0	0	3
RP 9032	Entrepreneurship Development	3	0	0	3

MA 9211 **MATHEMATICS III** **L T P C**
(Common to all branches of B.E / B.Tech. programmes) **3 1 0 4**

UNIT I FOURIER SERIES 9+3

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

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation – Solutions of first order equations – Sandard 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 III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

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

UNIT IV FOURIER TRANSFORM 9+3

Fourier integral theorem – Fourier transform pair-Sine and Consine transforms – Properties – Transform of simple function – Convolution theorem - Parseval's identity.

UNIT V Z – TRANSFORM AND DIFFERENCE EQUATION 9+3

Z-transform-Elementary properties-Inverse z transform – Convolution theorem-Formation of difference equation-Solution of difference equation using z transform.

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

TEXT BOOK

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

REFERENCES

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

AE 9201 ENGINEERING FLUID MECHANICS L T P C
3 1 0 4

UNIT I BASIC CONCEPTS 15

Introduction – Fluid properties – Newton's viscosity law – Classification of fluids and fluid motion – Fluid statics – Hydrostatic force on submerged surfaces – stability of floating bodies – Dimensional analysis – The Buckingham-Pi theorem – Significant dimensionless groups – Flow similarity and model studies

UNIT II BASIC EQUATIONS OF FLUID FLOW ANALYSIS 15

Basic laws for a system in integral form – Conservation of mass – Newton's 2^{nd} law – Laws of thermodynamics – Application of the basic laws for a control volume – Kinematics – Motion of a fluid particle – Fluid deformation – Differential analysis of fluid motion – Continuity equation – Differential momentum equation – The Navier Stokes equations

UNIT III INCOMPRESSIBLE INVISCID FLOW 8

Euler's equations of motion – Bernoulli's equations – Applications – Methods of pressure measurement – Flow measurement – Orifice plate – Venturi meter – Irrotational flow – Stream function and velocity potential – Laplace equation – Elementary plane flows

UNIT IV INCOMPRESSIBLE VISCOUS FLOW 8

Fully developed laminar flow between infinite parallel plates – Laminar and turbulent flow through pipes – Velocity profiles – Energy considerations in pipe flow – Calculation of head loss Pipe flow problems – Hydraulic and energy grade lines – Moody's diagram

UNIT V FLUID MACHINERY 14

Introduction and classification of fluid machines – Turbo machinery analysis – The angular momentum principle – Euler turbo machine equation – Velocity triangles – Application to fluid systems – Working principle of turbines, fans, blowers, pumps and compressors.

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

TEXT BOOKS

1. Shames I H, 'Mechanics of Fluids', Kogakusha, Tokyo, 1998
2. Robert W Fox & Alan T Mc.Donald, 'Introduction to fluid Mechanics', John Wiley and Sons, 1995,

REFERENCES

1. Yuan S W, 'Foundations of fluid Mechanics', Prentice-Hall, 1987
2. Milne Thompson L M, 'Theoretical Hydrodynamics', MacMillan, 1985
3. Rathakrishnan, E, 'Fundamentals of Fluid Mechanics', Prentice-Hall, 2007

EI 9211 ELECTRONICS AND INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVE

- To impart knowledge on basic concepts of electronic components, devices and circuits
- To impart knowledge on measurements and instruments

UNIT I ELECTRONIC COMPONENTS AND DEVICES 10

Resistors, Capacitors, Inductors and Transformers - properties, types. Simple PN Junction Diodes, Zener diode, Bipolar Junction transistor and Field Effect Transistors – operating principles and characteristics. Other Devices – UJT, SCR, LED, Photodetectors.

UNIT II ANALOG CIRCUITS 10

Rectifier and Power Supply Circuits, clipper, clamper using diodes, Operational Amplifiers (Ideal) – properties and typical circuits like differentiator, integrator, summer, comparator, single-stage BJT's and FET's amplifiers – Multistage Amplifier Principles(Qualitative Treatment only).

UNIT III DIGITAL CIRCUITS 10

Basics of Boolean Logic – Logic Gates, Flip-Flops, Shift-Registers, Counters, Decoders/Drivers, Timer, Display Devices, A/D and D/A Converters.

UNIT IV MEASUREMENTS AND INSTRUMENTS 7

Definitions of Accuracy, Precision, Sensitivity, Resolution, Linearity, Range, Measurement of Electrical Quantities – Voltmeter, Ammeter, Watt-Meter, DMM, CRO, DSO, Transducers and signal conditioning systems for pressure, temperature, acceleration measurements (Qualitative Treatment only).

UNIT V MICROPROCESSORS AND APPLICATIONS 8

Architecture of 8085 processors, Address Modes, Instruction set, simple programming like addition, subtraction, multiplication, logical operation, Peripherals and Interfacing – 8255, 8251. Applications like motor control, keyboard and PC interface, Introduction to Microcontrollers.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Millman.J. and Halkias.C., "Integrated Electronics", Tata McGraw Hill, 2004.
2. Paul Horowitz and Wilfred Hill "The Art of Electronics", Cambridge University press,1989.

REFERENCES

1. Donald P Leach, Albert Paul Malvino and Goutam Saha," Digital Principles & Applications",6E, Tata McGraw Hill, 2006.
2. A.K.Sawhney, A course in Electrical and Electronic Measurement and Instrumentation", Dhanpat Raj. and Sons, New Delhi, 1999
3. Helfrick.A.D., and Cooper.W.D., '"Electronic Instrumentation and Measurement techniques", Prentice Hall of India, 1998.
4. Gaonkar. Ramesh S, " Microprocessor Architecture Programming and Applications with 8085", 5th Ed. Penram International Publishing (India). 2003 .
5. Kenneth J.Ayala., "The 8051 Microcontroller Architecture Programming and Applications", 2ed, Penram International Publishing (India).2004.

RP 9201 PHYSICAL AND ORGANIC CHEMISTRY L T P C
3 0 0 3

UNIT I CHEMICAL KINETICS AND CATALYSIS 9

Chemical Kinetics – Order – Molecularity – rate of reaction – activation energy – Polymerization kinetics – Catalysis – Surface science – Application of catalysis – Phase rule - applications.

UNIT II ELECTRO CHEMISTRY / CORROSION 9

Electro Chemistry – Electrochemical series – Transport numbers and ionic mobility – Buffer indicators - redox reaction – potentiometric, conductometric, polarographic studies – Galvanic cells – Electrolysis – Thermodynamic parameters.

UNIT III STRUCTURE AND REACTIVITY IN ORGANIC COMPOUNDS 9

Bonding in Organic Compounds- Structure-property relationships - Electronic effects like inductive, mesomeric, electromeric and hyper conjugation effects – free radicals, carbo cations, carbanions, elementary ideas about stereo chemistry

UNIT IV DETAILS OF REACTION MECHANISMS 9

Free radical substitutions, Electophilic addition, Aromatic Electrophilic substitutions, Nucleophilic additions, condensation reactions, nucleophilic substitutions in aliphatic and aromatic compounds, cyclo additions, rearrangements, uses of these reactions in polymer preparation

UNIT V ORGANIC SUBSTANCES OF IMPORTANCE TO POLYMER TECHNOLOGY 9

Amines, heterocyclic compounds – furan, thiophene, pyrrole, pyridine, quinoline, iso quinoline, imidazoles, thiazoles

Preparation , properties and uses of simple monomers like ethylene, propylene, isobutylene, butadiene, styrene, methyl methacrylate , diisocyanates, glycols, polyols, epichlorohydrin, fluoro alkenes, acrylonitrile, vinyl chloride, vinyl acetate

TOTAL : 45 PERIODS

REFERENCES

1. Glasstone, S., and Lewis, D., Elements of Physical Chemistry, Macmillan India Press, Madras, 1995.
2. Maron and Pruton C.F., Physical Chemistry Macmillan, 1990.
3. Morrison and Boyd, Organic Chemistry Prentice Hall, N.Dli 1992
4. Finar I.L., Textbook of Organic Chemistry, ELBS, 1996.

AU 9201 THERMODYNAMICS AND THERMAL ENGINEERING L T P C
3 1 0 4

OBJECTIVE

- To introduce fundamental concepts in thermodynamics, heat tramsfer, propulsion and refrigeration and air conditioning.

UNIT I BASIC THERMODYNAMICS 16

Systems, Zeroth low, First law. Steady flow energy equation. Heat and work transfer in flow and non-flow processes. Second law, Kelvin-Planck statement - Clausius statement - Concept of Entropy, Clausius inequality, Entropy change in non-flow processes. Properties of gases and vapours.

UNIT II AIR CYCLE AND COMPRESSORS 12

Otto, Diesel, Dual combustion and Brayton cycles. Air standard efficiency . Mean effective pressure, Reciprocating compressors.

UNIT III STEAM AND JET PROPULSION 12

Properties of steam – Rankine cycle – Steam Nozzles – Simple jet propulsion system – Thrust rocket motor – Specific impulse.

UNIT IV REFRIGERATION AND AIR-CONDITIONING 10

Principles of Psychrometry and refrigeration - Vapour compression - Vapour absorption types - Co-efficient of performance, Properties of refrigerants – Basic Principle and types Air conditioning.

UNIT V HEAT TRANSFER 10

Conduction in parallel, radial and composite wall – Basics of Convective heat transfer - Fundamentals of Radiative heat transfer – Flow through heat exchangers.

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

(Use of standard thermodynamic tables, Mollier diagram and Refrigerant property tables are permitted)

TEXT BOOKS

1. Nag.P.K., “Engineering Thermodynamics”, Tata McGraw-Hill, New Delhi, 2007.
2. Rathakrishnan E., “Fundamentals of Engineering Thermodynamics”, Prentice-Hall India, 2005.

REFERENCES

1. Ramalingam K.K. “Thermodynamics”, Sci-Tech Publications, 2006
2. Holman.J.P., “Thermodynamics”, 3rd Ed. McGraw-Hill, 2007.
3. Venwylen and Sontag, “Classical Thermodynamics”, Wiley Eastern, 1987
4. Arora C.P, “ Thermodynamics”, Tata McGraw-Hill, New Delhi, 2003.
5. Merala C, Pother, Craig W, Somerton, “ Thermodynamics for Engineers”, Schaum Outline Series, Tata McGraw-Hill, New Delhi, 2004.

AU 9202 **SOLID MECHANICS** **L T P C**
3 1 0 4

OBJECTIVE

- To introduce concepts related to behaviour of deformable bodies under various loadings of the different structural elements like bar, beam, shaft and column

UNIT I AXIAL LOADING 12

Stresses and strains – Hooke's law – stress and strain diagrams - elastic constants – statically determinate and indeterminate problems in tension & compression – thermal stresses – impact loading.

UNIT II STRESSES IN BEAMS 10

Shear force & bending moment diagrams – bending stresses – shear stress variation in beams of symmetric sections – beams of uniform strength.

UNIT III DEFLECTION OF BEAMS 12

Double integration method – Macaulay's method – moment area method – conjugate beam method – principle of superposition – Strain Energy in axial, bending, torsion and shear loadings. Castigliano's theorems and their applications.

UNIT IV TORSION – SPRINGS – COLUMNS 14

Torsion of solid and hollow circular shafts – shear stress variation – power transmission in shafts – open and closed-coiled helical springs – stresses in helical springs – classification of columns – Euler buckling – columns with different end conditions.

UNIT V BIAXIAL STRESSES 12

Stresses in thin-walled pressure vessels – combined bending, torsion and axial loading of circular shafts – Mohr's circle and its construction – determination of principal stresses.

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

TEXT BOOKS

1. Gere & Timoshenko, 'Mechanics of Materials', McGraw Hill, 1993
2. William Nash, Strength of Materials, Tata McGraw Hill, 2004

REFERENCES

1. Dym,C.L., and Shames,I.H., 'Solid Mechanics', McGraw Hill, Kogakusha, Tokyo, 1973.
2. Stephen Timoshenko, 'Strength of Materials', Vol I & II, CBS Publishers and Distributors, Third Edition.
3. R.K.Rajput, 'Strength of Materials', S. Chand and Co., 1999.
4. Timoshenko,S. and Young,D.H., Elements of Strength of Materials,
5. T.Van Nostrand Co. Inc., Princeton, N.J., 1977.

PR 9202 COMPUTER AIDED PARTS & ASSEMBLY DRAWING L T P C
0 0 3 2

OBJECTIVE

- To train the students in construction of machine elements and assembly

DRAWING

Train the students to allocate geometrical tolerances and to develop part drawing

INSTRUCTION

Instruction to machine drawing & production drawing classification of drawing-BIS conventions – Orthogrphic and sectional views. Reviews of the concepts of limits, tolerance, fits, surface roughness, and symbols terminology used in Production drawing. Machine element joints – Types of joints – Screw fasteners – Pin joints, couplings welded joints.

COMPUTER AIDED PRODUCTION DRAFTING

Detailed part drawing and assembly drawings (with suitable tolerances, machine symbols, specification of fit).

1. Screw jack
2. Shaper tool head
3. Non return valve
4. Plummer block
5. Foot step drawing
6. Machine vice
7. Four jaw chuck of lathe
8. Lathe tail stock
9. Square tool post
10. Universal coupling
11. Hydraulic & Pneumatic Assembly

TOTAL : 45 PERIODS

TEXT BOOK

1. Narayana K.L., Kannaiah P and Venkata Reddy – “Production Drawing” New age International Limited, Delhi 2004.

REFERENCES

1. Bhat N.D., “Machine Drawing”, Charotar Publishing House, Anand 2000
2. Nagtal G.R., “Machine Drawing”, Khanna Publishers, New Delhi 1994.
3. Sache Singh & P.L. Shah – Fundamentals of Machine Drawing, Prentice Hall India, 2003.

PR 9203 MECHANICAL SCIENCES LAB L T P C
0 0 3 2

OBJECTIVE

- To train the students in testing and quantifying the mechanical properties of Engineering Materials, Engines and Heat Exchangers

LIST OF EXPERIMENTS

1. Tension Test
2. Torsion Test
3. Testing of springs
4. Impact test i) Izod, ii) Charpy
5. Hardness test i) Vickers, ii) Brinell, iii) Rockwell, iv) Shore
6. Deflection of Beams
7. Dye Penetrant Test
8. Performance test on a 4 storke engine
9. Viscosity determination of the given fluid
10. Moment of inertial of connecting rod
11. Determination of Effectiveness of a parallel and counter flow heat exchangers
12. Valve timing of a 4 stroke engine and port timing of a 2 stroke engine

TOTAL : 45 PERIODS

MA 9262 NUMERICAL METHODS L T P C
3 1 0 4

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 10 +3

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

UNIT II INTERPOLATION AND APPROXIMATION 8 + 3

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

UNIT III NUMERICAL DIFFERENTATION AND INTEGRATION 9 + 3

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

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

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

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

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

L : 45 T : 15 TOTAL : 60 PERIODS

TEXT BOOKS

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

REFERENCE BOOKS

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

PR 9251 THEORY OF MACHINES L T P C
3 1 0 4

OBJECTIVES

- To understand the basic concepts of mechanisms and machinery

UNIT I MECHANISMS 14

Definition – Machine and Structure – Kinematic link, pair and chain – classification of Kinematic pairs – Constraint & motion – Degrees of freedom - Slider crank – single and double – Crank rocker mechanisms – Inversions, applications – Introduction to Kinematic analysis and synthesis of simple mechanisms – Determination of velocity and acceleration of simple mechanisms.

UNIT II FRICTION 12

Types of friction – friction in screw and nut – screw jack – pivot, collar and thrust bearings – plate and cone clutch – belt (flat & vee) and rope drives – creep in belts – open and crossed belt drives – Ratio of tensions – Effect of centrifugal and initial tensions – condition for maximum power transmission.

UNIT III GEARING AND CAMS 12

Gear – Types and profile – nomenclature of spur & helical gears – laws of gearing – interference – requirement of minimum number of teeth in gears – gear trains – simple, compound and reverted gear trains – determination of speed and torque in epicyclic gear trains – cams different types of followers – Cam – Types of cams and followers – Cam design for different follower motions.

UNIT IV BALANCING 11

Static and dynamic balancing – single and several masses in different planes – primary and secondary balancing of reciprocating masses – Balancing of single and multi cylinder engines – Governors and Gyroscopic effects.

UNIT V VIBRATION 11

Free, forced and damped vibrations of single degree of freedom systems – force transmitted to supports – vibration Isolation – vibration absorption – torsional vibration of shafts – single and multirotor systems – geared shafts – critical speed of shafts.

L 45 , T : 15, TOTAL : 60 PERIODS

TEXT BOOKS

1. Bansal Dr.R.K. " Theory of Machines" Laxmi Publications (P) Ltd., New Delhi 2001
2. Rattan S.S."Theory of machines" Tata McGraw Hill publishing Co., New Delhi, 2002.

REFERENCES

1. Rao J.S.and Dukkipati R.V. "Mechanism and Machine Theory" Second Edition, Wiley Eastern Limited, 1992.
2. Malhotra D.R. and Gupta H.C "The Theory of machines" Satya Prakasam, Tech. India Publications, 1989
3. Gosh A and Mallick A.K. "Theory of Machines and Mechanisms" affiliated east west press, 1989
4. Shigley J.E. and Uicker J.J. Theory of Machines and Mechanisms" McGraw Hill, 1986.
5. Burton Paul "Kinematics and Dynamics of Machinery", Prentice Hall, 1979.

RP 9251 BASICS OF POLYMERS L T P C
3 0 0 3

UNIT I INTRODUCTION 6

History of Macromolecules – structure of natural products like cellulose, rubber, proteins – concepts of macro molecules – Staudinger's theory of macromolecules – difference between simple organic molecules and macromolecules.

UNIT II ADDITION POLYMERIZATION 12

Chemistry of Olefins and Dienes – double bonds – Chemistry of free radicals – monomers – functionality – Polymerization: Initiation – types of initiation – free radical polymerization – cationic polymerization – anionic polymerization – coordination polymerization – industrial polymerization – bulk, emulsion, suspension and solution polymerization techniques – Kinetics – Copolymerization concepts.

UNIT III CONDENSATION POLYMERIZATION 9

Simple condensation reactions – Extension of condensation reactions to polymer synthesis – functional group reactivity – polycondensation – kinetics of polycondensation- Carother's equation – Linear polymers by polycondensation – Interfacial polymerization – crosslinked polymers by condensation – gel point.

UNIT IV MOLECULAR WEIGHTS OF POLYMERS 9

Difference in molecular weights between simple molecules and polymers – number average and weight average molecular weights – Degree of polymerization and molecular weight – molecular weight distribution – Polydispersity – molecular weight determination. Different methods – Gel Permeation Chromatography – Osmometry, Light Scattering.

UNTI V TRANSITIONS IN POLYMERS 9

First and second order transitions – Glass transition, Tg – multiple transitions in polymers – experimental study – significance of transition temperatures – crystallinity in polymers – effect of crystallization – in polymers – factors affecting crystallization crystal nucleation and growth – relationship between Tg and Tm – Relationship between properties and crystalline structure.

TOTAL : 45 PERIODS

REFERENCES

1. Billmeyer.F.W.,Jr, Text Book of Polymer Science, Ed. Wiley-Interscience, 1984.
2. Seymour.R.B., and Carraher.C.E., Jr., Polymer Chemistry, 2nd Ed., Marcel Dekker, 1988.
3. Gowariker.V.T., Viswanathan.N.V., and Sreedar.J., Polymer Science, Wiley Eastern Ltd., 1988.
4. Joel,R.F; Polymer Science and Technology, Eastern Economy Edition, 1999.
5. Rodriguez, F., Cohen.C., Oberic.K and Arches, L.A., Principles of Polymer Systems, 5th edition, Taylor and Francis, 2003.

RP 9252 RUBBER MATERIALS L T P C
3 0 0 3

UNIT I 8

Structure-Property Relationships in Rubbers: Rubber Elasticity – Requirements for rubber elasticity – Effect of chemical structure on the performance properties of rubbers – Effect of structure on processing properties of elastomers

UNIT II 6

Natural Rubber: Origin – Natural Rubber Latex, tapping, processing, properties and applications – Conversion of Latex into dry rubber – Properties of dry rubber – Classification based on technical specifications – Modifications of Natural Rubber– Applications – Synthetic polyisoprene.

UNIT III 16

Synthetic Elastomers: Polybutadiene and SBR, Nitrile Rubber, Butyl Rubber and Polychloprene Rubbers – Ethylene Propylene Rubber and Ethylene – Vinyl acetate copolymers – Elastomers based on modified polyethylene – Acrylate rubbers Polysulphide rubbers- polyether rubbers – polyalkenamers

UNIT IV 7

High Performance Elastomers: – Fluoroelastomers and silicone elastomers, Manufacture, structure, Properties and applications

UNIT V **8**

Polyurethanes and thermoplastics Elastomers: Reactions of di isocyanates – polyols-chain extenders-types of urethane elastomers – properties and uses - Requirements for thermoplastic elastomeric behaviour – SBS and SIS Block copolymers – Thermoplastic Polyurethane elastomers – Thermoplastic-co-polyesters – Thermoplastic elastomers based on Plastics – Rubber Blends – Dynamic Vulcanization.

TOTAL : 45 PERIODS

REFERENCES

1. Brydson, J.A., Rubber Chemistry, Allied science Publishers, London, 1978.
2. Morton.M., Rubber Technology, Chapman Hall, 1995.
3. Franta, Elastomers and Rubber Compounding materials, Elsevier, 1989.
4. Blackely, D.C., Synthetic Rubbers – their Chemistry and Technology.

RP9253 **FUNDAMENTALS OF CHEMICAL ENGINEERING OPERATION** **L T P C**
3 0 0 3

UNIT I **9**

Classification of Unit Operations - Heat transfer – steady state – Fourier law – thermal conductivity – conduction through plane wall – cylindrical wall – convection – forced and natural convection – radiation – unsteady state heat transfer – methods of solution- fuels and combustion – stoichiometry .

UNIT II **9**

Heat exchange equipments – double pipe and shell and tube heat exchangers, condensers Mass Transfer – Principles of diffusion, Fick's law – theory of diffusion, Mass transfer coefficients and film theory Penetration theory. Distillation – Vapour liquid equilibria, Simple distillation, Steam distillation, Continuous binary distillation, Industrial equipments for distillation- industrial boilers.

UNIIT III **9**

Agitation of liquids – Types of impellers, Selection criteria, Power consumption calculations for agitated vesse Absorption – Principle and equipment (packed towers and plate columns). Adsorption – Principles and equipment for absorption

UNIT IV **9**

Drying – Principles and definitions, Rate of batch drying, Equipments for drying.
Humidification – Humidity and saturation, dry bulb and wet bulb temperatures, percentage saturation, dew point, humid volume, humid heat, enthalpy, Equipment – Water technology– cooling towers, spray chambers.

UNIT V **9**

Membrane Separation Processes - Separation of gases and liquids, Dialysis, Membrance liquid – liquid extraction, Pervaporation and reverse osmosis.
Size reduction Laws of crushing, Equipment – Classification, Crushers and grinders.
Mechanical separations – Screening and screening equipments, Filtration – Principle and filtration equipment, filter media, filter aids, Gravity settlers, Cyclones and hydro cyclones.

TOTAL : 45 PERIODS

REFERENCES
1. Mc. Cabe, W.L., Smith, J.C., Unit Operations of Chemical Engineering, Mc.Graw Hill. 1993.
2. Badger, W.L., Banchero, J.T., Introduction to Chemical Engineering, Mc.Graw Hill, UK, 1997.
3. Richardson and Coulson, Chemical Engineering, Vol. 1 & vol.2, Asian Books Pvt. Ltd., India. 1996.
4. Chattopadhyay, P., Unit Operations of Chemical Engineering Vol. I and Vol. II, Khanna Publishers, Delhi, 1998.
5. Foust A.S., Walzel.L.A., John Wiley - Principles of Unit Operations.

RP9254 POLYMER PHYSICS L T P C
3 0 0 3

UNIT I SOLUTION AND FLOW PROPERTIES OF POLYMERS 12

Size and shape of the macromolecules – Solubility parameter – polymer/solvent interaction parameter – Theta temperature – size and molecular weight of polymer from the solution properties of polymers, Fractionation of Polymers-importance of rheology-Newtonian and Non-Newtonian behaviour – polymer melt rheology

UNIT II MECHANICAL PROPERTIES 13

Stress – strain properties of polymers – comparison with conventional materials – tensile properties – flexural strength – impact strength – fatigue endurance – hardness tests – mechanical relaxations in polymers – temperature – effect on the mechanical behaviour of polymers – visco-elastic properties of polymers – Damping characteristics – crazing in glassy polymers – Role of crazing in fracture – macroscopical fracture theory – Fracture and microstructure.

UNIT III FRICTION AND WEAR IN POLYMERS 8

Elastic deformation – single contacts – multiple contacts – Rolling friction – sliding friction of rubbers and rigid polymers – lubrication by fluids – wear – wear testing – Abrasive wear.

UNIT IV ELECTRICAL PROPERTIES OF POLYMER 7

Introduction – Polar and Nonpolar polymers - charge carriers – carrier mobility – Dielectric properties of polymers - Anti static and conductive of polymers –Volume restivity measurements Molecular theories of dielectric relaxation in polymers – Dielectric breakdown.

UNIT V OPTICAL PROPERTIES OF POLYMERS 5

Introduction – Isotropic polymers – Anisotropic polymers – Dichroism – Oprical applications of polymers – Transmission – Rheoptical properties and application.

TOTAL : 45 PERIODS

REFERENCES
1. Ulrich Eisele, Introduction to Polymer Physics Springs – Verlag, New York, 1990.
2. Bill Meyer.F.W. Text Book of Polymer Science, Wiley Interscience Publications, 1994.
3. Bikales.N.M., Mechanical properties of Polymers, John Wiley & Sons, 1971.
4. Brown.R.P., Physical Testing of Rubber Elsevier, 1986.

EI 9261 ELECTRICAL AND ELECTRONICS ENGINEERING LAB L T P C
0 0 3 2

LIST OF EXPERIMENTS

1. Load test on separately excited DC shunt generator
2. Load test on DC shunt moor
3. Load test on Sϕ Transformer
4. Load test on Induction motor
5. Regulation of 3ϕ Alternator
6. Study of CRO
7. Logic gates
8. Operational amplifiers
9. Time constant of RC circuit
10. Characteristics of LVDT
11. Calibration of Rotometer
12. RTD and thermistor
13. Flapper Nozzle system

TOTAL : 45 PERIODS

RP 9261 POLYMER SCIENCE LABORATORY L T P C
0 0 3 2

LIST OF EXPERIMENTS

1. Identification of Plastics materials.
2. Density determination.
3. Bulk polymerization - Preparation of Polyethyl acrylate.
4. Solution Polymerization - Preparation of polyacrylamide.
5. Preparation of Phenol-Formaldehyde, UF and MF resins.
6. Measurement of viscosity of polymer solutions and determination of molecular weight of the polymer.
7. End group analysis.
8. Determination of acid value of a resin.
9. Study of Molecular weight distribution (GPC).
10. Determination of cure of a phenolic moulding (percentage acetone soluble matter).
11. Study of Thermal Stability of polymers.

TOTAL : 45 PERIODS

PR 9303 **MACHINE DESIGN** **L T P C**
3 1 0 4

OBJECTIVE

- To introduce students to the design and theory of common machine elements and to give students experience in solving design problems involving machine elements

UNIT I INTRODUCTION 9+3

Fundamentals of machine design – Engineering Design, Phases of Design, Design consideration – Standards and Codes – Selection of Materials – Design against static and dynamic load – modes of failure – Factor of safety, Principal stresses, Theories of Failure – stress concentration, stress concentration factors, variable stress, Fatigue Failure, Endurance limit, Design for finite and infinite life, Soderberg and Goodman Criteria

UNIT II DETACHABLE AND PERMANENT JOINTS 9+3

Design of Bolts under Static load, Design of bolt with tightening/initial stress, Design of bolts subjected to fatigue – keys – types, selection of square and flat keys – Design of riveted joints and welded joints

UNIT III SHAFTS, COUPLINGS AND BRAKES 9+3

Design of shaft – for static and varying loads, for strength and rigidity – Design of Coupling – types,flange,Muff and flexible rubber bushed coupling – Design of Brakes - Block and Band brakes

UNIT IV GEAR AND BELT DRIVES 9+3

Design of Spur, Helical , Bevel and Worm gear drives – Design of belt drives – flat and V belts

UNIT V SPRINGS AND BEARINGS 9+3

Design of Helical Spring – types, materials, static and variable loads – design of leaf spring – Design of Journal Bearing – Anti friction Bearing – types, life of bearing, reliability consideration, selection of ball and roller bearings

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

TEXT BOOK

1. Shingley J.E, Mischke C., Mechanical Engineering Design, Mc Graw Hill, International Edition, 1992

REFERENCES

1. 1.Bhandari V.B, Design of Machine Elements, Tata McGraw Hill Publishing Co Ltd, 1993
2. Sharma C.S, Purohit K., Design of Machine Elements, Prentice Hall of India Pvt Ltd, 2003
3. 3.Norton R.L, Machine Design – An Integrated Approach, Prentice Hall, International Edition, 2000

RP 9301 **PLASTICS MATERIALS** **L T P C**
4 0 0 4

UNIT I INTRODUCTION TO PLASTICS 12

Classification of Plastics – Thermoplastics & Thermosetting Plastics – Effect of Polymer structure on Thermal, Mechanical, Electrical, Optical, Chemical properties – Natural and Bio degradable plastics.

UNIT II COMMODITY PLASTICS – I 12

Olefinic Plastics – manufacturing methods – structure property relationships, processing and applications of PE, PP and modified PE & PP.

Styrenic Plastics – manufacturing methods – structure property relationships, processing & applications of PS, ABS, HIPS, EPS.

UNIT III COMMODITY PLASTICS – II 12

Acrylic Plastics – manufacturing methods – structure property relationships, processing & applications of PAN, PMMA & their Copolymers.

PVC – Polymerization – Structure property relationships, copolymers, chemical modifications – blends & alloys of PVC, additives – processing of pPVC & uPVC – Testing of PVC resins & compounding of PVC pastes – Applications of PVC.

UNIT IV THERMOSETS & ENGINEERING PLASTICS 12

Thermosets – Phenolic resins, UF, MF – preparation, curing, properties & uses – Moulding powders – additives , basic ideas about Epoxy resins & polyester resins – preparation – Engineering thermoplastics – Polyamides (nylons), PET, PBT, PC, Polyacetals – preparation, properties & uses.

UNIT V HIGH PERFORMANCE PLASTICS & SPECIALITY POLYMERS 12

Fluorine containing plastics (PTFE, PCTFE, PVDF) – Preparation, properties & uses. Other high performance plastics like PPO, PPS, Polysulphones, PEEK, Polimides – polybenzimidazoles, aromatic polyamides – Kevlar, Nomex specality polymers – conducting polymers – photoresists, polymers with piezoelectric, ferroelectric & pyroelectric properties – IPN's – water soluble polymers.

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

TEXT BOOKS

1. Brydson. J.A., Plastics Materials, Butterworth, 1995.
2. Athalye & Prakash Trivedi PVC Technology, Multitech Publishing Co., Bombay 1994.

REFERENCES

1. Dominighaus, H., Plastics for Engineering, Hanser Publisher – 1993
2. Engineering Materilas Hand Book, Vol.2, Engineering Plastics, ASM nternational, May 1997.
3. Rubin. I.I., Hand book of Plastics materials and technology, Wiley Interscience, 1990.

RP9302 RUBBER PROCESSING AND MACHINERY L T P C
3 0 0 3

UNIT I COMPOUNDING AND MIXING OPERATIONS 8

Open mill mixing – Internal mixers – continuous mixers – factors affecting mixing – latex compounding.

UNIT II FORMING OPERATIONS 9

Calendering: Sheeting – skim coating – fractioning – topping – doubling – profiling – spreading – roll configurations – control of thickness. Extrusion; Ram type – screw type – L/D ratio and its influence – hot, cold feed extruders – pin barrel extruder – twin screw extruder – criteria for machine selection.

UNIT III MOULDING AND OTHER VULCANISING TECHNIQUES 8

Compression, transfer and injection moulding – blanks & pre-heating techniques, preparation of surfaces for bonding

Curing: Autoclaves, Hot air chambers, curing of built up articles, continuous vulcanization, L.C.M. (Liquid Curing Media), Fluidised Bed, microwave curing. Hand building and forming equipment for tank, pipe lining, roller covering.

UNIT IV FINISHING OF RUBBER COMPONENTS – SAFETY IN RUBBER MACHINERY 5

Equipments for flash and spew removal – Cryogenic techniques – Hand trimming – roller trim, buffing, tumbling, punching, grinding, shot blasting, painting, lacquering – Guards, Trip devices, Photoelectric and pressure sensitive devices – Maintenance of guards.

UNIT V PROCESSING METHODS FOR VARIOUS RUBBER PRODUCTS 15

Tyres and tubes – belting and hoses – cables – footwear – sports goods – moulded products – miscellaneous products – latex products – rubber – to-metal bonding – Coated fabric.

TOTAL : 45 PERIODS

REFERENCES

1. Blow.C.M. and Hepburn.C. Rubber Technology and manufacture, Butterworths, 1982.
2. Evans.C.W., Practical Rubber Compounding and processing, Applied Science Publishers, London, 1981.
3. Whelan.A., Injection Moulding Mahines, Elsevier, 1989.
4. Stevens.M.J., Extruder Principles and Operations, Elsevier Applied Science, New York, 1985.
5. White.J.L., Rubber Processing Technology Materials, Principles, Hanser Publication, New York, 1995.

RP 9303	RUBBER COMPOUNDING	L T P C
		3 0 0 3

UNIT I PRINCIPLES OF COMPOUNDING 6

Need – mix design – order of mixing – handling and storage of mix – Standard Compound Design – Raw material – Specification data.

UNIT II RUBBER VULCANIZATION SYSTEMS 12

Vulcanisation of rubber - mechanism of sulphur cure - effect of accelerators, activators, PVI – peroxide cure, metal oxide cure, diamine cure – Curing by oximes, phenolic resin, irethane cure system – bisazoester – bis maleimmide, cross linking reactions in other polymers – Mechanisms of their actions.

UNIT III FILLERS AND OTHER ADDITIVES 9

Fillers – carbon blacks – preparation, characteristics, applications – reinforcement mechanisms – non-black fillers – silica – use of coupling agent – Short fibres – Antioxidants and antiozonants – materials mechanism of their actions – Processing aids – plasticisers – tackifiers – factice – reclaimed rubbers – blowing agents – colourants.

UNIT IV INDIVIDUAL RUBBER FORMULATIONS 9

Formulating for natural and synthetic rubbers and typical recipes for a few rubber products, Implications of FDA Regulations - toxicity and environmental issues.

UNIT V FORMULATION FOR PERFORMANCE REQUIREMENTS 9

Compounding to meet different Hardness requirements – low compression set – For damping application – Compounding to meet bonding requirements with metals – Compounding to meet processing – Economics of compounding – Cost estimation.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Franta, 1; Elastomers and Rubber Compounding materials, Elsevier, 1989.
2. Morton, M.; Rubber Technology Chapman Hall, 1995.
3. Dick. J.S., Rubber Technology Compounding and testing for Performance, Hanser Publisher, 2001.

REFERENCES

1. Blow. C.M. and Hepburn C., Rubber Technology and Manufacture, Butterworths, 1982.
2. Naunton, W.J.S.; Applied Science of Rubber Edward Arnold, 1961.

RP 9304 LATEX TECHNOLOGY L T P C
3 0 0 3

UNIT I LATEX CHARACTERISTICS AND CONCENTRATION METHODS 10

Definition of Latex, Classification, Latex particle size and distribution, stability and destabilization of latices, Comparison between Latices and polymer solution.

Natural rubber latex –origin, tapping, bulking and preservation, composition of field latex, properties, preservation, methods of concentrating latex- creaming, centrifuging, & evaporation,– Specification and testing- (National and ISO) for latex grades (ASTM D 1076)

UNIT II LATEX COMPOUNDING 10

Latex compounding - Ingredients, Preparation of Dispersions, Emulsion, Slurries, Machineries- Ball mill, Pearl mill. Preparation of latex compound and maturation. Prevulcanized latex, MG Latex, -Preparation, properties and application. Evaluation of the latex compound- Chloroform number, swelling index test. Design for latex products formulation.

UNIT III DIPPING PROCESS 11

Principle and types of dipping process, Principles of formulations, Dipping plant details, formers, sequence of operation, post processing-Protein allergy.

Manufacture of Condoms, Gloves, catheters, Balloons- formulations, process, Specification and testing and troubleshooting.

UNIT IV LATEX FOAM, SHEETING AND SPRAYING 7

Principle and Manufacture of Foam-Dunlop and Talalay process, Compound design-Process details, Foam properties, testing and defects, foam applications.

Latex sheeting, latex binders and carpet backing- Basics and processes.

UNIT V EXTRUSION AND PRODUCTS BASED ON SYNTHETIC LATEX 7

Principle and Manufacture of latex elastic threads, latex tubing, toys by casting-process, specification and testing, defects.

Synthetic latex-Types, properties, and application-Basics-surface coatings, adhesives, paper industries

TOTAL : 45 PERIODS

REFERENCES

1. Blackley, D.C., High Polymer Latices, Vol 1 and 2, Maclaren & Sons
2. Mausser,R.F., The Vanderbilt Latex Hand book 3rd edn.,
3. Waterman,R., Mausser R.F., & Miller,E.E., Vanderbilt Latex Book on Process and Compounding Ingredients, Publ. By R T Vanderbilt.

RP 9305 RUBBER PROCESSING LAB L T P C
0 0 3 2

LIST OF EXPERIMENTS

1. Study of
   - i) Mixing mill
   - ii) Hydraulic press
   - iii) Extruder and
   - iv) Calender and their operations.
2. Mixing of a few rubber compounds. (NR & SR)

3. Moulding of these compounds for test specimens and small products
4. Extrusion of a few rubber compounds
5. Autoclave curing of an extrudate
6. Study of steam generation in a boiler
7. Preparation of dispersions for latex compounding
8. Injection moulding of TPEs.

TOTAL : 45 PERIODS

RP 9306 RUBBER MATERIALS LAB L T P C
0 0 3 2

LIST OF EXPERIMENTS

1. Determination of T.S., D.R.C., V.F.A., number of Latex
2. Estimation of total alkalinity of the latex
3. Determination of volatile matter, dirt, ash content in Rubber from Natural sources
4. Estimation of Cu, Fe and Mn in rubber by colorimetry
5. Rubber identification pyrolysis and spot test by specific reagents
6. Soxhlet extraction – determination of total extractables
7. Rapid reflux extract
8. Chemical analysis of synthetic rubber components and vulcanisates
9. Determination of structure of carbon black (i) DBP absorption (ii) IAN (iii) Surface area Calculation
10. Estimation of total and free sulphur in rubber products
11. Estimation of process oils (i) Aniline point (ii) Flash point (iii) Viscosity (iv)Density etc.
12. Characterisation of accelerator, insoluble methanol.
13. Knowledge about Spectroscopy – UV – VIS – IR
14. TGA / DSC analysis of Rubber Compounds.

TOTAL : 45 PERIODS

RP 9307 TECHNICAL SEMINAR L T P C
0 0 2 1

Each student will have to present a seminar on technical topics selected based on the counseling of a staff member and the presentation will be evaluated by team of Faculty members.

PR9306 COMPUTER AIDED DEGISN LAB L T P C
0 0 3 2

a) Fundamentals of CAD
b) Use of 2D and 3D software
c) FEM and analysis
d) Surface modeling, IDEAS, ANSYS etc.

TOTAL : 45 PERIODS

RP 9351 TESTING OF RUBBERS AND PLASTICS L T P C
4 0 0 4

UNIT I INTRODUCTION 5

Standards and specification – codifications and nomenclatures – Principles of standard testing – rubber and plastics.

UNIT II PLASTICS TESTING – I 12

Tests on raw materials – Melt flow index - spiral flow tests – Tests on thermosets – Viscosity - Bulk factor – gelation tests – Molecular weight distribution – Flame resistance tests – Tensile strength – Modulus – Hardness of plastics – Flexural strength – Impact strength – Creep – Isochronous and isometric curve – Tests for fatigue loading – Tests on low temperature properties.

UNIT III PLASTICS TESTING II 8

Heat deflection temperature – softening point – thermal expansion – coefficient of friction – static and dynamic – thermal conductivity – Resistivity measurements – Dielectric properties - tracking index – Arc resistance – Refractive index - Gloss – Transmittance – Reflectance.

UNIT IV TESTS FOR RUBBER PROPERTIES 10

Testing of Natural rubber Principles of NR specification – scorch and cure parameters – techniques and instruments – types of curemeters – principles applictions of cure data. Cured properties – mechanical: Static properties –hardness, tear, tensile application of test data and abrasion.

UNIT V DESTRUCTIVE AND DURABILITY TESTS IN ELASTOMER 10

Fatigue – Flex cracking and cut growth – heat build up – Principle and applications. Effect of environment – oxygen, heat, ozone and swelling media; Rubber to non-rubber substore adhesions – product and standard methods of testing.

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

REFERENCES

1. Brown.R.P. Physical Testing of Rubber, Elsevier, 1986.
2. Schaefer.R. Dynamic Properties of Rubber (1-8) Series, rubber World, Vol.211, 1995.
3. Gent.A.N., Engineering with Rubber, Hanser Publishers, 1992.
4. Sanmer.J.G., rties and their meaning, 214 Rubber World, 1996.
5. Brydson.J.A., Plastics Materials, Butterworths, 1981.
6. Rubin.I.I. Hand Book of Plastics materials and technology, Wiley Interscience, 1990.
7. ASTM Standards Volumes 8 and 9, 2003.
8. ISO Standards.

RP9352 PLASTICS PROCESSING AND MACHINERY L T P C
3 0 0 3

UNIT I PLASTICS MIXING & COMPOUNDING 7

Plastic Compounding – Processing – Modification mechanical properties – Surface properties - optical properties – reduces formulation costs – Antiaging – Blowing agents – Flame retardants – Blending - Mixing – Distributed and depressive mixing – compounding machineries – PVC compounding.

UNIT II INJECTION MOULDING OF PLASTICS-I 8

Cycle of operation – Machine construction details – Injection side, clamping side – Machine control – specification for a injection moulding machine – Injection Machine ratings –Trouble shooting in injection moulding of Thermoplastics.

Co-injection moulding – RIM – GAS assists injection moulding – soluble core technology – push-pull moulding systems, Injection moulding for thermosetting plastics.

UNIT III INJECTION MOULDING OF PLASTICS-II 8

Basic mould constructions, two plate, tree plastics – Runnerless, stack moulds, mould designs – Sprue, Rubber, gate systems, venting, mould cooling, estimation of mould filling and mold cooling- Orienting arising in moulding – Shrinkage in injection moulding

UNIT IV EXTRUSION PROCESS & BLOW MOULDING 13

Extrusion components and their functions – Geometry & various types of extruder screws. Barrier screws flow analysis with extruder, two stage, vented extruders pipe extrusion – profile extrusion – sheet extrusion flat sheet extrusion – Blown film extrusion – Monofilament & fiber extrusion - trouble shooting in extrusion operations – Calendering - down stream equipment in extrusion process.

Extrusion blow moulding – Injection Blow moulding – Stretch Blow moulding – Co extrusion Blow moulding – Wall thickness and parisas thickness relationship.

UNIT V OTHER PROCESSING TECHNIQUES 9

Forming process – Vacuum forming, pressure forming, plug – assisted vacuum forming – Billow forming – Rotational moulding – casting process – powder coating processes – welding of plastics – Heated tool welding – Hot gas welding – Frictional weldings – Radiation based welding – Induction welding – Adhesive bonding of plastics – Machining of plastics.

TOTAL : 45 PERIODS

REFERENCES

1. Plastics product design and process engineering – Harold Belofsky – Hanser publishers, 1995.
2. Tin A. Osswald, Polymer Processing Fundamentals – Hanse publishers, 1998.
3. Walter – Michaeli, Plastics Processing An Introduction – Henser, publishers, 1995.
4. Rubin I. Hand book of Plastics Materials & Technology, wisley, Interscience, 1999.
5. The role of additives in plastics – L. MASCIA, Edward Arnold publication.

RP 9353 PRODUCT DESIGN & ENGINEERING APPLICATION OF POLYMERS

L T P C
4 0 0 4

UNIT I INTRODUCTION – DESIGN FUNDAMENTALS 12

Checklist to Develop Product Requirements, Product Design, Development and Manufacture – Checklist forms – Versatility of Design and assembly with Polymers – Property considerations in Designing of Plastics parts – Design and Mechanical properties of plastics – creep curves of Plastics.

UNIT II DESIGNING STRUCTURAL PRODUCTS 12

Defining Structural Requirements – Structural Analysis – Beams, Pressure vessels and tubes – Buckling of columns, Rings and arches – Flat Plates – Ribbed Plate Design – Plastics Springs – Snap Fit Designs – Designing Plastics gears and bearings.

UNIT III DESIGN FOR PRODUCT PERFORMANCE 12

Design for assembly and service – Product mould design considerations – Mould filling and cooling analysis – Control of product tolerances – Manufacturing control and capability – Increasing product strength and stiffness – Designing for assemblies.

UNIT IV DESIGNING WITH RUBBER – FUNDAMENTALS 12

Elastic properties at small strains – Large deformations – Dynamic Mechanical properties – Heat generation in Rubber components – Vibration isolation – Shock absorbers – Effects of Temperature and frequency – Mechanical Fatigue – Fatigue in rubber composites.

UNIT V DESIGN OF RUBBER COMPONENTS 12

Introduction – Viscoelasticity and its implication – creep and stress relaxation and inter relationship, Payne and mullins - Shear and compression bearings – Planar sandwich forms – Laminate bearings – Shape factors – Vibration and noise control - Design requirements – Design of seals and O-rings – V-belts.

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

TEXT BOOKS

1. Alan N Gent, Engineering with Rubber, 2nd Edition, Carl Hanser Verlag, Munich 2001.
2. Miller, E., Plastics Product Design Hand Book, Part A & B, Marcl Dekker, 1982.

REFERENCES

1. Joseph Gordon r., M., Industrial Design of Plastics Products, Wiley Interscience Publication 2003.
2. Herbert Rees, Understanding Products design for Injection Moulding, Hanser Publishers, Munich, 1996.
3. Robert A.Malloy, Plastic Part Design for Injection Moulding-An Introduction, Carl Hanser erlag, 1994.
4. Khairi Nagdi, Rubber as an Engineering Material: Gudieline for Uses, Hanser Publishers, 1993.

RP9354 POLYMER CHARACTERISATION TECHNIQUES L T P C
3 0 0 3

UNIT I INTRODUCTION 8

Chemical analysis – preliminary examination – polymer identification – Classification – Analysis – Latex, natural rubber, synthetic rubber and different plastic materials.

UNIT II CHARACTERIZATION 9

Density – solubility – isolation and purification of polymers – Polymer fractionation – Fractional precipitation – dissolution techniques – GPC – Mut distribution – Membrane and V.P. Osmometry – end group analysis – Ultra centrifuge and sedimental velocity method – Light scattering.

UNIT III INSTRUMENTAL METHODS OF ANALYSIS 8

Spectroscopy – UV – VIS – IR – Spectrophotometer – analysis of Cu, Mn, Fe in NR and diagnostic absorption frequency of some important polymer and rubber quantitative analysise.

UNIT IV TGA/DSC/DTA ANALYSIS 10

Thermal analysis – Instrumentation – Compositional analysis – volatile, Rubber, Polymer blends, C-black ash – estimation – Glass transition – Heat capacity – Thermal history of polymers – Degradation – State of cure studies.

UNIT V GC/GPC ANALYSIS 10

Instrumentation – Molecular wt distribution – analysis of antioxidant, process oil – PNA analysis TLC – Importance of mass spectra, ESCA, NMR in analysis of polymer / rubber.

TOTAL : 45 PERIODS

REFERENCES

1. Willard H.H. Merrit L L and John A Dean, Instrumental method of analysis, Wiley Interscience Pub 1986.
2. Crompton.I.R., Analysis of Polymers – Introduction Peregamon Press, 1989.
3. Gowariker.V.T., Viswanathan.N.V. and Sreeder.J., Polymer Science, Wiley Eastern Ltd., 1988.
4. Spectral data bank, Division of Rubber Technology, Anna University, 1998.

GE9371 COMMUNICATION SKILLS AND SOFT SKILLS LAB L T P C
0 0 2 1

AIM

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

OBJECTIVES

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

1. PC based session

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

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

II. Class Room Session **TOTAL :45 PERIODS**

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

   Note: Classroom sessions are practice sessions.

REFERENCES

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

LAB REQUIREMENT

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

RP 9355 PLASTICS PROCESSING LABORATORY L T P C
0 0 3 2

LIST OF EXPERIMENTS

1. Compounding ingredients of plastic and their characteristics.
2. Plastic processing machinery and their operations.
3. Injection moulding
4. Blow moulding
5. Extrusion and
6. Compression moulding
7. Reaction injection moulding experiments
8. Development of composites, GFRP etc
9. Study of machining of plastics
10. Study of Adhesive materials

TOTAL : 45 PERIODS

RP 9356 RUBBER TESTING LABORATORY L T P C
0 0 3 2

LIST OF EXPERIMENTS

1. Specific gravity – hardness measurement-pocket hardness meter and dead loadmeter
2. Cure characteristics of rubber compounds-scorch and cure times, post cure behaviour
3. Tensile properties of rubbers
4. Tear strength
5. Resilience
6. De mattia fatigue tests for crack initiation and crack growth
7. Abrasion resistance
8. Heat build up
9. Change in volume on swelling by solvents/fuels
10. Rubber-to-fabric, rubber-to-metal, strip peel adhesion strengths
11. Ageing studies on rubbers
12. tension and compression set studies

TOTAL : 45 PERIODS

RP 9357 DESIGN AND DRAWING OF MOULDS AND DIES LAB L T P C
0 0 3 2

LIST OF EXPERIMENTS

I. DESIGN AND DRAWING OF MOULDS FOR THE FOLLOWING

1. Hand Mould
2. Semi – Injection Mould
3. Automatic Mould – with working area calculations
4. Multi Cavity – Multiday Light Mould
5. Split Cavity – Finger Cam Mechanism
6. Split Cavity – Dog Leg Cam Mechanism
7. Split Cavity – Cam tract Actuation
8. Side Core – Hydraulic Actuation
9. Collapsable core – Mechanism
10. Gear Core – Mechanism
11. Compression Mould
12. Transfer Mould

II. DESIGN AND DRAWING OF DIES FOR

(i) Hot and Cold Extrusions
(ii) Extrusion of Tubes and profiles

TOTAL : 45 PERIODS

RP 9401 POLYMER COMPOSITES L T P C
3 0 0 3

UNIT I INTRODUCTION 8

Various matrix materials used in composites – theory of composites – macromolecular behaviour of laminates – stress strain relationships – other mechanical properties.

UNIT II MATERIALS USED IN POLYMER COMPOSITES 12

Glass fibres – forms or reinforcements – carbon and Kevlar fibres – other fibres – polyester resins – epoxy resins – phenolic resins – other resins systems curing of the resins – other ingredients in FRP – carbon – carbon composites.

UNIT III PROCESSING METHODS FOR FRPS 12

Hand lay up – spray up – resin injection moulding – bulk moulding compounds – compounding of polyester machines – machinery and equipment – SMC, BMC compression and injection moulding, filament winding – pultrusion – autoclave moulding, matched die moulding – injection moulding and forming of thermoplastic composites.

UNIT IV TESTING AND CHARACTERISATION OF COMPOSITES 10

General test methods for tension, flexure, interlaminates shear stress, compression tests – elevated temperature tests – shear modules, void content, resin content, fibre content, impact strength tests.

UNIT V APPLICATIONS OF COMPOSITES 3

Application in aerospace, automotive industry, marine industry, civil engineering applications, electrical industry etc.

TOTAL : 45 PERIODS

REFERENCES

1. Burns,R., Polyester Moulding Compounds, Marcel Dekker Inc., 1982.
2. Mathews F.L., and Rawlings, Composite Material Engg. Science, Chapman and Hall, London, 1994.
3. Riew, K., Rubber Toughened Plastics, ACS, 1989.

RP 9402 TECHNOLOGY OF TYRES AND TUBES L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Functions of tyres and tubes – Role of Rubber and unique properties of rubbers for the applications. Type of tyre constructions – general design features and materials. Tubeless tyres – comparison. Role of carcass in tyre behaviour and materials. Carcas design variables and construction principles.

UNIT II TYRE CORD AND CORD REINFORCED RUBBER 9

Mechanics of rubber – cord composites. Inflation pressure – contact area, tyre deflections – design factors and principles. Classifications of tyres – Essential design criteria. Rolling resistance, friction, mechanical loss on tyre behaviour.

UNIIT III STRUCTURE OF THE PNEUMATIC TYRE 9

Tread design – principles and materials. Abrasion – concepts and recent understanding. Design of tyre moulds and moulding techniques. Forces acting on beads and carcass. Tyre endurance and life related properties.

UNIT IV TYRE STRESS, DEFORMATION, TYRE TRACTION AND WEAR 9

Rubber-to-non rubber bonding: Rubber-cord and rubber-bead adhesion. Mechanism, materials and methods. Evaluation procedures and effect of rubber ingredients on adhesions. RFL systems, in-situ bonding agents. Methods of heat treatment and effect on tyre cord properties.

UNIT V MEASUREMENT AND ANALYSIS OF TYRE PROPERTIES 9

Tyre nomenclature-Aero tyres and tube assembly. Inner tube extrusion, concepts and manufacturing techniques-Building and curing of passenger car tyre, truck tyre, four wheeler tyre – Testing of tyres and tubes – Defects and remedial measures. Tyre retreads – methods and materials – compounding principle, and evaluation process.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Setright J.K., Automobile Tyres, Champan & Hall, 1972.
2. Woods, E.C. Pnuematic Tyre Design, 1955.

REFERENCES

1. Clark, S.K. Mechanics of Pneumatic Tyres.
2. Wake W.C. and Wootton, D.B. Textiles in Reinforcement of Elastomers, 1982.

RP 9403 POLYMER RECYCLING L T P C
3 0 0 3

UNIT I FUNDAMENTALS OF PLASTICS RECYCLING 6

Need for recycling –Source of Plastic waste – depolymerization - Thermal depolymerization – Ceiling temperature and its importance – Degradation – Biodegradation, Primary, Section, Textile recycling.

UNIT II RECYCLING OPERTIONS 8

Sorting and separation techniques – Density based – Optical sorting – Electrostatic sorting – Sorting by melting temperature – Sorting by selective dissolution sorting of metal contaminants size reduction of cutting – Densification – Pulverization – Chemical methods, melt filtration of contamination in recycled plastics – screen changes – filtration requirements of different recycled plastics.

UNIT III RECYCLING – MATERIALS I 12

Recycling of PET – PET separation – Melt reprocessing – Chemical reprocessing – Energy recovery – application.

HDPM recycling – Application of HDPE recyclate – LDPE recycling – Application of LDPM recyclate LDPE – film recycling – Polypropylene recycling – Application of recycled PP – Recycling of polystyrene - Application of Recycled EPS.

Nylon recycling – Chemical recycling – Mechanical recycling – applications Depolymerzation of PMMA.

UNIT IV RECYCLING MATERIALS – II 11

Recycling of Engineering Thermoplastics – PC – ABS Mechanical chemical recycling of polyacetats – Uses recycling of polyurethanes – Physical methods – Chemical methods Feed stock recycling and energy recovery.

Recycling of Thermoset composites – grinding of SMC – selective chemical degradation of SMC scrap – solvent recycling – pyrolysis – Energy recovery tray SMC scrap – Recycling of thermoplastics composites.

Recycling of PVC - Separation techniques for PVC and PET – size reduction – melt filtration – Mechanical recycling – chemical recycling – Energy recovery – applications.

Feed Stock Recycling – Pyrolysis – kiln / Retort – Fluidized based – application – Hydrogenation of plastics waste – Gasification – different gasification process – economic aspects – Incineration of plastic waste with energy recovery.

UNIT V RUBBER RECYCLING 8

Tyre size reduction – Application of ground Rubber crump – Filler – Bound Rubber products – Thermoplastics binder – Civil enging applications – Surface teates crump rubber – applications – Rubber reclaiming and devulcanization scrap rubber and fuel source (Tyre oriented fuel TDF) – Pyrolysis.

TOTAL : 45 PERIODS

REFERENCES

1. John Scheirs, Polymer Recycling Science, Technology and Applications, JohnWiley & Sons, 1998.
2. Ann Christine Albertson and Samuel J Huang, Degradable Polymers, Recycling and Plastics, Marcel Dekker Inc, 1995.
3. Randall Curlec, T. and Sujit Das, Plastics Wastes: Management Control, Recycling and Disposal, US Environmental Protection Agency, Noyes Data Corporation, 1991.
4. Gerald D Andrews and Pallatheri M Subramanian, Emerging Technologies in Plastics Recycling, ACS Symposium Series, 513, 1992.
5. Mustafa.N. Plastics Waste Management Disposal Recycling and Reuse, Marcel Dekker Inc, 1993.

RP 9404 **DESIGN PROJECT** **L T P C**
0 0 4 2

The students are expected to carryout one design project in the following fields of Rubber/Plastics Technology:

1. Computer Aided Drafting and Design.
2. Product Development and Analysis.
3. Development of Machines for Rubber Processing.
4. Development of machines / apparatus for rubber / plastics testing.
5. Mould/Die Design.
6. Process Control/Modification.
7. Plant Layout.

TOTAL : 60 PERIODS

RP 9405 **INDUSTRIAL TRAINING** **L T P C**
- - - 2

All the students have to undergo practical industrial training of six weeks duration in recognized establishments. At the end of which they have to submit a report. The internal assessment will be based on the report and presentation and the examination marks be based on viva voce examination.

RP 9406 **PLASTICS TESTING LABORATORY** **L T P C**
0 0 3 2

LIST OF EXPERIMENTS

1. Melt flow index measurement.
2. Tensile and compressive properties – strength, strain to failure, modulus
3. Flexural properties for plastics.
4. Rockwell and Shore hardness.
5. Heat distortion temperature.
6. Vicat softening point measurement.
7. Izod impact strength and Resilience test.
8. Gel point determination thermoset resin.
9. Electrical properties (Break down voltage) / Arc Rensitance.
10. Thermal history/ageing studies of polymers.
11. Determination of K value for PVC Resins.
12. Determination of Dart impact strength of films.

TOTAL : 45 PERIODS

RP 9407 **COMPREHENSION AND SEMINAR** **L T P C**
0 0 4 2

In the VII Semester each student must present a minimum of three seminars. This will be followed by comprehension examination with atleast one written test in the middle of the Semester with Objective type of questions and a terminal viva-voce test in order to evaluate the comprehension of the students in all the subjects covered in the all early Semesters subjects.

RP 9451 **PROJECT WORK** **L T P C**
0 012 6

Each student will be assigned a project involving some design and fabrication work as well as theoretical and experimental studies on some problem related to Rubber and Plastics Technology. Continuous internal assessment marks for the project will be given during project review meeting. The student has to prepare and present a detailed project report at the end of the semester and give a talk about the work done. End semester examination mark will be based on viva voce examination.

AE 9306 **EXPERIMENTAL STRESS ANALYSIS** **L T P C**
3 0 0 3

UNIT I EXTENSOMETERS 8

Principles of measurements, Accuracy, Sensitivity and range of measurements. Mechanical, Optical, Acoustical and Electrical extensometers and their uses, Advantages and disadvantages.

UNIT II ELECTRICAL RESISTANCE STRAIN GAUGES 10

Principle of operation and requirements, Types and their uses, Materials for strain gauge, Calibration and temperature compensation, cross sensitivity, Rosette analysis, Wheastone bridge and potentiometer circuits for static and dynamic strain measurements, strain indicators.

UNIT III PHOTOELASTICITY 10

Two dimensional photo elasticity, Photo elastic materials, Concept of light - photoelastic effects, stress optic law, Transmission and Reflection polariscopes, Interpretation of fringe pattern, Compensation and separation techniques, Introduction to three dimensional photo elasticity.

UNIT IV BRITTLE COATINGS AND MORE METHODS 9

Introduction to More techniques, Brittle coating methods and holography

UNIT V NON – DESTRUCTIVE TESTING 8

Fundamentals of NDT, Acoustic Emission Technique, Brittle coating methods, Introduction to Moiré techniques, Holography, ultrasonic C- Scan, Fiber – optic Sensors.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Dally, J.W., and Riley, W.F., Experimental Stress Analysis, McGraw Hill Inc., New York 1998.
2. Srinath, L.S., Raghava, M.R., Lingaiah, K., Garagesha, G., Pant B., and Ramachandra, K., Experimental Stress Analysis, Tata McGraw Hill, New Delhi, 1984.

REFERENCES

1. Hetyenyi, M., Hand book of Experimental Stress Analysis, John Wiley and Sons Inc., New York, 1972.
2. Pollock A.A., Acoustic Emission in Acoustics and Vibration Progress, Ed. Stephens R.W.B., Chapman and Hall,1993.

AE 9354 FINITE ELEMENT METHOD L T P C
3 0 0 3

UNIT I INTRODUCTION 8
Review of various approximate methods – Raleigh Ritz's, Galerkin and finite doifference methods- Governing equation and convergence criteria of finite element method.

UNIT II DISCRETE ELEMENTS 10
Bar elements, uniform sections, mechanical and thermal loading, varying section, truss analysis, Beam element- problems for various loadings and boundary conditions – longitudinal and lateral vibration – use of local and natural coordinates

UNIT III CONTINUUM ELEMENTS 8
Plane stress, plane strain and axisymmetric problems. Derivation of element matrices for constant and linear strain triangular elements and axisymmetric elements

UNIT IV ISOPARAMETRIC ELEMENTS 10
Definitions, shape function for 4,8 and 9 nodal quadrilateral elements, stiffness matrix and consistent load vector, Gaussian integration

UNIT V FIELD PROBLEM 9
Heat transfer problems, steady state fin problems, Derivation of element matrices for two dimensional problems, torsion problems

TOTAL : 45 PERIODS

TEXT BOOKS
1. Tirupathi.R. Chandrapatha and Ashok D. Belegundu – Introduction to Finite Elements in Engineering – Printice Hall India, Third Edition, 2003.
2. Rao S.S, Finite Element Methods in Engineering, Butterworth and Heinemann, 2001

REFERENCES
1. Reddy J.N. – An Introduction to Finite Element Method – McGraw Hill – 2000.
2. Krishnamurthy, C.S., Finite Element Analysis, Tata McGraw Hill, 2000.
3. Bathe, K.J. and Wilson, E.L., Numerical Methods in Finite Elements Analysis, Prentice Hall of India, 1985.
4. Robert D Cook, David S malkus, Michael E Plesha, 'Concepts and Applications of Finite Element Analysis', 4th edition, John Wiley and Sons, Inc., 2003.

IE 9311 PRINCIPLES OF MANAGEMENT L T P C
3 0 0 3

UNIT I THE BASIS OF MANAGEMENT THEORY AND SCIENCE 9
Management Science – theory and practice – Management and society – social responsibility and ethics .

UNIT II PLANNING 9
The nature and purpose of Planning – Objectives – Strategies - Policies - Planning premises - Decision making

UNIT III ORGANISING 9

The nature and purpose of organizing - Basic departmentation - line/staff authority and decentralization – Effective organizing and organizing culture

UNIT IV STAFFING 9

Human resource management and selection – performance appraisal – career strategy – manager and organizational development

UNIT V LEADING 9

Management and the human factor - Motivation – Leadership - Communication

Controlling:

The system and process of controlling – control techniques and information technology - Productivity and operations management – overall and preventive control

International Management and the future:

Towards a unified global management theory

TOTAL: 45 PERIODS

REFERENCES

1. Koontz.H, Weihrich H., Essentials of Management, McGraw Hill Publishing Co., Singapore International Edition, 1990
2. James,A.F., Freeman R. E, Management, Prentice Hall of India Ltd, New Delhi, 1992
3. Massie J.L., Essentials of Management, Prentice Hall of India Ltd, 1985

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

AIM

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

OBJECTIVES

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

UNIT I ENGINEERING ETHICS 9

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

UNIT II ENGINEERING AS SOCIAL EXPERIMENTATION 9

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

UNIT III ENGINEER'S RESPONSIBILITY FOR SAFETY 9

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

UNIT IV RESPONSIBILITIES AND RIGHTS 9

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

UNIT V GLOBAL ISSUES 9

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

TOTAL: 45 PERIODS

TEXT BOOKS

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

REFERENCES

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

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

AIM

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

OBJECTIVES

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

UNIT I INTRODUCTION 9

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

UNIT II TQM PRINCIPLES 9

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

UNIT III TQM TOOLS & TECHNIQUES I 9

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

UNIT IV TQM TOOLS & TECHNIQUES II 9

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

UNIT V QUALITY SYSTEMS 9

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

TOTAL: 45 PERIODS

TEXT BOOK

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

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, 3rd 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.

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

AIM

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

OBJECTIVES

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

UNIT I INTRODUCTION 10

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

UNIT II PREPARATION METHODS 10

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

UNIT III PATTERNING AND LITHOGRAPHY FOR NANOSCALE DEVICES 5

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

UNIT IV PREPARATION ENVIRONMENTS 10

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

UNIT V CHARECTERISATION TECHNIQUES 10

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

TOTAL : 45 PERIODS

TEXT BOOKS

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

REFERENCES

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

RP 9021 ADHESIVES AND SURFACE COATINGS L T P C

3 0 0 3

UNIT I FUNDAMENTALS OF ADHESIVES 8

Adhesives – Fundamentals – types of substrates – immiscible planar, immiscible with complex surface, miscible etc – setting, adhesive strength – thermodynamics of adhesives – concepts of surface energy, contact angle etc – types of joints – joint selection

UNIT II NON REACTIVE ADHESIVES 10

Natural adhesives like animal glue, casein, starch – rubber based adhesives – NR, SBR, NBR, CR, IIR adhesives – Latex based & solution based – Formulations – Pressure sensitive & hot melt adhesives based on SBS, EVA – polyvinyl acetate & polyvinyl alcohol

UNIT III REACTIVE ADHESIVES 10

Phenolics, epoxies, acrylics & anaerobics, cyanoacrylates – uses of adhesives in civil Engineering, automobile, aerospace, electrical & electronic industries.

UNIT IV SURFACE COATINGS 9

Components of Paints – Preparations formulations, pigment dispersion, drying & film formation mechanisms, types of points – based on emulsion, oil, alkyds, epoxies, Analysis, PF, UF eh, Urethanes, Silicones – Primers like chlorinated rubber – applications, powder coatings.

UNIT V SURFACE PREPARATION 8

Surface Preparation for adhesion & painting, powder coatings, factors affecting coating properties, barrier properties – rheology & its importance, paint & adhesion performance testing.

TOTAL : 45 PERIODS

REFERENCES

1. Skiest I (ed), Hand book of Adhesives – Van Nostrand Reinhold, 1990.
2. Shields, Hand Book of Adhesives, Butterworths, 1984.
3. Paul,S. Surface Coatings, John Wiley & Sons, 1985.

RP 9022 MULTIPHASE POLYMER SYSTEMS L T P C

3 0 0 3

UNIT I THERMODYNAMICS 9

Thermodynamics of Polymer Solutions and Blends – Criteria for Blend miscibility – Analysis of phase behaviour of Polymer Blends, Polymer – Polymer Interactions – Interaction Energies – Interfacial properties – Hydrogen boding systems – Crystalline polymer blends.

UNIT II MORPHOLOGY 9

Introduction – Phase visualization methods such as TEM, SEM and Optical Microscopy – Applications – Dispersed phase size and Dispersion Uniformity – the Glass transition in Polymers blends – Morphology and properties of blends containing copolymers – Interpenetrating Polymer networks.

UNIT III MELT PROCESSING OF POLYMER BLENDS 9

Material Factors influencing Morphology – Influence of Processing methods on Morphology – Reactive compatibilization – Commercially important Blends: Structure – Property relationships – Compatibilizers and other processing aids – Compounding polymer blends.

UNIT IV PERFORMANCE OF POLYMER BLENDS 9

Thermo-mechanical Performance of amorphous – amorphous and amorphous – crystalline blends – Permeability of miscible blends – Barrier materials through control of Blend morphology – reinforced polymer blends

UNIT V ELASTOMER BLENDS 9

Miscible and immiscible elastomers blends – Thermoplastic vulcanizates – Thermoset – Thermoplastic Blends – Properties of cured Blends – Toughening of thermoset and semi-crystalline plastics – Recycling of polymer blends.

TOTAL : 45 PERIODS

REFERENCES
1. Paul, D.R. and Bucknall, C.B., Polymer Blends, Volumes I and II, Wiley Interscience, 2000.
2. Utracki, L.A., Polymer Blends Handbook, Volumes I and II, Kluwer Academic Publishers, 2002.
3. Riew, C.K. and Kinloch, A.J., Toughened Plastics I – Science and Engineering, ACS, Advance in Chemistry Series 233, 1993.

RP 9023 FIBRES AND ENGINEERING MATERIALS IN POLYMER PRODUCTS **L T P C 3 0 0 3**

UNIT I **7**

Engineering materials – Ferrous – non ferrous alloys – polymers – fibre – science and technology – Mechanical properties – importance.

UNIT II **9**

Role of metals and alloys in rubber products mounts – steel cord, oil seals and bushes, anti seismic and bridge bearing – adhesion to rubbers.

UNIT III **12**

General properties of yarns – numbering system – manufacturing of Nylon 6, Nylon 66, Polyester, Kevlar, Nomex, Glass, Steel wire, fibre properties – functional behaviour. Rubber Textile adhesion and techniques – Heat setting and shrinkage – structure property relation – twist and fatigue behaviour.

UNIT IV **8**

Fabric properties – Strength – abrasion resistance air permeability – thermal properties - Short and cut fibres in elastomers – plain and adhesive treated. For packaging applications – surface and surface preparation, nano size materials in rubber, cellular products and design.

UNIT V **9**

Testing of tyre cord for various properties such as adhesion – dynamic mechanical properties – Instrumentation for tyre cord testing and process control.

TOTAL : 45 PERIODS

TEXT BOOKS
1. Wake. W.C., and Wooton, D.B., Textile reinforcements of Elastomers, Applied Science Pub., 1980.
2. Evans, C.W., Hose Technology, Applied Science Pub, London, 1980.

REFERENCE
1. Blow C.W., and Hepburn , C., Rubber Technology and Manufacture, 1982.

RP 9024 FOOTWEAR TECHNOLOGY L T P C
3 0 0 3

UNIT I PRODUCTION OF FOOTWEAR 10

Operations involved in making footwear – 'Built-up' footwear – DVP/DIP (Direct Vulcanising / Direct injection Moulding) process – Materials used in manufactures of footwear (Other than rubber)

UNIT II ADHESIVES AND SYNTHETIC FABRICS IN FOOTWEAR 9

Fabrics used – Cotton, Rayon, Nylon, Polyester – treatment of textiles for combining with rubber – types of adhesives water, chloroprene, NBR, PU passed adhesives – NR and synthetic rubber latex based adhesives.

UNIT III CELLULAR AND MICROCELLULAR MATERIALS 10

Natural and Synthetic Rubber based microcellular materials – PU, PVC, EVA in microcellular soling – Direct vulcanizing / injection processes.

UNIT IV MANUFACTURE OF FOOTWEAR COMPONENTS 8

Materials and machinery for the manufacture of soles, insoles, foot bed, toe puff, stiffeners, finishers, uppers etc- direct injection moulding

UNIT V SPECIALITY SHOES 8

Sports / athletics shoes, mountaineering / hiking shoes, fireman, hospital (operating threatre) and oil refinery shoes.

TOTAL : 45 PERIODS

REFERENCES

1. Bhowmick.A.K., (ed) Hall M.M. and Henry A.Benary, Rubber Products Manufacturing Technology, Marcel Dekkar Inc, 1994.
2. Blow.C.M. and Hepburn C., Rubber Technology and Manufcture, Butterworths, 1982.
3. Robert O Babbit (ed), The Vanderbilt Rubber Hand Book, R.T. Vanderbilt Co Inc, 1978.
4. Skiest.I., Hand Book of Adhesives, Van Nostrand Reinhold, 1990.

RP 9026 PRODUCT DESIGN AND COST ESTIMATION L T P C
3 0 0 3

UNIT I INTRODUCTION 8

The design process – Selection of the right product – Market survey and research – factors to be studied preparatory to design – market development – product life cycle.

UNIT II CRITERIA FOR PRODUCT SUCCESS 8

Functional design – aesthetic design – Incorporating – quality, durability and reliability into design – design for case of manufacture and maintenance – design optimization.

UNIT III PROCESS PLANNING 8

Process Planning – Definition – Aims – Informations required – Process Sheet – Informations required – Process sheet – primary process selection rules – Steps to prepare detailed process sheets – case studies – Break even analysis – Applications.

UNIT IV ESTIMATING, COSTING AND ELEMENTS OF COST 12

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 – Elements of cost – Material Cost – Determination of Material cost – Labour cost – determination of direct Labour Cost – Expenses – Cost of Product (Ladder of cost) – Illustrative examples.

UNIT V ANALYSIS OF OVERHEAD EXPENSES: 9

Overhead expenses – Factory expenses – Depreciation – Causes of depreciation – Methods of depreciation – Administrative expenses – Selling and Distributing expenses – Allocation of overhead expenses – Critical analysis and value enhancement of typical products.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Narang,G.B.S. and Kumar, V., Production and costing, Khanna Publishers, 2000.
2. Banga, T.R. and Sharma, S.C., Estimating and costing, Khanna Publlishers, 2000.

REFERENCES

1. Adithan, M. and Pabla, B.S., Estimating and Costing, Konark Publilshers Pvt. Ltd., 1989.
2. Khanna, O.P. Mechanical Estimating and Costing, Dhanpat Rai Publications, 1999.

PR 9402 ENGINEERING MANAGEMENT L T P C
3 0 0 3

UNIT I PRINCIPLES OF MANAGEMENT AND PERSONNEL MANAGEMENT 7

General Principles of Management – Management Functions – Organization – Types – Comparison – Functions of Personnel Management – Recruitment – Training Leadership/Motivation – Communication – Conflict- Industrial Relations – Trade unions.

UNIT II INVENTORY MANAGEMENT 11

Purpose of Inventory – Cost Related to inventory – Basic EOQ Model – Variations in EOQ Model – Finite Production – Quality Discounts – ABC Analysis – MRP

UNIT III OPERATIONS MANAGEMENT 10

Plant Location – Layout – Materials Handling – Method Study – Time Study Ergonomics – Aggregate Planning – Value Analysis —

UNIT IV FINANCIAL MANAGEMENT 10

Capital – Types – Sources – Break Even Analysis – Financial Statements – Income Statement – Balance Sheet – Capital Budgeting – Working Capital Management – Inventory Pricing.

UNIT V MARKETING MANAGEMENT 7

Functions of Marketing – Sales Promotion Methods – Advertising – Product Packaging – Marketing Variables – Distribution Channels – Organisation – Market research – Market Research Techniques.

TOTAL : 45 PERIODS

TEXT BOOKS

1. R.Kesavan, C.Elanchezhian and T.Sundar Selwyn, Engg Management – Eswar Press, 2005
2. R.Panneerselvam – Production and Operations Management –Prentice Hall of India, 2003

REFERENCES

1. Koontz and Weihrich-Essentials of Management, Mc Graw Hill 1992.
2. Philips Kotler – Principles of Marketing, Prentice Hall of India, 1995.
3. Pandey, I.M. – Financial Management, Vikas Publishing house, 1995.
4. Ahuja, K.K. – Personal Management, Kalyane Publication, 1992.

RP 9029 POLYMER COMPONENTS IN AUTOMOTIVE APPLICATIONS L T P C
3 0 0 3

UNIT I INTRODUCION 6

Identification of plastics / rubber components in automobiles – function – selection criteria.

UNIT II STRUCTURE-PROPERTY RELATIONSHIPS IN RUBBERS 10

Resilience, creep, hysteresis and damping, stability, set and stress relaxation, behaviour in dynamic applications.

UNIT III VIBRATION AND RUBBER SPRING 10

Principles of vibration isolation – rubber mounts – spring design – comparison with metallic springs – shape factor and its effect – forced and free vibrations with damping – typical mounts, compounding and manufacture.

UNIT IV FLUID SEALINGS AND FLEXIBLE COUPLINGS AND HOSES 10

Seals for static and dynamic applications – effect of heat / oil ageing – frictional behaviour – fundamental of sealability.

UNIT V COMPOUNDING AND MANUFACTURE 9

Types of couplings – specification and selection – torque vs deflection relationship – brake fluid / hydraulic hoses, materials and manufacture.

TOTAL : 45 PERIODS

REFERENCES

1. Freakley.P.K., and Payne A.R., Theory and Practice of Engineering with Rubber, Applied Science Publishers Ltd.
2. Hobel.E.F., Rubber Springs Design
3. Blow.C.M. and Hepburn C., Rubber Technology and Manufacture, 1982.

RP 9030 RUBBER MACHINERY L T P C
3 0 0 3

UNIT I RUBBER MIXING EQUIPMENT 9

Mills, Internal mixers, continuous mixer, dough mixers – roll / rotor geometry – influence of rotor (Internal mixer) design on mastication / mixing – coolant considerations – power requirements – Z type blades and their design, use of CAD, CAM in rubber process (machines).

UNIT II RUBBER SHAPING EQUIPMENT (EXTRUDERS, CALENDER) 12

Types of extruders and their engineering aspects – screw design and its influence on processing characteristics – ancillary equipment of extruders – roll configurations and their significance – gauge / pick-up control devices – calender roll and extruder jacket cooling techniques.

UNIT III RUBBER VULCANISING MACHINERY (PRESSES) 9

Compression / transfer / injection moulding presses – moulding pressure considerations – clamping system – mould partings, hydraulic system (injection moulding) – design of multi cavity moulds – mould finish –

UNIT IV VULCANISERS, CV MACHINERY 9

Equipment for microwave curing, fluidized bed curing, salt bath curing, CV of cables and profiles.

UNIT V SAFETY ASPECTS OF RUBBER MACHINERY 6

Safety bars, trip switches, safety mats, safety cages, braking system, safety bushes, travel – limit switches – photo electric safety devices.

TOTAL : 45 PERIODS

REFERENCES

1. Freakley, P.K., Rubber Processing and Production Organization, Plenum Press, 1985.
2. Bhowmick A.K., (ed) Hall, M.M. and Benard,H.A., Rubber Products manufacturing Technology, Marcel Dekker Inc., 1994.
3. Whelan.A., Injection Moulding Machine, Elsevier, 1989.
4. Blow, C.M., and Hepburn,C., Rubebr Technology and Manufacture, Butterworths, 1982.

RP 9031 PLASTICS MACHINERY L T P C
3 0 0 3

UNIT I PLASTICS MIXING AND COMPOUNDING 9

Additives – Heat stabilizers – Antidegradants – Fillers, flame retardants – Blowing agents – Coupling agents – Antistatic agents – Impact modifiers – Processing aids – Blending, mixing and compounding machineries.

UNIT II EXTRUSION AND CALENDERING OF PLASTICS 9

Introduction – melting – shaping and shape stabilization – Extruder components and their functions – Flow analysis in the extruder – Downstream extrusion Processing – Pipe extrusion – Profile extrusion – Sheet extrusion – Wire covering – Coextrusion – Dies – Calendering of plastics – Operation and analysis of calenders – Defects in calendered products.

UNIT III MOULDING OF PLASTICS 9

Injection moulding – Machine description and principles of operation – Injection moulds – Moulds filling – Moulding cycle and machine control structural features of injection moulded plastics – Blow moulding – Extrusion blow moulding – Injection blow moulding – Stretch blow moulding – Rotational moulding – Thermoforming techniques.

UNIT IV ELEMENTARY IDEAS ABOUT MOULD DESIGN 9

Compression moulding, transfer moulding, Injection moulding of thermosets – Mould design – Moulds for thermoplastics – Cores – Cavity, Layout, Flow channel in Injection moulds – Runners, Gates, ejection system, cooling circuits etc – Basic concepts.

UNIT V MODERN TECHNIQUES 9

Reaction injection moulding – Gas assisted injection moulding – Resin transfer moulding – pultrution – BMC Technology – Joining and machining of plastics.

TOTAL : 45 PERIODS

REFERENCES

1. Stevens.M.J., Extruder Principles and Operations, Elsevier Applied Science, 1988.
2. Crawford.R.J., Plastics Engg, Pergaman, 1979.
3. Middleman.S., Fundamentals of Polymer Processing, McGraw Hill, 1977.
4. Resato and Rosato., Injection moulding Handbook, Van Nostran Reinhold, 1986.
5. Rubin.I.I. Hand Book of Plastic Materials and Technology, Wiley Interscience, 1994.

RP 9032 ENTREPRENEURSHIP DEVELOPMENT L T P C

3 0 0 3

UNIT I INTRODUCTION 10

Design Process – Morphology of design – Role of a technocrat – Trade cycle – Production – consumption cycle – Industrial Policies – Design of an Industrial Project – Stages of development of the project – preparation of project report.

UNIT II FEASIBILITY STUDY 10

Information and Needs analysis – input/output analysis – translation needs into goals – physical realizability – Economic viability – market survey demand forecasting – predicting share in the market.

UNIT III PRODUCT DESIGN AND DEVELOPMENT 8

Physical realisability – Functional aesthetic, production and economic cost aspect value analysis – product analysis and specifications.

UNIT IV DISTRIBUTION 8

Sales strategies – sales organization – Distribution channels – After sales service.

UNIT V FINANCE AND CAPITAL REQUIREMENTS 9

Price fixation – cash flow statement – Return on investment – sources of finance – Execution of project and commencement of production – organization and institutions promoting entrepreneurship in India.

TOTAL : 45 PERIODS

REFERENCES

1. Mossis Asimow, Engineering Design.
2. Woodson,T.T., Introduction to Engineering.
3. Wilson,A., The Assessment of Industrial Markets.
4. Guideline for Preparation of feasibility reports for Industrial Projects: Project Appraisal Division of Planning Commission.