ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

R - 2008

B.TECH. POLYMER TECHNOLOGY

II – VIII SEMESTERS CURRICULA AND SYLLABI

SEMESTER II

(Common to all B. E. / B. Tech. Degree Programmes except B. E. – Marine Engineering)

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	HS2161	Technical English – II*	3	1	0	4
2.	MA2161	Mathematics – II*	3	1	0	4
3.	PH2161	Engineering Physics – II*	3	0	0	3
4.	CY2161	Engineering Chemistry – II*	3	0	0	3
5. a	ME2151	Engineering Mechanics **(For non-circuit branches)**	3	1	0	4
5. b	EE2151	Circuit Theory **(For branches under Electrical Faculty)**	3	1	0	4
5. c	EC2151	Electric Circuits and Electron Devices **(For branches under I & C Faculty)**	3	1	0	4
6. a	GE2151	Basic Electrical & Electronics Engineering **(For non-circuit branches)**	4	0	0	4
6. b	GE2152	Basic Civil & Mechanical Engineering **(For circuit branches)**	4	0	0	4
PRACTICALS						
7.	GE2155	Computer Practice Laboratory-II*	0	1	2	2
8.	GS2165	Physics & Chemistry Laboratory - II*	0	0	3	2
9. a	ME2155	Computer Aided Drafting and Modeling Laboratory **(For non-circuits branches)**	0	1	2	2
9. b	EE2155	Electrical Circuits Laboratory **(For branches under Electrical Faculty)**	0	0	3	2
9. c	EC2155	Circuits and Devices Laboratory **(For branches under I & C Faculty)**	0	0	3	2
					TOTAL : 28 CREDITS	
10.	-	English Language Laboratory +	0	0	2	-

A. CIRCUIT BRANCHES

I Faculty of Electrical Engineering

1. B.E. Electrical and Electronics Engineering
2. B.E. Electronics and Instrumentation Engineering
3. B.E. Instrumentation and Control Engineering

II Faculty of Information and Communication Engineering

1. B.E. Computer Science and Engineering
2. B.E. Electronics and Communication Engineering
3. B.E. Bio Medical Engineering
4. B.Tech. Information Technology

B. NON – CIRCUIT BRANCHES

I Faculty of Civil Engineering

1. B.E. Civil Engineering

II Faculty of Mechanical Engineering

1. B.E. Aeronautical Engineering
2. B.E. Automobile Engineering
3. B.E. Marine Engineering
4. B.E. Mechanical Engineering
5. B.E. Production Engineering

III Faculty of Technology

1. B.Tech. Chemical Engineering
2. B.Tech. Biotechnology
3. B.Tech. Polymer Technology
4. B.Tech. Textile Technology
5. B.Tech. Textile Technology (Fashion Technology)
6. B.Tech. Petroleum Engineering
7. B.Tech. Plastics Technology

SEMESTER – III

(Applicable to the students admitted from the Academic year 2008 – 2009 onwards)

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
GE 2211	Environmental Science and Engineering	3	0	0	3
PT 2201	Materials Engineering	3	0	0	3
MA 2211	Transforms and Partial Differential Equation	3	1	0	4
PT 2202	Organic Chemistry and Technology	3	1	0	4
PT 2203	Physical Chemistry of Polymers	3	0	0	3
PT 2204	Polymer Chemistry	4	0	0	4
PRACTICALS					
PT 2207	Polymer Chemistry Lab.	0	0	3	2
PT 2208	Organic Chemistry Lab.	0	0	3	2
		19	**2**	**6**	**25**

SEMESTER – IV

(Applicable to the students admitted from the Academic year 2008 – 2009 onwards)

CODE NO	COURSE TITLE	L	T	P	C
THEORY					
MA 2263	Probability and Statistics	3	1	0	4
PT 2251	Mould Engineering	3	1	0	4
PT 2252	Polymer Structure and Property Relationship	3	0	0	3
PT 2253	Principles of Chemical Engineering	3	0	0	3
PT 2254	Strength of Materials	3	0	0	3
PT 2255	Polymeric Materials I	4	0	0	4
PRACTICALS					
PT 2257	Chemical Engineering I Lab.	0	0	3	2
PT 2258	Mould Engineering Lab.	0	0	3	2
	TOTAL	**19**	**2**	**6**	**25**

SEMESTER – V

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
MA 2264	Numerical Methods	3	1	0	4
PT 2301	Fluid Mechanics	4	0	0	4
PT 2302	Analysis and Characterisation of Polymers	3	0	0	3
PT 2303	Computer Programming	3	0	0	3
PT 2304	Processing Technology I	3	0	0	3
PT 2305	Polymeric Materials II	3	0	0	3
PRACTICALS					
GE 2321	Communication skills Laboratory	0	0	4	2
PT 2307	Computer Programming Lab	0	0	3	2
PT 2308	Polymer Preparation and Characterization Lab	0	0	3	2
	TOTAL	**19**	**1**	**10**	**26**

SEMESTER – VI

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
PT 2351	Mould and Die Design	3	1	0	4
PT 2352	Polymer Rheology	4	0	0	4
PT 2353	Polymer Testing Methods	3	0	0	3
PT 2354	Process Control and Instrumentation	3	0	0	3
PT 2355	Processing Technology II	3	0	0	3
PT 2356	Rubber Engineering	4	0	0	4
PRACTICALS					
PT 2357	Polymer Testing Lab I	0	0	3	2
PT 2358	Processing Technology Lab.	0	0	3	2
	TOTAL	**20**	**1**	**6**	**25**

SEMESTER – VII

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
PT 2401	Polymer Reaction Engineering	3	1	0	4
PT 2402	Polymer Blends and Composites	4	0	0	4
MG2351	Principles of Management	3	0	0	3
PT 2404	Polymer Product Design	3	1	0	4
	Elective I	3	0	0	3
	Elective II	3	0	0	3
PRACTICALS					
PT 2407	Design and Analysis Practice using CAD, CAE	0	0	3	2
PT 2408	Polymer Testing Lab II	0	0	3	2
PT 2409	Comprehension	0	0	2	1
	TOTAL	**19**	**2**	**8**	**26**

SEMESTER – VIII

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
	Elective III	3	0	0	3
	Elective IV	3	0	0	3
PRACTICALS					
PT 2451	Project work	0	0	12	6
	TOTAL	**6**	**0**	**12**	**12**

LIST OF ELECTIVES

ELECTIVE I

CODE NO.	COURSE TITLE	L	T	P	C
PT 2021	Polymer Recycling	3	0	0	3
PL 2023	Plastics Packaging Technology	3	0	0	3
PT 2023	Fibre Technology	3	0	0	3
PT 2024	Tyre Technology	3	0	0	3

ELECTIVE II

CODE NO.	COURSE TITLE	L	T	P	C
PL 2026	Biodegradable Polymers	3	0	0	3
PL 2027	Specialty Polymers	3	0	0	3
PL 2033	Specialty Elastomers	3	0	0	3
PL 2029	Polyurethane Technology	3	0	0	3

ELECTIVE III

CODE NO.	COURSE TITLE	L	T	P	C
PT 2031	Product Design Using CAD	3	0	0	3
PT 2032	Information Technology	3	0	0	3
PL 2043	Polymer Degradation and Stabilisation	3	0	0	3
PL 2034	Adhesives and surface coatings	3	0	0	3
PT 2035	Fibre Reinforced Plastics	3	0	0	3

ELECTIVE IV

CODE NO.	COURSE TITLE	L	T	P	C
PL 2036	Biomedicals Plastics	3	0	0	3
GE 2022	Total Quality Management	3	0	0	3
PT 2037	Conducting Polymers	3	0	0	3
PT 2038	Nylon Technology	3	0	0	3
GE 2023	Fundamentals of Nano Science	3	0	0	3

HS2161	TECHNICAL ENGLISH II	L T P C
		3 1 0 4

AIM

To encourage students to actively involve in participative learning of English and to help them acquire Communication Skills.

OBJECTIVES

- To help students develop listening skills for academic and professional purposes.
- To help students acquire the ability to speak effectively in English in real-life situations.
- To inculcate reading habit and to develop effective reading skills.
- To help students improve their active and passive vocabulary.
- To familiarize students with different rhetorical functions of scientific English.
- To enable students write letters and reports effectively in formal and business situations.

UNIT I **12**

Technical Vocabulary - meanings in context, sequencing words, Articles- Prepositions, intensive reading& predicting content, Reading and interpretation, extended definitions, Process description

Suggested activities:

1. Exercises on word formation using the prefix 'self' - Gap filling with preposition.
2. Exercises - Using sequence words.
3. Reading comprehension exercise with questions based on inference – Reading headings
4. and predicting the content – Reading advertisements and interpretation.
5. Writing extended definitions – Writing descriptions of processes – Writing paragraphs based on discussions – Writing paragraphs describing the future.

UNIT II **12**

Phrases / Structures indicating use / purpose – Adverbs-Skimming – Non-verbal communication - Listening – correlating verbal and non-verbal communication -Speaking in group discussions – Formal Letter writing – Writing analytical paragraphs.

Suggested activities:

1. Reading comprehension exercises with questions on overall content – Discussions analyzing stylistic features (creative and factual description) - Reading comprehension exercises with texts including graphic communication - Exercises in interpreting non-verbal communication.
2. Listening comprehension exercises to categorise data in tables.
3. Writing formal letters, quotations, clarification, complaint – Letter seeking permission for Industrial visits– Writing analytical paragraphs on different debatable issues.

UNIT III **12**

Cause and effect expressions – Different grammatical forms of the same word - Speaking – stress and intonation, Group Discussions - Reading – Critical reading - Listening, - Writing – using connectives, report writing – types, structure, data collection, content, form, recommendations .

Suggested activities:

1. Exercises combining sentences using cause and effect expressions – Gap filling exercises using the appropriate tense forms – Making sentences using different grammatical forms of the same word. (Eg: object –verb / object – noun)
2. Speaking exercises involving the use of stress and intonation – Group discussions– analysis of problems and offering solutions.
3. Reading comprehension exercises with critical questions, Multiple choice question.
4. Sequencing of jumbled sentences using connectives – Writing different types of reports like industrial accident report and survey report – Writing recommendations.

UNIT IV **12**

Numerical adjectives – Oral instructions – Descriptive writing – Argumentative paragraphs – Letter of application - content, format (CV / Bio-data) - Instructions, imperative forms - Checklists, Yes/No question form – E-mail communication.

Suggested Activities:

1. Rewriting exercises using numerical adjectives.
2. Reading comprehension exercises with analytical questions on content – Evaluation of content.
3. Listening comprehension – entering information in tabular form, intensive listening exercise and completing the steps of a process.
4. Speaking - Role play – group discussions – Activities giving oral instructions.
5. Writing descriptions, expanding hints – Writing argumentative paragraphs – Writing formal letters – Writing letter of application with CV/Bio-data – Writing general and safety instructions – Preparing checklists – Writing e-mail messages.

UNIT V **9**

Speaking - Discussion of Problems and solutions - Creative and critical thinking – Writing an essay, Writing a proposal.

Suggested Activities:

1. Case Studies on problems and solutions
2. Brain storming and discussion
3. Writing Critical essays
4. Writing short proposals of 2 pages for starting a project, solving problems, etc.
5. Writing advertisements.

TOTAL: 60 PERIODS

TEXT BOOK

1. Chapters 5 – 8. Department of Humanities & Social Sciences, Anna University, 'English for Engineers and Technologists' Combined Edition (Volumes 1 & 2), Chennai: Orient Longman Pvt. Ltd., 2006. Themes 5 – 8 (Technology, Communication, Environment, Industry)

REFERENCES

1. P. K. Dutt, G. Rajeevan and C.L.N Prakash, 'A Course in Communication Skills', Cambridge University Press, India 2007.
2. Krishna Mohan and Meera Banerjee, 'Developing Communication Skills', Macmillan India Ltd., (Reprinted 1994 – 2007).
3. Edgar Thorpe, Showick Thorpe, 'Objective English', Second Edition, Pearson Education, 2007.

Extensive Reading:

1. Robin Sharma**, '**The Monk Who Sold His Ferrari', Jaico Publishing House, 2007

Note:

The book listed under Extensive Reading is meant for inculcating the reading habit of the students. They need not be used for testing purposes.

MA2161 **MATHEMATICS – II** **L T P C**
3 1 0 4

UNIT I ORDINARY DIFFERENTIAL EQUATIONS 12

Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy's and Legendre's linear equations – Simultaneous first order linear equations with constant coefficients.

UNIT II VECTOR CALCULUS 12

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and stokes' theorem (excluding proofs) – Simple applications involving cubes and rectangular parallelpipeds.

UNIT III ANALYTIC FUNCTIONS 12

Functions of a complex variable – Analytic functions – Necessary conditions, Cauchy – Riemann equation and Sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping : w= z+c, cz, 1/z, and bilinear transformation.

UNIT IV COMPLEX INTEGRATION 12

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor and Laurent expansions – Singular points – Residues – Residue theorem – Application of residue theorem to evaluate real integrals – Unit circle and semi-circular contour(excluding poles on boundaries).

UNIT V LAPLACE TRANSFORM 12

Laplace transform – Conditions for existence – Transform of elementary functions – Basic properties – Transform of derivatives and integrals – Transform of unit step function and impulse functions – Transform of periodic functions.

Definition of Inverse Laplace transform as contour integral – Convolution theorem (excluding proof) – Initial and Final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Bali N. P and Manish Goyal, "Text book of Engineering Mathematics", 3rd Edition, Laxmi Publications (p) Ltd., (2008).
2. Grewal. B.S, "Higher Engineering Mathematics", 40th Edition, Khanna Publications, Delhi, (2007).

REFERENCES

1. Ramana B.V, "Higher Engineering Mathematics",Tata McGraw Hill Publishing Company, New Delhi, (2007).
2. Glyn James, "Advanced Engineering Mathematics", 3rd Edition, Pearson Education, (2007).
3. Erwin Kreyszig, "Advanced Engineering Mathematics", 7th Edition, Wiley India, (2007).
4. Jain R.K and Iyengar S.R.K, "Advanced Engineering Mathematics", 3rd Edition, Narosa Publishing House Pvt. Ltd., (2007).

PH2161 ENGINEERING PHYSICS – II L T P C
3 0 0 3

UNIT I CONDUCTING MATERIALS 9

Conductors – classical free electron theory of metals – Electrical and thermal conductivity – Wiedemann – Franz law – Lorentz number – Draw backs of classical theory – Quantum theory – Fermi distribution function – Effect of temperature on Fermi Function – Density of energy states – carrier concentration in metals.

UNIT II SEMICONDUCTING MATERIALS 9

Intrinsic semiconductor – carrier concentration derivation – Fermi level – Variation of Fermi level with temperature – electrical conductivity – band gap determination – extrinsic semiconductors – carrier concentration derivation in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration – compound semiconductors – Hall effect –Determination of Hall coefficient – Applications.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Origin of magnetic moment – Bohr magneton – Dia and para magnetism – Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – anti – ferromagnetic materials – Ferrites – applications – magnetic recording and readout – storage of magnetic data – tapes, floppy and magnetic disc drives.

Superconductivity : properties - Types of super conductors – BCS theory of superconductivity(Qualitative) - High Tc superconductors – Applications of superconductors – SQUID, cryotron, magnetic levitation.

UNIT IV DIELECTRIC MATERIALS 9

Electrical susceptibility – dielectric constant – electronic, ionic, orientational and space charge polarization – frequency and temperature dependence of polarisation – internal field – Claussius – Mosotti relation (derivation) – dielectric loss – dielectric breakdown – uses of dielectric materials (capacitor and transformer) – ferroelectricity and applications.

UNIT V MODERN ENGINEERING MATERIALS 9

Metallic glasses: preparation, properties and applications.

Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, advantages and disadvantages of SMA

Nanomaterials: synthesis –plasma arcing – chemical vapour deposition – sol-gels – electrodeposition – ball milling - properties of nanoparticles and applications.

Carbon nanotubes: fabrication – arc method – pulsed laser deposition – chemical vapour deposition - structure – properties and applications.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Charles Kittel ‘Introduction to Solid State Physics’, John Wiley & sons, 7th edition, Singapore (2007)
2. Charles P. Poole and Frank J.Ownen, ’Introduction to Nanotechnology’, Wiley India(2007) (for Unit V)

REFERENCES

1. Rajendran, V, and Marikani A, ‘Materials science’Tata McGraw Hill publications, (2004) New delhi.
2. Jayakumar, S. ‘Materials science’, R.K. Publishers, Coimbatore, (2008).
3. Palanisamy P.K, ‘Materials science’, Scitech publications(India) Pvt. LTd., Chennai, second Edition(2007)
4. M. Arumugam, ‘Materials Science’ Anuradha publications, Kumbakonam, (2006).

CY2161 ENGINEERING CHEMISTRY – II L T P C
3 0 0 3

AIM

To impart a sound knowledge on the principles of chemistry involving the different application oriented topics required for all engineering branches.

OBJECTIVES

- The student should be conversant with the principles electrochemistry, electrochemical cells, emf and applications of emf measurements.
- Principles of corrosion control
- Chemistry of Fuels and combustion
- Industrial importance of Phase rule and alloys
- Analytical techniques and their importance.

UNIT I ELECTROCHEMISTRY 9

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problem) – reference electrodes –Standard Hydrogen electrode -Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – electrochemical series – significance – potentiometer titrations (redox - Fe^{2+} vs dichromate and precipitation – Ag^{+} vs Cl^{-} titrations) and conduct metric titrations (acid-base – HCl vs, NaOH) titrations,

UNIT II CORROSION AND CORROSION CONTROL 9

Chemical corrosion – Pilling – Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion – factors influencing corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion inhibitors – protective coatings – paints – constituents and functions – metallic coatings – electroplating (Au) and electroless (Ni) plating.

UNIT III FUELS AND COMBUSTION 9

Calorific value – classification – Coal – proximate and ultimate analysis metallurgical coke – manufacture by Otto-Hoffmann method – Petroleum processing and fractions – cracking – catalytic cracking and methods-knocking – octane number and cetane number – synthetic petrol – Fischer Tropsch and Bergius processes – Gaseous fuels-water gas, producer gas, CNG and LPG, Flue gas analysis – Orsat apparatus – theoretical air for combustion.

UNIT IV PHASE RULE AND ALLOYS 9

Statement and explanation of terms involved – one component system – water system – condensed phase rule – construction of phase diagram by thermal analysis – simple eutectic systems (lead-silver system only) – alloys – importance, ferrous alloys – nichrome and stainless steel – heat treatment of steel, non-ferrous alloys – brass and bronze.

UNIT V ANALYTICAL TECHNIQUES 9

Beer-Lambert's law (problem) – UV-visible spectroscopy and IR spectroscopy – principles – instrumentation (problem) (block diagram only) – estimation of iron by colorimetry – flame photometry – principle – instrumentation (block diagram only) – estimation of sodium by flame photometry – atomic absorption spectroscopy – principles – instrumentation (block diagram only) – estimation of nickel by atomic absorption spectroscopy.

TOTAL: 45 PERIODS

TEXT BOOKS

1. P.C.Jain and Monica Jain, “Engineering Chemistry” Dhanpat Rai Pub, Co., New Delhi (2002).
2. S.S.Dara “A text book of Engineering Chemistry” S.Chand & Co.Ltd., New Delhi (2006).

REFERENCES

1. B.Sivasankar “Engineering Chemistry” Tata McGraw-Hill Pub.Co.Ltd, New Delhi (2008).
2. B.K.Sharma “Engineering Chemistry” Krishna Prakasan Media (P) Ltd., Meerut (2001).

ME2151 ENGINEERING MECHANICS L T P C
3 1 0 4

OBJECTIVE

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

UNIT I BASICS & STATICS OF PARTICLES 12

Introduction – Units and Dimensions – Laws of Mechanics – Lame’s theorem, Parallelogram and triangular Law of forces – Vectors – Vectorial representation of forces and moments – Vector operations: additions, subtraction, dot product, cross product – Coplanar Forces – Resolution and Composition of forces – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility – Single equivalent force.

UNIT II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram – Types of supports and their reactions – requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon’s theorem – Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions – Examples

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

Determination of Areas and Volumes – First moment of area and the Centroid of sections – Rectangle, circle, triangle from integration – T section, I section, - Angle section, Hollow section by using standard formula – second and product moments of plane area – Rectangle, triangle, circle from integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem – Polar moment of inertia – Principal moments of inertia of plane areas – Principal axes of inertia – Mass moment of inertia – Derivation of mass moment of inertia for rectangular section, prism, sphere from first principle – Relation to area moments of inertia.

UNIT IV DYNAMICS OF PARTICLES 12

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12

Frictional force – Laws of Coloumb friction – simple contact friction – Rolling resistance – Belt friction.

Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion.

TOTAL: 60 PERIODS

TEXT BOOK

1. Beer, F.P and Johnson Jr. E.R. "Vector Mechanics for Engineers", Vol. 1 Statics and Vol. 2 Dynamics, McGraw-Hill International Edition, (1997).

REFERENCES

1. Rajasekaran, S, Sankarasubramanian, G., "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd., (2000).
2. Hibbeller, R.C., "Engineering Mechanics", Vol. 1 Statics, Vol. 2 Dynamics, Pearson Education Asia Pvt. Ltd., (2000).
3. Palanichamy, M.S., Nagam, S., "Engineering Mechanics – Statics & Dynamics", Tata McGraw-Hill, (2001).
4. Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", IV Edition – Pearson Education Asia Pvt. Ltd., (2003).
5. Ashok Gupta, "Interactive Engineering Mechanics – Statics – A Virtual Tutor (CDROM)", Pearson Education Asia Pvt., Ltd., (2002).

EE2151 CIRCUIT THEORY L T P C

(Common to EEE, EIE and ICE Branches) **3 1 0 4**

UNIT I BASIC CIRCUITS ANALYSIS 12

Ohm's Law – Kirchoffs laws – DC and AC Circuits – Resistors in series and parallel circuits – Mesh current and node voltage method of analysis for D.C and A.C. circuits.

UNIT II NETWORK REDUCTION AND NETWORK THEOREMS FOR DC AND AC CIRCUITS 12

Network reduction: voltage and current division, source transformation – star delta conversion.

Thevenins and Novton & Theorem – Superposition Theorem – Maximum power transfer theorem – Reciprocity Theorem.

UNIT III RESONANCE AND COUPLED CIRCUITS 12

Series and paralled resonance – their frequency response – Quality factor and Bandwidth - Self and mutual inductance – Coefficient of coupling – Tuned circuits – Single tuned circuits.

UNIT IV TRANSIENT RESPONSE FOR DC CIRCUITS 12

Transient response of RL, RC and RLC Circuits using Laplace transform for DC input and A.C. with sinusoidal input.

UNIT V ANALYSING THREE PHASE CIRCUITS 12

Three phase balanced / unbalanced voltage sources – analysis of three phase 3-wire and 4-wire circuits with star and delta connected loads, balanced & un balanced – phasor diagram of voltages and currents – power and power factor measurements in three phase circuits.

TOTAL : 60 PERIODS

TEXT BOOKS

1. William H. Hayt Jr, Jack E. Kemmerly and Steven M. Durbin, "Engineering Circuits Analysis",Tata McGraw Hill publishers, 6th edition, New Delhi, (2002).
2. Sudhakar A and Shyam Mohan SP, "Circuits and Network Analysis and Synthesis",Tata McGraw Hill, (2007).

REFERENCES

1. Paranjothi SR, "Electric Circuits Analysis," New Age International Ltd., New Delhi, (1996).
2. Joseph A. Edminister, Mahmood Nahri, "Electric circuits", Schaum's series, Tata McGraw-Hill, New Delhi (2001).
3. Chakrabati A, "Circuits Theory (Analysis and synthesis), Dhanpath Rai & Sons, New Delhi, (1999).
4. Charles K. Alexander, Mathew N.O. Sadik, "Fundamentals of Electric Circuits", Second Edition, McGraw Hill, (2003).

EC2151 ELECTRIC CIRCUITS AND ELECTRON DEVICES L T P C

(For ECE, CSE, IT and Biomedical Engg. Branches) **3 1 0 4**

UNIT I CIRCUIT ANALYSIS TECHNIQUES 12

Kirchoff's current and voltage laws – series and parallel connection of independent sources – R, L and C – Network Theorems – Thevenin, Superposition, Norton, Maximum power transfer and duality – Star-delta conversion.

UNIT II TRANSIENT RESONANCE IN RLC CIRCUITS 12

Basic RL, RC and RLC circuits and their responses to pulse and sinusoidal inputs – frequency response – Parallel and series resonances – Q factor – single tuned and double tuned circuits.

UNIT III SEMICONDUCTOR DIODES 12

Review of intrinsic & extrinsic semiconductors – Theory of PN junction diode – Energy band structure – current equation – space charge and diffusion capacitances – effect of temperature and breakdown mechanism – Zener diode and its characteristics.

UNIT IV TRANSISTORS 12

Principle of operation of PNP and NPN transistors – study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in transistors – operation and comparison of N-Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation – comparison of BJT with MOSFET – thermal effect on MOSFET.

UNIT V SPECIAL SEMICONDUCTOR DEVICES (Qualitative Treatment only) 12

Tunnel diodes – PIN diode, varactor diode – SCR characteristics and two transistor equivalent model – UJT – Diac and Triac – Laser, CCD, Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Shaum series,Tata McGraw Hill, (2001)
2. S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits",Tata McGraw Hill, 2nd Edition, (2008).
3. David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, (2008).

REFERENCES

1. Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7th Education, (2006).
2. William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "Engineering Circuit Analysis",Tata McGraw Hill, 6th Edition, 2002.
3. J. Millman & Halkins, Satyebranta Jit, "Electronic Devices & Circuits",Tata McGraw Hill, 2nd Edition, 2008.

GE2151 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C

(Common to branches under Civil, Mechanical and Technology faculty) **4 0 0 4**

UNIT I ELECTRICAL CIRCUITS & MEASURMENTS 12

Ohm's Law – Kirchoff's Laws – Steady State Solution of DC Circuits – Introduction to AC Circuits – Waveforms and RMS Value – Power and Power factor – Single Phase and Three Phase Balanced Circuits.

Operating Principles of Moving Coil and Moving Iron Instruments (Ammeters and Voltmeters), Dynamometer type Watt meters and Energy meters.

UNIT II ELECTRICAL MECHANICS 12

Construction, Principle of Operation, Basic Equations and Applications of DC Generators, DC Motors, Single Phase Transformer, single phase induction Motor.

UNIT III SEMICONDUCTOR DEVICES AND APPLICATIONS 12

Characteristics of PN Junction Diode – Zener Effect – Zener Diode and its Characteristics – Half wave and Full wave Rectifiers – Voltage Regulation.

Bipolar Junction Transistor – CB, CE, CC Configurations and Characteristics – Elementary Treatment of Small Signal Amplifier.

UNIT IV DIGITAL ELECTRONICS 12

Binary Number System – Logic Gates – Boolean Algebra – Half and Full Adders – Flip-Flops – Registers and Counters – A/D and D/A Conversion (single concepts)

UNIT V FUNDAMENTALS OF COMMUNICATION ENGINEERING 12

Types of Signals: Analog and Digital Signals – Modulation and Demodulation: Principles of Amplitude and Frequency Modulations.

Communication Systems: Radio, TV, Fax, Microwave, Satellite and Optical Fibre (Block Diagram Approach only).

TOTAL : 60 PERIODS

TEXT BOOKS

1. V.N. Mittle "Basic Electrical Engineering",Tata McGraw Hill Edition, New Delhi, 1990.
2. R.S. Sedha, "Applied Electronics" S. Chand & Co., 2006.

REFERENCES

1. Muthusubramanian R, Salivahanan S and Muraleedharan K A, "Basic Electrical, Electronics and Computer Engineering",Tata McGraw Hill, Second Edition, (2006).
2. Nagsarkar T K and Sukhija M S, "Basics of Electrical Engineering", Oxford press (2005).
3. Mehta V K, "Principles of Electronics", S.Chand & Company Ltd, (1994).
4. Mahmood Nahvi and Joseph A. Edminister, "Electric Circuits", Schaum' Outline Series, McGraw Hill, (2002).
5. Premkumar N, "Basic Electrical Engineering", Anuradha Publishers, (2003).

GE2152 BASIC CIVIL & MECHANICAL ENGINEERING L T P C

(Common to branches under Electrical and I & C Faculty) **4 0 0 4**

A – CIVIL ENGINEERING

UNIT I SURVEYING AND CIVIL ENGINEERING MATERIALS 15

Surveying: Objects – types – classification – principles – measurements of distances – angles – leveling – determination of areas – illustrative examples.

Civil Engineering Materials: Bricks – stones – sand – cement – concrete – steel sections.

UNIT II BUILDING COMPONENTS AND STRUCTURES 15

Foundations: Types, Bearing capacity – Requirement of good foundations.

Superstructure: Brick masonry – stone masonry – beams – columns – lintels – roofing – flooring – plastering – Mechanics – Internal and external forces – stress – strain – elasticity – Types of Bridges and Dams – Basics of Interior Design and Landscaping.

TOTAL: 30 PERIODS

B – MECHANICAL ENGINEERING

UNIT III POWER PLANT ENGINEERING 10

Introduction, Classification of Power Plants – Working principle of steam, Gas, Diesel, Hydro-electric and Nuclear Power plants – Merits and Demerits – Pumps and turbines – working principle of Reciprocating pumps (single acting and double acting) – Centrifugal Pump.

UNIT IV I C ENGINES 10

Internal combustion engines as automobile power plant – Working principle of Petrol and Diesel Engines – Four stroke and two stroke cycles – Comparison of four stroke and two stroke engines – Boiler as a power plant.

UNIT V REFRIGERATION AND AIR CONDITIONING SYSTEM 10

Terminology of Refrigeration and Air Conditioning. Principle of vapour compression and absorption system – Layout of typical domestic refrigerator – Window and Split type room Air conditioner.

TOTAL: 30 PERIODS

REFERENCES

1. Shanmugam G and Palanichamy M S, "Basic Civil and Mechanical Engineering",Tata McGraw Hill Publishing Co., New Delhi, (1996).
2. Ramamrutham. S, "Basic Civil Engineering", Dhanpat Rai Publishing Co. (P) Ltd. (1999).
3. Seetharaman S. "Basic Civil Engineering", Anuradha Agencies, (2005).
4. Venugopal K and Prahu Raja V, "Basic Mechanical Engineering", Anuradha Publishers, Kumbakonam, (2000).
5. Shantha Kumar S R J., "Basic Mechanical Engineering", Hi-tech Publications, Mayiladuthurai, (2000).

GE2155 COMPUTER PRACTICE LABORATORY – II L T P C
0 1 2 2

LIST OF EXPERIMENTS

1. UNIX COMMANDS 15

Study of Unix OS - Basic Shell Commands - Unix Editor

2. SHELL PROGRAMMING 15

Simple Shell program - Conditional Statements - Testing and Loops

3. C PROGRAMMING ON UNIX 15

Dynamic Storage Allocation-Pointers-Functions-File Handling

TOTAL : 45 PERIODS

HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Hardware

- 1 UNIX Clone Server
- 33 Nodes (thin client or PCs)
- Printer – 3 Nos.

Software

- OS – UNIX Clone (33 user license or License free Linux)
- Compiler - C

GS2165 **PHYSICS LABORATORY – II** **L T P C**
0 0 3 2

LIST OF EXPERIMENTS

1. Determination of Young's modulus of the material – non uniform bending.
2. Determination of Band Gap of a semiconductor material.
3. Determination of specific resistance of a given coil of wire – Carey Foster Bridge.
4. Determination of viscosity of liquid – Poiseuille's method.
5. Spectrometer dispersive power of a prism.
6. Determination of Young's modulus of the material – uniform bending.
7. Torsional pendulum – Determination of rigidity modulus.

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**
- **The lab examinations will be held only in the second semester.**

GS2165 **CHEMISTRY LABORATORY – II** **L T P C**
0 0 3 2

LIST OF EXPERIMENTS

1. Conduct metric titration (Simple acid base)
2. Conduct metric titration (Mixture of weak and strong acids)
3. Conduct metric titration using $BaCl_2$ vs Na_2SO_4
4. Potentiometric Titration (Fe^{2+} / $KMnO_4$ or $K_2Cr_2O_7$)
5. PH titration (acid & base)
6. Determination of water of crystallization of a crystalline salt (Copper sulphate)
7. Estimation of Ferric iron by spectrophotometry.

- **A minimum of FIVE experiments shall be offered.**
- **Laboratory classes on alternate weeks for Physics and Chemistry.**
- **The lab examinations will be held only in the second semester.**

ME2155 COMPUTER AIDED DRAFTING AND MODELING LABORATORY L T P C
0 1 2 2

List of Exercises using software capable of Drafting and Modeling

1. Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar, etc.) – Creation of simple figures like polygon and general multi-line figures.
2. Drawing of a Title Block with necessary text and projection symbol.
3. Drawing of curves like parabola, spiral, involute using Bspline or cubic spline.
4. Drawing of front view and top view of simple solids like prism, pyramid, cylinder, cone, etc, and dimensioning.
5. Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Base of a mixie, Simple stool, Objects with hole and curves).
6. Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.)
7. Drawing of a simple steel truss.
8. Drawing sectional views of prism, pyramid, cylinder, cone, etc,
9. Drawing isometric projection of simple objects.
10. Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.

TOTAL: 45 PERIODS

Note: Plotting of drawings must be made for each exercise and attached to the records written by students.

List of Equipments for a batch of 30 students:

1. Pentium IV computer or better hardware, with suitable graphics facility -30 No.
2. Licensed software for Drafting and Modeling. – 30 Licenses
3. Laser Printer or Plotter to print / plot drawings – 2 No.

EE2155 ELECTRICAL CIRCUITS LABORATORY L T P C
(Common to EEE, EIE and ICE) **0 0 3 2**

LIST OF EXPERIMENTS

1. Verification of ohm's laws and kirchoff's laws.
2. Verification of Thevemin's and Norton's Theorem
3. Verification of superposition Theorem
4. Verification of maximum power transfer theorem.
5. Verification of reciprocity theorem
6. Measurement of self inductance of a coil
7. Verification of mesh and nodal analysis.
8. Transient response of RL and RC circuits for DC input.
9. Frequency response of series and parallel resonance circuits.
10. Frequency response of single tuned coupled circuits.

TOTAL: 45 PERIODS

EC2155 CIRCUITS AND DEVICES LABORATORY **L T P C**
0 0 3 2

1. Verification of KVL and KCL
2. Verification of Thevenin and Norton Theorems.
3. Verification of superposition Theorem.
4. Verification of Maximum power transfer and reciprocity theorems.
5. Frequency response of series and parallel resonance circuits.
6. Characteristics of PN and Zener diode
7. Characteristics of CE configuration
8. Characteristics of CB configuration
9. Characteristics of UJT and SCR
10. Characteristics of JFET and MOSFET
11. Characteristics of Diac and Triac.
12. Characteristics of Photodiode and Phototransistor.

TOTAL: 45 PERIODS

ENGLISH LANGUAGE LABORATORY (Optional) **L T P C**
0 0 2 -

1. Listening: **5**

Listening & answering questions – gap filling – Listening and Note taking- Listening to telephone conversations

2. Speaking: **5**

Pronouncing words & sentences correctly – word stress – Conversation practice.

Classroom Session **20**

1. Speaking: Introducing oneself, Introducing others, Role play, Debate- Presentations: Body language, gestures, postures.
   Group Discussions etc
2. Goal setting – interviews – stress time management – situational reasons

Evaluation

(1) Lab Session – 40 marks

Listening – 10 marks
Speaking – 10 marks
Reading – 10 marks
Writing – 10 marks

(2) Classroom Session – 60 marks

Role play activities giving real life context – 30 marks
Presentation – 30 marks

Note on Evaluation

1. Examples for role play situations:
   a. Marketing engineer convincing a customer to buy his product.
   b. Telephone conversation – Fixing an official appointment / Enquiry on availability of flight or train tickets / placing an order. etc.

2. Presentations could be just a Minute (JAM activity) or an Extempore on simple topics or visuals could be provided and students could be asked to talk about it.

REFERENCES

1. Hartley, Peter, Group Communication, London: Routledge, (2004).
2. Doff, Adrian and Christopher Jones, Language in Use – (Intermediate level), Cambridge University Press, (1994).
3. Gammidge, Mick, Speaking Extra – A resource book of multi-level skills activities , Cambridge University Press, (2004).
4. Craven, Miles, Listening Extra - A resource book of multi-level skills activities, Cambridge, Cambridge University Press, (2004).
5. Naterop, Jean & Rod Revell, Telephoning in English, Cambridge University Press, (1987).

LAB REQUIREMENTS

1. Teacher – Console and systems for students
2. English Language Lab Software
3. Tape Recorders.

GE 2211 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

(Common to EEE, EIE, ICE, Biotech, Chemical, Textile Tech.(Fashion Tech.) / Fashion Tech., Plastic Tech., Polymer Tech. & Textile Tech.)

OBJECTIVES

- To create an awareness on the various environmental pollution aspects and issues.
- To give a comprehensive insight into natural resources, ecosystem and biodiversity.
- To educate the ways and means to protect the environment from various types of pollution.
- To impart some fundamental knowledge on human welfare measures.

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 10

Definition, scope and importance – need for public awareness – forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their ground water, floods, drought, conflicts over water, dams-benefits and problems – mineral resources: use effects on forests and tribal people – water resources: use and over-utilization of surface and exploitation, environmental effects of extracting and using mineral resources, case studies – food resources: world food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – energy resources: growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies – land resources: land as a resource, land degradation, man induced

landslides, soil erosion and desertification – role of an individual in conservation of natural resources – equitable use of resources for sustainable lifestyles.
Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT II ECOSYSTEMS AND BIODIVERSITY 14

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

UNIT III ENVIRONMENTAL POLLUTION 8

Definition – causes, effects and control measures of: (a) air pollution (b) water pollution (c) soil pollution (d) marine pollution (e) noise pollution (f) thermal pollution (g) nuclear hazards – solid waste management: causes, effects and control measures of urban and industrial wastes – role of an individual in prevention of pollution – pollution case studies – disaster management: floods, earthquake, cyclone and landslides.
Field study of local polluted site – urban / rural / industrial / agricultural

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – environmental ethics: issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment protection act – air (prevention and control of pollution) act – water (prevention and control of pollution) act – wildlife protection act – forest conservation act – issues involved in enforcement of environmental legislation – public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

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

TOTAL : 45 PERIODS

TEXT BOOKS:

1. Gilbert M.Masters, “Introduction to Environmental Engineering and Science”, Pearson Education Pvt., Ltd., Second Edition, ISBN 81-297-0277-0, 2004.
2. Miller T.G. Jr., “Environmental Science”, Wadsworth Publishing Co.

REFERENCES:
1. Bharucha Erach, “The Biodiversity of India”, Mapin Publishing Pvt. Ltd., Ahmedabad India.
2. Trivedi R.K., “Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards”, Vol. I and II, Enviro Media.
3. Cunningham, W.P.Cooper, T.H.Gorhani, “Environmental Encyclopedia”, Jaico Publ., House, Mumbai, 2001.
4. Wager K.D. “Environmental Management”, W.B. Saunders Co., Philadelphia, USA, 1998.
5. Townsend C., Harper J and Michael Begon, “Essentials of Ecology”, Blackwell Science.
6. Trivedi R.K. and P.K. Goel, “Introduction to Air Pollution”, Techno-Science Publications.

PT2201 MATERIALS ENGINEERING L T P C
3 0 0 3

(Common Polymer & Plastic Technology)

AIM

To learn about the properties and testing of materials.

OBJECTIVES

- To study the mechanical behaviour of materials, types of fractures and testing
- To know the importance of phase diagram
- To understand the various diffusion processes and heat treatment of steel

UNIT I **9**

Mechanical Behavior of materials – Stress – Strain curve, Elastic deformation- Characteristics of elastic deformations, atomic mechanism of elastic deformation, Inelastic deformation, Strain-Time curves, Damping capacity, Viscous deformation, Plastic deformation, Mechanism of plastic deformation- slip & twinning, Schmidt’s law, critical resolved shear stress.

UNIT II **9**

Mechanical testing and fracture of materials – tensile test, stress-strain curves for ductile and brittle materials – mild steel, copper, proof stress, yield point phenomena, Luder’s bands, compression test, hardness test – various hardness tests. Impact test – ductile-brittle transitions. Fatigue- Stress cycles for fatigue testing, endurance limit, fatigue limit, S-N curve, Creep-curve, primary creep, secondary creep, tertiary creep. Fracture – ideal fracture stress, brittle fracture- Griffith’s theory- fracture toughness, ductile failure, cup & cone type fracture, fatigue failure.

UNIT III **9**

Phase diagram – solid solutions, inter metallic compound, cooling curves, non-equilibrium cooling, phase rule, equilibrium diagrams – Isomorphous diagrams, Eutectic, Peritectic and eutectoid reactions with examples. Ferrous and non-ferrous alloys – Fe-C diagram, Effect of alloying elements on properties of steel, tool steel, heat resisting and die steel. Alloys of copper, aluminium, magnesium, nickel and zinc – compositions and their uses, bearing materials, brazing and soldering alloys. Polymeric and composite materials, metal matrix composites, ceramics, refractories, abrasives , shape memory materials.

UNIT IV **9**

Special diffusion process – Aluminizing, Siliconising, Boriding – Laser hardening, Electroplating-hard chrome & nickel plating - Hard dip coating, Cladding - Physical and chemical vapor deposition - Metal spraying – Plastics and rubber coating – Conversion coating – Coating of tools – TiC, TiN, Alumina and diamond coating of tools – Selection of coating of tools – Selection of coating for wear and corrosion resistance – Elastic materials – Applications.

UNIT V **9**

Heat treatment of steel – Critical temperature and heating - Annealing- Spheroidzing-normalizing – hardening - Isothermal transformations – TTT diagram - tempering - austempering - martempering and ausforming. Hardenability and its testing. Selection of the steel – Case-hardening steel – Nitriding steels – Quenched and tempered steels – Fully-hardening steels – Corrosion-resistance steels – Maraging steels – Hard material alloys – Heat treatment of steels – Proper design for proper heat treatment – Stress-relief annealing – Preheating to the treatment temperature – Types of structure and their specific volume – Heat treatment of case-hardening steels – Heat treatment of nitriding steels – Heat treatment of quenched and tempered steels – Heat treatment of fully-hardening steels – Heat treatment of corrosion - resistance steels – Heat treatment of maraging steels.

TOTAL : 45 PERIODS

TEXT BOOKS

1. M. Arumugham, Material Science, Anuradha Agencies, 1st Ed., 1987.
2. G. E. Dieter, Mechanical metallurgy, McGraw-Hill, 2000.

REFERENCES

1. Klaus Stoeckhert, Mold making handbook for the Plastic engineers, Hanser Pub.
2. Data book on Plastics – CIPET, Chennai.
3. J. C. Anderson, K. D. Leaver, R. D.Rawlings, J. M. Alexander, Material Science,
4. Donald S. Clark and Wilbur R Warney, Physical metallurgy, Affltd. East west press.
5. C. W. Richards, Engineering material Science, Prentice Hall Of India.

MA2211 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATION **L T P C**
3 1 0 4

(Common to all branches of BE / B.Tech Programmes)

OBJECTIVES

The course objective is to develop the skills of the students in the areas of Transforms and Partial Differential Equations. This will be necessary for their effective studies in a large number of engineering subjects like heat conduction, communication systems, electro-optics and electromagnetic theory. The course will also serve as a prerequisite for post graduate and specialized studies and research.

UNIT I FOURIER SERIES **9 + 3**

Dirichlet's conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval's identify – Harmonic Analysis.

UNIT II FOURIER TRANSFORMS 9 + 3

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT III PARTIAL DIFFERENTIAL EQUATIONS 9 +3

Formation of partial differential equations – Lagrange's linear equation – Solutions of standard types of first order partial differential equations - Linear partial differential equations of second and higher order with constant coefficients.

UNIT IV APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9 + 3

Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.

UNIT V Z -TRANSFORMS AND DIFFERENCE EQUATIONS 9 + 3

Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem - Formation of difference equations – Solution of difference equations using Z-transform.

L : 45 T : 15 TOTAL : 60 PERIODS

TEXT BOOK

1. Grewal, B.S, "Higher Engineering Mathematic", 40th Edition, Khanna publishers, Delhi, (2007)

REFERENCES

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematic", 7th Edition, Laxmi Publications(P) Ltd. (2007)
2. Ramana.B.V., "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company limited, New Delhi (2007).
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education (2007).
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th edition, Wiley India (2007).

PT2202 ORGANIC CHEMISTRY AND TECHNOLOGY L T P C
(Common Polymer & Plastic Technology) 3 1 0 4

AIM

To learn about the various basic organic reactions, their mechanisms, preparation, properties and uses of monomers.

OBJECTIVES

- To get know about the basics of organic chemistry, mechanism of organic reactions; preparation, properties and uses of majority of the monomers involved in polymer formation.

UNIT I 12

Structure reactivity and mechanism: Classification and IUPAC Nomenclature of organic compounds, Functional groups, classification and reactions, Bonding in organic molecules – Methane, ethylene, acetylene, and butadiene. Polarity of bonds (electron displacement effect) – Inductive – Electromeric – Conjugative - mesomeric and Resonance effects. Types of bond breakage- homolysis and heterolysis with examples, Stereochemistry: General idea of optical and stereoisomerisms, geometrical isomerism.

UNIT II **12**

Types of reagents- Electrophiles and Nucleophiles, types of reactions – addition (>C=C<, >C=O) substitution – Electrophilic and Nucleophilic substitution - elimination and rearrangement reactions – Inter and Intra molecular rearrangement – Hoffman , Beckman ,Benzidine rearrangemnts - General conditions and mechanism of each of the above.

UNIT III **12**

Natural gas – Synthesis gas – Petroleum and petroleum products – Coal and coal products –Cellulose and cellulose products.

Synthesis, properties and uses of Ethylene - Propylene - Butadiene - Vinyl chloride – Vinylidiene chloride – Vinyl fluoride - Vinylidene fluoride – Vinyl acetate.

UNIT IV **12**

Synthesis, properties and uses of – Formaldehyde – Epicholorohydrin - Ethylene oxide - Propylene oxide – Ethylene glycol, Propylene glycol – Phenol - Bisphenol-A, Phthalic acid - Adipic acid - Maleic acid - Maleic anhydride - Phthalic anhydride.

UNIT V **12**

Synthesis, Properties and uses of Styrene – Hexa Methylene Diamine – Urea – Acrylic acid - Methacrylic acid - Acrylonitrile - Methyl methacrylate – Tolulenediisocyanate (TDI)- Hexamethylene di-isocyanate (HMDI)- Diphenyl methane di-isocyanate (MDI).

TOTAL : 60 PERIODS

TEXT BOOKS

1. Morrison & Boyd, “Organic Chemistry”, Prentice Hall. New Delhi, 6th Edition, 1992.
2. B.S.Bahl and Arun Bhal, “Advanced Organic Chemistry”, S. Chand & Co. Ltd., New Delhi, 15th Edition, 1998

REFERENCES

1. I.L.Finar, “Textbook of Organic Chemistry”, ELBS, 5th edition, 1996.
2. Jerry March, “Advanced Organic Chemistry”, John Wiley & Sons, New York, 1992.
3. A.Brydson, “Plastics materials”, Butterworth - Heinemann – Oxford, 1995.
4. K.J. Saunders, “Organic Polymer Chemistry”, Chapman and Hall Publishers.

PT2203 **PHYSICAL CHEMISTRY OF POLYMERS** **L T P C**
3 0 0 3

(Common Polymer & Plastic Technology)

AIM

To learn about the structures, conformations and orientation of polymeric materials.

OBJECTIVES

To understand

- Physical and conformational properties of polymeric materials
- Molecular arrangement in polymers and their orientation under the influence of stress.
- Solubility behaviour of polymers

UNIT I **9**

Potential energy and conformational energy of molecules - Staggered and eclipsed states - conformations and configurations, isomeric states and isomerism in polymers - Tacticity, stereoisomerism, geometric isomerism - Unperturbed and Gaussian chains - Random coils and average end to end distance - Freely jointed and freely rotating chain models - Random flight analysis.

UNIT II **9**

Thermodynamics - First and second law of Thermodynamics, Carnot cycle - Entropy and enthalpy - Energy driven and entropy driven elasticity - Thermoelasticity - Thermodynamic treatment of rubbers - entropic and energetic contributions to the elastic force in rubbers - Stastical mechanical theory.

UNIT III **9**

Amorphous State - Transition temperatures - Glass transition temperature - Free volume, kinetic, and thermodynamic views of glass transition - Factors influencing glass transition temperature.

Crystalline State - Crystal systems, unit cells, primitive cell, Bravais lattices, polymorphism - Polymer single crystals, lamellae, spherulites, supermolecular structures, fringed micelle model - Degree of crystallinity, factors affecting crystallinity - X-ray diffraction.

UNIT IV **9**

Chain orientation - Concept of chain orientation - orientation in amorphous and crystalline polymers - Uniaxial and biaxial orientation practical significance - Orientation processes - fibre spinning, blown film extrusion, solid state extrusion, profile extrusion - Properties of oriented polymers - Birefringence.

UNIT V **9**

Polymer solutions - Terms and definitions, types of solutions - Hilderbrand approach, Flory Huggins theory - Thermodynamic view of miscibility, upper critical solution temperature (UCST), lower critical solution temperature (LCST) - Concentration regimes in polymer solutions - theta conditions.

TOTAL : 45 PERIODS

TEXT BOOKS

1. S. Glasstone and D. Lewis, Elements of Physical Chemistry, Macmillan India Press, Madras, 1995.
2. Paul C. Painter and Michael M. Coleman, Fundamentals of Polymer Science, Technomic Publishing Co. Inc., Lancaster, USA, 1994.

REFERENCE

1. Ulf W. Gedde, Polymer Physics, Chapman & Hall, 1995.

PT 2204 **POLYMER CHEMISTRY** **L T P C**
4 0 0 4

(Common Polymer & Plastic Technology)

AIM

To learn the basic concepts of polymers, reactions and kinetics involved in polymerization and characterization.

OBJECTIVES

To understand the mechanism of polymerization, various techniques of polymerization, characterization of polymers by molecular weight, reactions and degradation of polymers

UNIT I **12**

Basic concepts of macromolecules – Monomers- Functionality – Classification and nomenclature of polymers. Types of polymers - plastics and rubbers - Step growth polymerization – Mechanism – Kinetics – Bi-functional systems – Poly functional systems.

UNIT II **12**

Addition polymerization Mechanism and kinetics of free radical- Cationic – Anionic polymerisation – Initiator systems – Chain length and degree of Polymerisation – Control of molecular weight – Chain transfer – Inhibition Coordination polymerisation – Mechanism – Kinetics- Ring opening polymerization – Diene polymerization.

UNIT III **12**

Copolymerization – Mechanism and Kinetics of free radical – Ionic copolymerization Types of copolymers- Copolymer composition – Determination of Monomer reactivity ratios. Polymerization techniques – Bulk polymerization – Solution polymerization – Suspension polymerization – Emulsion polymerization – Interfacial condensation.

UNIT IV **12**

Molecular weight – Molecular weight averages – Molecular weight distribution – Unidispersity, polydispersity, degree of polymerization - Molecular weight determination - Basic concepts of end group analysis, colligative properties, osmametry, light scattering, and gel permeation chromatography - Viscosity of polymers solutions, size of the polymer molecules.

UNIT V **12**

Chemical reactions of polymers – Hydrolysis – Acidolysis – Aminolysis- Hydrogenation – Addition and substitution reactions – cross linking reactions. Polymer degradation – Mechanical degradation – Mechano-chemical degradation – Oxidative degradation – Hydrolytic degradation – Photo degradation.

TOTAL : 60 PERIODS

TEXT BOOKS

1. F.W. Billmeyer, “Textbook of Polymer Science”, Wiley international publishers, 2000
2. George Odian , “ Principles of polymerisation”, Seymor Robert

REFERENCES

1. JM.G. Cowie, “Polymers: Chemistry and Physics of Modern Materials”, Blackie, and London, 1991.
2. R.J. Young and P.Lovell, “Introduction to Polymers”, 2nd Ed., Chapman & Hall, 1991.
3. Premamoy Ghosh, “Polymer Science and Technology of Plastics and Rubbers”, Tata McGraw - Hill, New Delhi, 1990.

PT 2207	POLYMER CHEMISTRY LAB	L T P C 0 0 3 2

(Common Polymer & Plastic Technology)

Lab Requirements

Bunsen Burner	15Nos
Electronic Balance	1 No
Thermostatic Water bath	2 Nos
Melting Point Apparatus	1 No
Retort Stand	15Nos
Polymer Samples and Glass wares	

Experiments:

Identification of polymers by simple methods like density, melting point, burning characteristics, solubility and confirmatory test by chemical analysis.

A. PLASTICS
1. Polyethylene
2. Polypropylene
3. Polystyrene
4. Polyvinyl Chloride
5. Polyamide
6. Polyethylene terephthalate
7. Polybutylene terephthalate
8. Polycarbonate
9. Polyacetal
10. Polyphenylene oxide
11. Polyphenylene sulphide
12. Phenol Formaldehyde
13. Urea formaldehyde
14. Melamine formaldehyde

B. IDENTIFICATION OF RUBBERS BY SIMPLE METHODS
1. Natural Rubber (NR)
2. Polybutylene Rubber (BR)
3. Styrene Butadiene Rubber (SBR)
4. Isoprene Rubber (IR)
5. Isobutiene Isoprene Rubber (IIR)
6. Chloroprene Rubber (CR)
7. Acrylonitrile – Butadiene Rubber (NBR)
8. Silicone Rubber

TOTAL : 45 PERIODS

REFERENCE

1. Identification of plastics and rubbers by simple methods , CIPET publications 2002

PT2208 ORGANIC CHEMISTRY LABORATORY L T P C
0 0 3 2

(Common Polymer & Plastic Technology)

Lab Requirements

Conical flask	15 No.
Liebig condenser	15 No
Round bottom flask	15 No.
Burette	15 No.
Pipette	15 No.
Iodine flask	15 No.
Test tubes	01 Gross
Test tube holder	15 No.
Tongs	15 No.
Bunsen burner	15 No.
Chemicals	-------

Experiments :

PART A: Identification of Organic compounds of the following types:

1. Alcohols
2. Aldehydes
3. ketones
4. Carboxylic acids
5. Esters
6. Nitro compounds
7. Amines
8. Amides
9. Carbohydrates
10. Halogen compounds
11. Phenols

PART – B: Single step preparation of organic compounds by the following methods

1. Nitration
2. Acetylation
3. Bromination
4. Oxidation
5. Hydrolysis

II. Quantitative Estimation of

1. Phenol
2. Acetone
3. Urea
4. Formaldehyde
5. Methyl Methacrylate
6. Acrylonitrile

TOTAL : 45 PERIODS

REFERENCES

1. A.I. Vogel, Organic Qualitative and Quantitative Analysis.

MA2263 PROBABILITY AND STATISTICS L T P C
3 1 0 4

(Common to Biotech, Chemical, Fashion, Petroleum, Polymer, Plastic)

OBJECTIVES

At the end of the course, the students would

- Acquire skills in handling situations involving more than one random variable and functions of random variables.
- Be introduced to the notion of sampling distributions and have acquired knowledge of statistical techniques useful in making rational decision in management problems.
- Be exposed to statistical methods designed to contribute to the process of making scientific judgments in the face of uncertainty and variation.

UNIT I RANDOM VARIABLES 9 + 3

Discrete and continuous random variables - Properties- Moments - Moment generating functions and their properties. Binomial, Poisson ,Geometric, Negative binomial, Uniform, Exponential, Gamma, and Weibull distributions.

UNIT II TWO DIMENSIONAL RANDOM VARIABLES 9 + 3

Joint distributions - Marginal and conditional distributions – Covariance - Correlation and Regression – function of a random variable-Transformation of random variables - Central limit theorem.

UNIT III TESTING OF HYPOTHESIS 9 + 3

Sampling distributions – Testing of hypothesis for mean, variance, proportions and differences using Normal, t, Chi-square and F distributions - Tests for independence of attributes and Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 9 + 3

Analysis of variance – One way classification – CRD - Two – way classification – RBD - Latin square.

UNIT V RELIABILTY AND QUALITY CONTROL 9 + 3

Concepts of reliability-hazard functions-Reliability of series and parallel systems- control charts for measurements (x and R charts) – control charts for attributes (p, c and np charts)

L : 45 T : 15 TOTAL: 60 PERIODS

Note : Use of approved statistical table is permitted in the examination.

TEXT BOOKS

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

REFERENCES

1. Walpole, R. E., Myers, R. H. Myers R. S. L. and Ye. K, "Probability and Statistics for Engineers and Scientists", Seventh Edition, Pearsons Education, Delhi, 2002.
2. Navidi, W, "Statistics for Engineers and Scientists", Special Indian Edition, Tata McGraw-Hill Publishing Company Ltd, New Delhi,2008.
3. Spiegel, M.R, Schiller, J and Alu Srinivasan, R, "Schaum's Outlines Probability and Statistics", Tata McGraw-Hill Publishing Company Ltd. New Delhi ,2007.

PT 2251 **MOULD ENGINEERING** **L T P C**
3 1 0 4

(Common Polymer & Plastic Technology)

AIM

To learn the techniques employed in mould making.

OBJECTIVES

- To study the mould making techniques such as metal cutting, metal erosion, metal deposition, metal displacement and mould polishing

UNIT I **12**

Mold Making: Materials used in mold making , Introduction of mold parts, Mechanism of metal cutting, types of tools, influence of tool angles, Cutting fluids, Tool materials used including coated tools. Studies of various machining operations: Turning, Shaping, Planning, Drilling, Grinding (Surface, Cylindrical, Tool & Cutter, Rotary Grinding), Milling (Horizontal / Copy Milling / Vertical / Ram / Tool Milling).

UNIT II **12**

Die sinking (copy milling), Pentograph, Profile grinding, Electrical discharge machining – Characteristics, physical processes, special technological features, types of EDM, design consideration & functions and technological planning. Applications of wire cut EDM in mold making.

UNIT III **12**

Electroforming for mold manufacturing – discussion of the process, materials for electroforming, design & materials for models, machining for electroformed blanks, mold cavities, economy & service life.

Hobbing for mold making – Discussion of the hobbing process & its advantages, elements of hobbing like hobbing punch, shape of the hob, materials used for cavity, lubrication, and depth of hobbing, Hobbing presses, Hobbing operations & its economy with examples.

UNIT IV **12**

Polishing technology in mold making: Definition of surface roughness, basis of polishing technology, Effect of mold materials on polishability, Types of polishing tools, Methods of polishing - Basic information on Electro sonic polishing – Principles of Electro deposition in damaged molding surfaces.

Surface Texturing of molds – Process description, types of molds, types of patterns and mold shapes, metals that can be etched, mold preparation, limitations of chemical texturing.

UNIT V **12**

Metrology and inspection: Scope of inspection, Procedures, Choices of basic measuring instruments, Vernier, Micrometer, Surface Plates, Angle plates, Squares, Vernier height gauges, Depth gauges, Slip gauges, Dial gauges, Surface roughness measurement, Hardness testing, Comparators, Optical profiles projectors, Tool makers microscope, Optical flats – types and uses.

TOTAL : 60 PERIODS

TEXT BOOKS

1. Klus Stokhert (Edt.), Mold making handbook for Plastic Engineers, Hanser Publishers, NY, 1983
2. HMT Production Technology, TMH (India), 1992
3. Plastics Mould design , CIPET Publications , 2007

REFERENCES

1. Bhattacharya, A New Technology, IB Publishers, 1984
2. P.C.Pandey & H. S. Shah, Modern Machining Processes, TMH, 1990
3. R.G.W.Pye, Injection Mold Design, East West Press Pvt. Ltd., New Delhi.
4. Stoeckhert & Menning, Mold making handbook, 2nd edition, Hanser Publishers, Munich.
5. W.A.J Chapman, Workshop Technology, Vol I & II, ELBS.
6. Herbert Rees, Mold Engineering, Hanser Publishers, NY.
7. George Menges & Paul Mohren, How To Make Injection Molds, Hanser Publishers.

PT 2252 POLYMER STRUCTURE AND PROPERTY RELATIONSHIP L T P C
3 0 0 3

(Common Polymer & Plastic Technology)

AIM

To emphasize the relationship between the structure and properties of polymers.

OBJECTIVES

To understand

- The structure of polymers and prediction of polymer properties
- The relationship between polymer structure and properties such as mechanical, thermal, electrical, optical and chemical properties

UNIT I **9**

Structure of polymers - Linear, branched, crosslinked, and network polymers - Homochain and hetero atomic chain polymers - Copolymers - Linear and cyclic arrangement - Prediction of polymer properties, group contribution techniques, topological techniques- Volumetric properties - molar volume, density, Van der Waals volume - Coefficient of linear thermal expansion and volumetric thermal expansion - Pressure volume temperature (PVT) relationship.

UNIT II **9**

Mechanical properties - Stress-strain properties of polymers - Effect of polymer structure on modulus of elasticity, tensile strength, flexural strength, impact strength, yield strength, fracture toughness - Crazing in glassy polymers - Ductile brittle transition. Effect of additives on mechanical properties of polymers - Creep, stress relaxation, and fatigue.

UNIT III **9**

Thermodynamic and transition properties - Transition temperature in polymers, glass transition (T_g), melt transition (T_m), relationship between T_g and T_m - other transitions like β-transitions, upper and lower glass transition temperatures - Prediction of T_g and T_m of polymers by group contributions.

Calorimetric properties - Heat capacity, specific heat, latent heat of crystallization and fusion, enthalpy and entropy - Calculation of heat capacities of polymers.

UNIT IV **9**

Electrical and optical properties - Effect of polymer structure on dielectric constant, power factor, dissipation factor, and loss factor - effect of frequency of voltage and temperature on dielectric properties - Prediction of molar polarization and effective dipole moment. Effect of additives on electrical properties of polymers.

Optical properties - Effect of polymer structure on optical properties - clarity, transparency, haze, transmittance, reflectance, and gloss - Prediction of refractive indices of polymers by group contributions, Static charges, volume & surface resistivity, arc resistance.

UNIT V **9**

Chemical Properties - Cohesive energy, cohesive energy density, solubility parameter, determination of solubility parameter of polymers - Prediction of solubility parameter - Effect of polymer structure on solubility in solvents and oils - Influence of structure in prediction of flame retardancy, water repellency - Chemical resistance of polymers - Polymer toxicity.

TOTAL : 45 PERIODS

TEXT BOOKS

1. D.W. Van Krevelen And P.J. Hoftyzen, "Properties Of Polymer, 3rd Edition Elsevier Scientific Publishing Company Amsterdam – Oxford – New York. 1990.
2. J.E. Mark Ed. AIP, Physical Properties Of Polymers Hand Book, Williston, Vt, 1996.

REFERENCES

1. D.A.Seanor, ed., Electrical properties of polymers, Academic press, New York, 1982.
2. Jozef.Bicerano, Prediction Of Polymer Properties, Second Edition, Marcel Dekker Inc. New York, 1995.
3. J.M.Margolis (Ed.), Engineering Thermoplastics Properties & Applications, Marcel Dekker, New York 1985.
4. R.J.Samuels, Structured Polymer Properties, John Wiley & Sons, New York, 1974.
5. I.M.Ward & D.W.Hadley, An Introduction to the Mechanical Properties of Solid Polymers, John Wiley & Sons, Chichester, England, 1993.
6. C.C.Ku & R.Liepins, Electrical Properties of Polymers, Hanser Publications, Munich, 1987.
7. F. Bueche, Physical properties of polymers, Wiley, New York, 1962.
8. J.Mort & G.Pfister, eds., Electronic properties of polymers, Wiley Interscience, New York, 1982.

PT 2253 PRINCIPLES OF CHEMICAL ENGINEERING L T P C
3 0 0 3

(Common Polymer & Plastic Technology)

UNIT I **9**

Classification of Unit Operations

Fluid flow -Types of fluids – Newtons's law of viscosity; Reynolds number regimes, internal flow - flow through pipes – pressure drop under laminar and turbulent flow conditions Mixing and agitation – types of impellers, power requirement for mixing.

UNIT II **9**

Mechanical operations

Properties of solids - Sieve analysis; Laws of crushing, Crushers and grinders. Principle of separation and selection and details of equipment for screening, sedimentation, cyclones and hydro cyclones and filtration

UNIT III **9**

Heat transfer

Modes of heat transfer; Heat transfer by conduction - Fourier's law, conduction across composite walls. Film concept and convective heat transfer coefficient. Heat transfer by natural & forced convection. Cocurrent, Counter current, shell & tube heat exchangers. Heat transfer with phase change – boiling and condensation; Evaporators.

UNIT IV

Mass transfer **9**

Principles of diffusion, theory of diffusion, Two film theory and mass transfer coefficients Humidification – operation, humidity chart, equipments – cooling towers and spray chambers Drying – Principles and definitions. Rate of batch drying. Equipments for drying.

UNIT V **9**

Absorption – Principle and equipment (packed towers and plate columns).
Distillation – Vapour liquid equilibria, flash distillation, Binary distillation. Industrial equipments for distillation
Adsorption – Principle and equipment for adsorption.
Extraction - Principle and equipment for adsorption.

TOTAL : 45 PERIODS

TEXT BOOKS

1. W.L .Mc Cabe, J.C. Smith, "Unit Operations of Chemical Engineering", McGraw-Hill, 1993.
2. W.L.Badger, J.T. Banchero. "Introduction to Chemical Engineering", McGraw-Hill, UK, 1997.

REFERENCES

1. Richardson and Coulson, "Chemical Engineering", Vol. 1 & Vol. 2, Asian Books Pvt. Ltd., India, 1996.
2. Chemical Engineer's handbook - Perry and Chilton.
3. Principles of Unit Operations - Foust A.S., Walzel.L.A. , John Wiley.

PT2254 **STRENGTH OF MATERIALS** **L T P C**
3 0 0 3

(Common Polymer & Plastic Technology)

AIM

To acquire knowledge on behaviour of materials on application of load.

OBJECTIVES

To study the behavior and failure pattern of different materials under different loading conditions
Design of structural member under given loading conditions

UNIT I **9**

Elasticity: Stress and strain, compressive, tensile, shear and bearing stress – Stress – strain diagram, Hooks law, modulus of elasticity, modulus of rigidity, bulk modulus of rigidity, bulk modulus, Poisson's ratio. Relationship between elastic constants and temperature stresses, composite bars.

UNIT II **9**

Properties of section, calculation of areas, centroid, neutral axis, moment of inertia, modulus of section, radius of gyration with reference to structural shapes.

UNIT III **9**

Theory of simple bending – relationship between load shearing force and bending moment. Bending moment and shear force diagram for cantilever, simple supported and over hanging beams – bending and shear stresses. Torsion in solid and hollow shafts – combined bending and torsion.

UNIT IV **9**

Principal stresses and strains - Thin cylinders and shells subjected to internal pressures.

UNIT V **9**

Deflection – deflection of beams in simple cases column and struts – long and short columns – axial loading – effect of end conditions – equivalent length and slenderness ratio – Euler and Rankine formulae.

TOTAL : 45 PERIODS

TEXT BOOKS

1. R.S. Khurmi, Applied Mechanics and Strength of Materials S.Chand & Co., (6^{th} ed), New Delhi, 1987.
2. P.N. Singh and I.K.Jha, Elementary Mechanics and Solids, Wiley Eastern, New Delhi.

PT 2255 **POLYMERIC MATERIALS I** **L T P C**
4 0 0 4

AIM

To learnt about the various methods of preparation, properties and applications of thermoplastic materials.

OBJECTIVES

To understand the methods of preparation, properties and applications of thermoplastic materials covering commodity, engineering and high performance plastics.

UNIT I **12**

Methods of manufacturing – Properties and applications of polyethylene – LDPE – LLDPE- HDPE, HMWHDPE- UHMWHDPE - Crosslinked polyethylene- Chlorinated polyethylene – Polypropylene – Homopolymers – Copolymers.

UNIT II **12**

Methods of manufacturing – Properties and applications of poly(vinyl chloride)- Poly (vinylidene chloride)- Poly(vinyl alcohol) – Poly(vinyl acetate)- Chlorinated poly(vinyl chloride)- Plastisols, Polystyrene, HIPS, EPS, SAN, EVA, EPDM, ABS.

UNIT III **12**

Methods of manufacturing – properties and applications of Acrylates – Poly (methyl methacrylate)- Polyacrylonitrile. Aliphatic polyamides –Aromatic polyamides – Polyethylene terephthalate - Polybutylene terephthalate - Polyacetals and copolymers – Polycarbonates-Thermoplastic polyurethane (TPU)

UNIT IV **12**

Methods of manufacturing – Properties and applications of Fluoro polymers – Polytetrafluoroethylene, Polychlorofluoroethylene, Thermoplastic polyurethanes, Cellulose nitrate – Cellulose acetate- ethyl cellulose- Cellulose esters.

UNIT V **12**

Preparation, properties and applications of High performance Thermoplastic materials- PPS, PPO, Polysulphone, Polyether Sulphone, PEEK, Polyimide- Biodegradable plastics , photodegradable plastics

TOTAL : 60 PERIODS

TEXT BOOKS

1. J.A.Brydson, “Plastics Materials”, Butterworth- Heinemann – Oxford, 6th Ed., 1995.
2. Feldman.D and Barbalata.A, “Synthetic Polymers”, Chapman Hall, 1996.

REFERENCES

1. Olagoke Olabisi, “Hand Book of Thermoplastics”, Marcel Decker, inc., 1997
2. K.J. Saunders, “Organic Polymer chemistry”, Chapman & Hall, NY, 1988.
3. Irvin.I. Rubin, “Hand Book of Plastic Materials and Technology”, Wiley Interscience, NY, 1990.

PT 2257 CHEMICAL ENGINEERING - I LAB **L T P C**
0 0 3 2

(Common Polymer & Plastic Technology)

AIM:

LAB REQUIREMENTS

Fluidized bed	1 No.
Packed bed	1 No.
Stop watch	2 No.
Measuring cylinder (1 Lit)	2 No.
Sieve shaker and sieve set	1 No.
Ball mill	1 No.
Jaw crusher	1 No.
Electronic balance	1 No.
Plastics tray	2 No.
Friction pipe apparatus	1 No.
Single speed centrifugal pump	1 No.
Venturi meter apparatus	1 No.
Orifice/mouth piece apparatus	1 No.
Stop watch	4 No.
Meter scale	4 No.
Vernier caliper	2 No
Flow measuring meters	3 No.
Stop watch	2 No.
Thermometer	5 No.
Tacho meter	1 No.
Measuring jar (2 lit and 1 Lit each one)	2 No.
Air compressor	1 No.
Parallel and counter flow heat exchanger	1 No.
Stephen Boltzman apparatus	1 No.
Thermal conductivity Apparatus	1 No.

Experiments:

1. Flow through rough and smooth pipes.
2. Centrifugal pump.
3. Calibration of orifice meter.
4. Air compressor
5. Calibration of rotameter

6. Pressure drop in packed bed
7. Fluidization
8. Flow through weirs
9. Air-lift pump.
10. Open orifice and drainage time
11. Thermal conductivity of solids.
12. Heat exchanger
13. Stefan-Boltzman constant
14. Jaw crusher
15. Ball Mill
16. Screening efficiency.
17. Simple distillation
18. Steam distillation

(Any Nine Experiments)

TOTAL : 45 PERIODS

REFERENCES

1. W.L. Mc cabe and J.C Smith, Unit operations In Chemical Engineering, McGraw-Hill Book Co., 1976.
2. W.L. Badger and J.P Bancro, Introduction to Chemical Engineering, McGraw-Hill Book Co., 1982.

PT 2258 MOULD ENGINEERING LAB L T P C
0 0 3 2

(Common to Plastic & Polymer Technology)

AIM

To learn the techniques employed in mould making.

OBJECTIVES

To study the mould making techniques such as metal cutting, metal erosion, metal deposition, metal displacement and mould polishing.

LAB REQUIREMENTS

Shaping machine	5 No.
Vertical milling machine	2 No.
Horizontal milling machine	2 No
Lathe	15 No.
Plain surface grinding machine	1 No.
Bench grinder	2 No.
Vernier caliper	2 No.
Vernier height gauge	2 No.
Sine bar	2 No.
Sine center	1 No.
Gear tooth vernier caliper	1 No.

Experiments

1) Exercise on Shaping machine – making square rod from round rod and cutting V-groove.
2) Exercise on Plain Milling.
3) Exercise on Vertical Milling.
4) Screw Cutting on lathe – external thread.
5) Exercise on Surface Grinding.
6) Exercise on Slotting Machine.
7) Grinding of Cutting tools.

8) Study of different types of Cutting tools.
9) Measurements using Micrometer, vernier, Height gauge and Slip gauge.
10) Measurement of angles and tapers.
11) Checking of straightness using auto collimeter.
12) Application of Dial gauge.

(Any 8 experiments from the above)

Demonstration Experiment : To make a simple mold for hand molding machine

TOTAL : 45 PERIODS

MA2264 NUMERICAL METHODS L T P C
3 1 0 4

AIM

To apply mathematical principles to engineering problems and design of process equipments

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9

Iterative method, Newton – Rap son method for single variable and for simultaneous equations with two variables Solutions of linear system by Gaussian, Gauss-Jordan, Jacobi and Gauss – Seidel methods Inverse of a matrix by Gauss – Jordan method Eigen value of a matrix by power and Jacobi methods

UNIT II INTERPOLATION 9

Newton's divided difference formula, Lagrange's and Hermite's polynomials Newton forward and backward difference formulae Stirling's and Bessel's Central difference formulae

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9

Numerical differentiation with interpolation polynomials, Numerical integration by Trapezoidal and Simpson's ($1/3^{rd}$ and $3/8^{th}$) rules Two and three point Gaussian Quadrature formula Double integrals using Trapezoidal and Simpson's rules

UNIT IV INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS 9

Single step Methods – Taylor Series, Euler and Modified Euler, Runge – Kutta method of order four for first second order differential equations. Multi step methods-Milne and Adam's Bash forth predictor and corrector methods

UNIT V BOUNDARY VALUE PROBLEMS FOR ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS 9

Finite difference solution for the second order ordinary differential equations Finite difference solution for one dimensional heat equation (both implicit and explicit), one dimensional wave equation and two dimensional lap lace and poison equations

L: 45, T: 15 TOTAL : 60 PERIODS

TEXT BOOKS

1. Sastry, S.S., "Introduction of Numerical Analysis (Third Edition)", Printice Hall of India, New Delhi, 1998.
2. Gerald C.F., Wheatley P.O., "Applied Numerical Analysis (Fifth Edition)", Addison – Wesley, Singapore, 1998.

REFERENCES
1. Kandasamy, P., Thilakavthy, K and Gunavathy, K. “Numerical Methods”, S.Chand and Co., New Delhi, 1999.
2. Grewal B.S., Grewal J.S., “Numerical Methods in Engineering and Science”, Khanna Publishers, New Delhi, 1999.
3. Jain M.K., Iyengar S.R.K and Jain R.K., “Numerical Methods for Engineering and Scientific Computation (Third Edition)”, New Age International (P) Ltd., New Delhi, 1995.
4. Narayanan S., Manickavachakam Pillai K. and Ramanaiah G., “Advanced Mathematics for Engineering Students Vol.-III”, S.Viswanathan Pvt. Ltd., Chennai, 1993.

PT2301 FLUID MECHANICS LT P C
4 0 0 4

UNIT I **12**

State of Aggregation and phase states of matter Molecular motion in Polymers Transition relaxation processes in Polymers. Glass Transition, Theories to determine the glass transition i.e. Dilatometric, Heat capacity, measurement, Thermo mechanical, Measurement of modulus of elasticity, effect of Tg on molecular mass, kinetic chain flexibility and chemical constituent, Importance of Tg and Tm, HDT.

UNIT II **12**

Viscoelastic behavior of Polymer solution and melts stress-strain curves for Polymers, creep of Polymeric material, elastic deformation, and irrecoverable follow deformation. Rubber like deformation, Time-temp superposition (WLF Equation) Models of viscoellasticity such as Maxwell and kelvin model. Types of viscosity, stress relaxation.

UNIT III **12**

Introduction and Basic concept of Rheology, classification of fluids, Newtonian and non Newtonian fluids, shear stress, shear strain and shear rate, shear modulus, bulk modulus, Zero shear viscosity, Dependence of viscosity with temp, shear stress, shear rate fluid through channel, characteristic parameter during shear deformation.

UNIT IV **12**

Methods to determine shear viscosity by capillary Rheometer, cone and plate viscometer, Cup and bob viscometer, Measurement of normal stresses. Theories of viscosities of dilute (De-bye Bueche theory) and conc. Solutions (Grasselley’s entanglement theory), (Entanglement concern)

UNIT V **12**

Rheology of dilute and concentrated suspensions, effect of Rheology during Injection, moulding Extrusion: Film extrusion, sheet Extrusion and Blow mouldings of polymers Rheometer, Bubble inflation rheometer, compression rheometers, stress relaxation instruments. Torque rheometers, rotational & sliding surface rheometers and their use in determining processability

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

REFERENCES

1. The Flow of High polymers, S. Middleman John Wiley and Sons, George St. 1968.
2. Rheometry K.Walters, Chapman and Hall London 1975
3. Rheology of Polymers :G.V.Vinogradov and A.Ya Malkin Mir Pub MOSCOW 1980.
4. J.J. Alkonis and W.J.Macknight - Introduction to Polymer Viscoelasticity - Willey Inter Science, New York-1982.
5. Viscoelasticity of Polymers D.D.Ferry III Edn. John Willey and Sons New York 1981.
6. Physical Chemistry of Polymers - Tager.
7. Polymer Sc. and Tech. of Plastics and Rubber ; D.Ghosh.
8. Melt Rheology and its Role in Plastics Processing : Dealy
9. Flow Properties of Polymer Melt by J.A.Brydson.
10. Cogswell; F. N., Polymer Melt Rheology, George Goodwin Ltd. and P. R. London—John Wiley and Sons, (1981)
11. May; Clayton A. (Ed.), Chemorheology of Thermosetting Polymers, ACS Symposium
12. Series 227, American Chemical Society, Washington D. C. (1985).

PT2302 ANALYSIS AND CHARACTERISATION OF POLYMERS L T P C
3 0 0 3

AIM

To familiarize the techniques of identification and analysis of polymers

OBJECTIVES

To prepare the students with methodology for facing the industrial and academic challenges in

- Identifying various polymers
- Controlling the quality of incoming raw materials and processing
- Characterizing different fluid of polymers
- Analyzing polymers through various instrumental methods

UNIT I IDENTIFICATION AND ANALYSIS 9

Identification of rubbers and plastics by simple physical methods by chemical analysis, application of instrumental techniques for identification of polymers and additives Thermoplastics – melting point, density, viscosity, melt flow index, K-value. Thermo sets – moisture analysis, particle size, apparent density, spiral flow test, cup flow test, gel time and peak exothermic temperature. Resins – acid value, hydroxyl value, isocyanate index, epoxy equivalent

UNIT II SPECIFICATIONS, QUALITY CONTROL AND PROCESS ABILITY TESTS 9

Rubber latex and dry rubber – cup viscosity, total alkalinity, total solids, dry rubber content, volatile matter, KOH number, mechanical stability and heat stability, Plasticity, plasticity retention index (PRI), scorch time and cure characteristics (plastimeter, Mooney viscometer, oscillating disc rheometer)

UNIT III MOLECULAR CHARACTERIZATION OF POLYMERS 9

Determination of molecular weight, viscometry, end group analysis, colligative property, osmometry light scattering technique, determination of molecular weight and molecular weight distribution, gel permeation chromatography

UNIT IV THERMAL ANALYSIS OF POLYMERS 9

Differential thermal analysis (DTA), differential scanning calorimetry (DSC), thermo gravimetric analysis (TGA), thermo mechanical analysis (TMA), dynamic mechanical thermal analysis (DMTA)

UNIT V PHYSICAL METHODS OF ANALYSIS 9

X-ray diffraction (Wide angle and small angle), Infrared spectroscopy (IR & FTIR), and Nuclear magnetic resonance spectrometer (NMR), GC – Mass spectrometer, optical microscopy, scanning electron microscopy, and transmission electron microscopy

TOTAL: 45 PERIODS

TEXT BOOK

1. Chermisinoff, Polymer Characterization – Laboratory Techniques and Analysis. Hunt & James, Polymer Characterization, Chapman & Hall, London, 1993

REFERENCES

1. Hoffman, Rubber technology Handbook, Hanser Publishers, Munich 1996
2. ASTM - 9.01 & 9.02; 8.01 & 8.04, 2000
3. Kampff, Characterization of Plastics using physical methods, Experimental Techniques and practical applications
4. D. Campbell & J.R. White, Polymer Characterization, Chapman & Hall, 1989.

PT2303 COMPUTER PROGRAMMING L T P C
3 0 0 3

AIM

To learnt “C” and java programming.

OBJECTIVES

To understand Preparing methodologies, basics of C++, classes, inheritance, and polymorphism templates and brief details on java programming

UNIT I INTRODUCTION 9

Programming methodologies – comparison – Object oriented concepts – Basics of C++ environment**.**

UNIT II CLASSES 9

Definition – Data members – Access specifiers – Constructors – Default constructors – Copy constructors – Destructors – Static members – This pointer – Constant members – Free store operators – Control statements.

UNIT III INHERITANCE AND POLYMORPHISM 9

Overloading operators – Functions – Friends – Class derivation – Virtual functions – Abstract base classes – Multiple inheritance

UNIT IV TEMPLATES 9

Class templates – Function templates – Exception handling – Streams

UNIT V JAVA PROGRAMMING **9**

Java environment – Classes –Definition – Field methods – Object creation – Constructors – Overloading methods – Static members – This keyword – Nested classes Extending classes – members accessibility – overriding – methods – Abstract classes – Interfaces

TOTAL : 45 PERIODS

TEXT BOOKS

1. Bjarne Stroustrup, "The C++ Programming Language", Addison Wesley, 2000
2. Ken Arnold, James Gosling, "The JAVA Language", II edition, Addison Wesley, 1998.

REFERENCES

1. E. Balaguruswamy, "Object Oriented Programming with C++", II edition, TMH, 2001
2. Herbert Schildt, "C++ The Complete Reference", TMH, 1997
3. Stanley B. Lipman. Jore Lajoie, "C++ Primer", III edition, Addison Wesley, 2000
4. Barkakati. N, "Object Oriented Programming in C++", PHI, 1995
5. Kris Jamsa, "Java Programming – A Complete Reference", Galgotia Publication, 1994.
6. Patrick Naughton, Herbert Schildt, "Java Complete Reference", TMH, 1997.

PT2304 PROCESSING TECHNOLOGY – I **L T P C**
3 0 0 3

AIM

To learn the basic processing methods employed for plastics**.**

OBJECTIVES

To study different plastic processing techniques such as injection, blow moulding and thermoforming to learn about various compounding machinery and technology

UNIT I **9**

Introduction to polymer processing – Plastics processing techniques – Selection of plastic materials – Selection of additives - General considerations in formulation – Methods of incorporation of additives - Mixing and compounding equipment.

UNIT II **9**

Injection moulding –terminology – Process description- Theory of injection moulding – Design and consideration -moulding cycle – Classification and functions of moulds – Cavity lay out – Setting up of mould – Trouble shooting operations.

UNIT III **9**

Types Injection unit & Elements of plasticating process – Classification of screw – Screw design – Process control – Clamping unit – Classification of Machine Hydraulics – Ancillary equipment – Computer operation

UNIT IV **9**

Blow moulding – terminology – Basis in blow moulding - Process variables – Injection & stretch blow moulding – Single and multi layer. Extrusion blow moulding – Extrusion heads, moulding process controls for blow moulding – Machine, process and product controls.

UNIT V **9**

Thermoforming – Definition – Methods of forming Thermoforming machinery – Heating of sheet – Heating cycle - Stretching – Concept – Hot strength- Bustering – Sags - Cooling and trimming the parts – Heat balance – Shrinkage –Trimming operations.

TOTAL : 45 PERIODS

TEXT BOOKS

1. D.V. Rosato Kluwer, "Injection Moulding Handbook", Academic Publishers Boston 2nd Edition 1995
2. Richard C. Progelhof James. L. Throne, "Polymer Engg. Principles", Hanser Publisher Munich 1993

REFERENCES

1. N.P. Charemisinoff & P.N. Chere, "Handbook of Applied Polymer Processing Tech", Marcel Dekker, Inc, NY 1996.
2. Herbert Recs, "Understanding of Injection Moulding Tech.", Hanser Pub., Munich 1994.

PT2305 **POLYMERIC MATERIALS II** **L T P C**
3 0 0 3

AIM

To understand the manufacture, properties and applications of polymeric materials.

OBJECTIVES

To study the manufacturing technology, properties and applications of thermoplastics, thermosets and elastomers.

UNIT I **9**

Manufacture, properties and applications - polyethylene, polypropylene, polystyrene Polyvinylchloride, polyvinyl alcohol, polyacetal, fluoroplastics.

UNIT II **9**

Manufacture, properties and applications - polyethyleneterephthalate, polybutylene terephthalate, polycarbonate, polyacrylate, liquid crystalline polyesters.

UNIT III **9**

Manufacture, properties and applications-aliphatic polyamides-polyamide thermoplastic Elastomer-aromatic polyamides, polyimides

UNIT IV **9**

Manufacture, properties, curing and applications- phenolics,aminoplastics, epoxy,Unsaturated polyester, vinyl ester resins, BMI.

UNIT V **9**

Manufacture, properties and applications –NR, polybutadiene, styrene-butadiene rubber-nitrile rubber, polyisoprene, polychloroprene, silicone rubber, EPDM rubber, chlorosulfonated polyethylene, acrylic rubbers, polyurethane and fluoroelastomers.

TOTAL : 45 PERIODS

TEXTBOOK

1. D.Feldman and A.Barbalata- "Synthetic Polymers-Technology, Properties and Applications" Chapman and Hall,1996

REFERENCES

1. J.M.Martin,W.K.Smith "Handbook of Rubber Technology" Vol.1 CBS Publishers, New Delhi,2004.
2. Irvin .I.Rubin, "Handbook of Plastics Materials" John Wiley and Sons Inc, 1990.
3. John S.Dic,Annicelli.R.A. "Rubber Technology: Compounding and Testing for Performance" Hanser Gardner Publisication,2001.
4. Cornelia Vasile,ed "Handbook of Polyolefins",2nd Edition,Marcel Dekker,2000.
5. Gottfried.W.Ehrenstein "Polymeric Materials : Structure-Properties-Applications" Hanser Gardner, 2001.
6. Olagoke Olabisis "Handbook of Thermoplastics" -Marcel Dekker,Inc,1997

GE2321 COMMUNICATION SKILLS LABORATORY

L T P C
0 0 4 2

AIM

Globalization has brought in numerous opportunities for the teeming millions, with more focus on the students' overall capability apart from academic competence. Many students, particularly those from non-English medium schools, find that they are not preferred due to their inadequacy of communication skills and soft skills, despite possessing sound knowledge in their subject area along with technical capability. Keeping in view their pre-employment needs and career requirements, this course on Communication Skills Laboratory will prepare students to adapt themselves with ease to the industry environment, thus rendering them as prospective assets to industries. The course will equip the students with the necessary communication skills that would go a long way in helping them 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.

I. PC based session	**(Weightage 40%)**	**24 periods**

A. ENGLISH LANGUAGE LAB (18 Periods)

1. LISTENING COMPREHENSION: (6)

Listening and typing – Listening and sequencing of sentences – Filling in the blanks - Listening and answering questions.

2. READING COMPREHENSION: (6)

Filling in the blanks - Close exercises – Vocabulary building - Reading and answering questions.

3. SPEAKING: (6)

Phonetics: Intonation – Ear training - Correct Pronunciation – Sound recognition exercises – Common Errors in English.

Conversations: Face to Face Conversation – Telephone conversation – Role play activities (Students take on roles and engage in conversation)

B. DISCUSSION OF AUDIO-VISUAL MATERIALS (6 PERIODS)

(Samples are available to learn and practice)

1. RESUME / REPORT PREPARATION / LETTER WRITING (1)

Structuring the resume / report - Letter writing / Email Communication - Samples.

2. PRESENTATION SKILLS: (1)

Elements of effective presentation – Structure of presentation - Presentation tools – Voice Modulation – Audience analysis - Body language – Video samples

3. SOFT SKILLS: (2)

Time management – Articulateness – Assertiveness – Psychometrics – Innovation and Creativity - Stress Management & Poise - Video Samples

4. GROUP DISCUSSION: (1)

Why is GD part of selection process ? - Structure of GD – Moderator – led and other GDs - Strategies in GD – Team work - Body Language - Mock GD -Video samples

5. INTERVIEW SKILLS: (1)

Kinds of interviews – Required Key Skills – Corporate culture – Mock interviews- Video samples.

II. Practice Session	**(Weightage – 60%)**	**24 periods**

1. **Resume / Report Preparation / Letter writing**: Students prepare their Own resume and report. (2)
2. **Presentation Skills:** Students make presentations on given topics. (8)
3. **Group Discussion**: Students participate in group discussions. (6)
4. **Interview Skills**: Students participate in Mock Interviews (8)

REFERENCES

1. Anderson, P.V, **Technical Communication**, Thomson Wadsworth , Sixth Edition, New Delhi, 2007.
2. Prakash, P, **Verbal and Non-Verbal Reasoning**, Macmillan India Ltd., Second Edition, New Delhi, 2004.
3. John Seely, **The Oxford Guide to Writing and Speaking**, Oxford University Press, New Delhi, 2004.
4. Evans, D, **Decisionmaker**, Cambridge University Press, 1997.
5. Thorpe, E, and Thorpe, S, **Objective English**, Pearson Education, Second Edition, New Delhi, 2007.
6. Turton, N.D and Heaton, J.B, **Dictionary of Common Errors**, Addision Wesley Longman Ltd., Indian reprint 1998.

LAB REQUIREMENT

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

Guidelines for the course

GE2321 COMMUNICATION SKILLS LABORATORY

1. A batch of 60 / 120 students is divided into two groups – one group for the PC-based session and the other group for the Class room session.

2. The English Lab (2 Periods) will be handled by a faculty member of the **English Department**. The Career Lab (2 Periods) may be handled by any competent teacher, **not necessarily from English Department**

3. **Record Notebook:** At the end of each session of English Lab, review exercises are given for the students to answer and the computer evaluated sheets are to be compiled as record notebook. Similar exercises for the career lab are to be compiled in the record notebook.

4. **Internal Assessment:** The 15 marks (the other 5 marks for attendance) allotted for the internal assessment will be based on the record notebook compiled by the candidate. 10 marks may be allotted for English Lab component and 5 marks for the Career Lab component.

5. **End semester Examination:** The end-semester examination carries 40% weightage for English Lab and 60% weightage for Career Lab.

   Each candidate will have separate sets of questions assigned by the teacher using the teacher-console enabling PC–based evaluation for the 40% of marks allotted.

   The Career Lab component will be evaluated for a maximum of 60% by a local examiner & an external examiner drafted from other Institutions, similar to any other lab examination conducted by Anna University.

Requirement for a batch of 60 students

Sl.No.	Description of Equipment	Quantity required
1.	**Server**	1 No.
	o PIV system	
	o 1 GB RAM / 40 GB HDD	
	o OS: Win 2000 server	
	o Audio card with headphones (with mike)	
	o JRE 1.3	
2.	**Client Systems**	60 No.
	o PIII or above	
	o 256 or 512 MB RAM / 40 GB HDD	
	o OS: Win 2000	
	o Audio card with headphones (with mike)	
	o JRE 1.3	

3.	Handicam Video Camera (with video lights and mic input)	1 No.
4.	Television - 29”	1 No.
5.	Collar mike	1 No.
6.	Cordless mikes	1 No.
7.	Audio Mixer	1 No.
8.	DVD Recorder / Player	1 No.
9.	LCD Projector with MP3 /CD /DVD provision for audio / video facility - **Desirable**	1 No.

PT2307 COMPUTER PROGRAMMING LAB L T P C
0 0 3 2

LAB REQUIREMENT

1. Computer Systems 30 Nos
2. Soft wares for C++ and Java

C++ PROGRAMMING

- Simple C++ program
- Function overloading
- Operator overloading
- Inheritance
- Virtual functions and Dynamic binding
- File handling
- Exception handling
- JAVA PROGRAMMING
- Simple Java programs
- Inheritance
- Event handling programs

TOTAL: 45 PERIODS

PT2308 POLYMER PREPARATION AND CHARACTERIZATION LABORATORY L T P C
0 0 3 2

AIM

To familiarize the techniques of identification and analysis of polymers

OBJECTIVES

To prepare the students with Methodology for facing the Industrial and academic challenges in

- Identifying various polymers
- Controlling the quality of incoming raw materials and processing
- Analyzing polymers through various instrumental methods

LAB REQUIREMENT

Magnetic stirrer	10 Nos
Thermostatic Water bath	2 Nos.
Vacuum Pump	1 No
Heating Mantle	10 Nos.
Water distillation set up	1 No
Bunsen burner	15 Nos
Electronic balance	2 Nos.
Air oven	1 No
Melting point apparatus	1 No
Retard stands	15 Nos

- Preparation of phenol – formaldehyde (Novalac) resin.
- Preparation of phenol – formaldehyde (Resol) resin.
- Preparation of Urea formaldehyde resin.
- Preparation of Bisphenol – An epoxy resin.
- Preparation of Unsaturated polyester resin.
- Preparation of a polyester using Diethylene glycol & adipic acid.
- Bulk polymerization of styrene.
- Emulsion Polymerization of styrene.
- Solution Polymerization of acrylonitrile.
- Solution Polymerization of vinyl acetate.
- Suspension Polymerization of Methyl methacrylate.
- Copolymerization of styrene and methyl methacrylate.

TOTAL : 45 PERIODS

PT2351 MOULD AND DIE DESIGN L T P C
3 1 0 4

AIM

To get a basic understanding in design of moulds

OBJECTIVES

To learn the design of moulds such as injection, compression, transfer, blow and extrusion dies and moulds.

UNIT I **12**

Classification of Injection Moulds – Methodical Mould Design – Number of Cavities, Selection of Injection Moulding Machine, Layout of Cavities in multi-impression Mould, Feed Systems – Design of Runners & gate, Ejection Systems, Cooling Systems, Venting – Other aspects in Injection Mould Design.

UNIT II **12**

Classification of Compression Moulds – Factors that Influence Thermoset Moulding – Materials Selection in Relation to Moulding Conditions, Design of Mould Cavity – Advantages and Disadvantages of Compression moulds

UNIT III **12**

Transfer Moulding – Types, principles, Design of Pot and Plunger, Feed System, Economic determination of the number of cavities, Technological determination of the number of cavities, design of mould cavity, design of loading chamber, Heat losses and energy requirement to heat the mould – Advantages and disadvantages of Transfer mould.

UNIT IV **12**

Blow Mould Design – Materials Selection, Mould Cooling, Clamping Force, Mould Venting, Pinch-off, Head die design, Parison Diameter Calculation, Wall Thickness, Vertical-load strength, Blow ratio, Base pushup, Highlights, Rigidizing, Shapes, Design based consideration – Shrinkage, Neck and Shoulder Design, Thread and beads, Bottom Design.

UNIT V **12**

Extrusion die design–Construction features of an extruder, Process, Characteristics of Polymer melt, Die geometry, Die head Pressure, characteristics of land length to Profile thickness, Extrudate die swell, Die materials, Classification of dies-Dies for Solid Section, Dies for Hollow Profiles, Blown film dies, Flat film dies, Parison dies, Wire and cable Coating dies, Spiral mandrel die, Fish tail die, Adjustable Core die.

TOTAL: 60 PERIODS

TEXT BOOKS

1. P.S.CRACKNELL and R.W DYSON, “Hand Book of Thermoplastics - Injection Mould Design”, Chapman & Hall, 1993.
2. Laszlo Sors and Imre Balazs, “Design of Plastics Moulds and Dies”, Elsevier, Amsterdam - Oxford - Tokyo - NY, 1989.

REFERENCE

1. R.G.W.PYE, Injection Mould Design, SPE Publication.

PT2352 **POLYMER RHEOLOGY** **L T P C**
4 0 0 4

AIM

To learn the flow characteristics of polymers

OBJECTIVES

To understand Mechanical behaviour of polymeric materials under applied load for short tern and long term Flow behavior of polymer melts and the experimental techniques for measuring the rheological properties.

UNIT I **12**

Introduction to Rheology – types of mechanical deformation – Elastic materials – Vicous materials – Viscoelasticity – effect of rate of strain, temperature and time on mechanical behaviour of polymeric materials – creep – stress relaxation – Boltzman principle – time temperature super position principle – WLF equation.

UNIT II **12**

Mechanical models – stress strain response of spring and dashpot – viscoelstic models Maxwell element – Voigt kelvin element – response to creep and stress relaxation – four-parameter model – dynamic mechanical properties – behavior of Maxwell element and relaxation spectra.

UNIT III **12**

Fluid flow – types of fluid flow – time dependant fluids, shear rate dependant fluids, Newtonian and Non Newtonian fluids – viscosity of polymer melts – shear thinning and shear thickening – zero-shear rate viscosity – laminar flow of Newtonian fluids – power law – general treatment of isothermal viscous flow in tubes – entrance and exit effects - elastic effects in polymer melt flow - die- swell and melt fracture – Weissenberg effect – normal stress difference – Elongational viscosity.

UNIT IV **12**

Measurements of rheological properties – capillary rheometers – melt flow index – cone and plate viscometer – torque rheometers – Mooney viscometer – curemeters – Rheo-optical methods – birefringence.

UNIT V **12**

Rheological behaviour of important thermoplastics (PE,PVC,PS,PP,nylons and PC)- Applications of rheology to polymer processing (injection moulding, extrusion and blow moulding

TOTAL: 60 PERIODS

REFERENCES

1. J.A.Brydson, Flow properties of polymer melts, life books, London, 1978.
2. P.N.Cogswell, Polymer Melt Rheology, A guide for Industrial Practice, George Godwin
3. Richard C. Progelhof and James L. Throne, Polymer Engineering Principles, Hanser Publishers, New York, 1993.
4. John M. Dealy and Kurt F. Wissburn, Melt rheology and its role in plastics processing, Chapman, London, 1995.
5. R.S. Lenk, Polymer Rheology, Applied Science, London, 1978.
6. R.J. Crawford, Plastics Engineering, Butterworth – Heinemann, Oxford, 1998
7. J.D. Ferry, Viscoelastic Properties of Polymers, john Wiley & Sons, New York, 1986.
8. Chang Dae Han. Rheology in Polymer Processing, Academic Press, New York, 1976

PT2353 **POLYMER TESTING METHODS** **L T P C**
3 0 0 3

AIM

To learn about the various testing methods employed for polymers.

OBJECTIVES

- To familiarize the students with standards and methodology in
- Preparing various polymers specimen
- Testing raw materials and components for evaluating various properties
- Testing products for predicting product performance

UNIT I STANDARDS AND SPECIMEN PREPARATION **9**

Standards and specifications and their importance with reference to polymer Preparation of test specimen by various techniques for thermoplastics, thermo sets, and elastomers conditioning and test atmospheres

UNIT II MECHANICAL PROPERTIES **9**

Tensile, compression, flexural, shear, tear, impact, abrasion, hardness, permanent set, resilience, flex and cut growth resistance. Creep and stress relaxation, fatigue.

UNIT III THERMAL AND RHEOLOGICAL PROPERTIES **9**

Transition temperatures, Vicat softening temperature, heat distortion temperature, coefficient of expansion, specific heat, thermal conductivity, shrinkage, brittleness temperature, thermal stability, and flammability, melt flow index,
viscosity (Rotational viscometer, MPT, capillary rheometer, and torque rheometer)

UNIT IV ELECTRICAL, OPTICAL AND OTHER PROPERTIES 9

Volume and surface resistivity, dielectric constant and power factor, dielectric strength, arc resistance, tracking resistance, static charge Refractive index, light transmission, transparency, haze, gloss clarity, and birefringence. Environmental stress crack resistance (ESCR) - water absorption, weathering and chemical resistance, aging, ozone resistance, permeability, adhesion.

UNIT V TESTING OF PRODUCTS 9

Plastic films, sheeting, pipes, laminates, foams, containers, and cables.Rubber hose, Microcellular sheet, wire and cables, foams, gloves, tyres and tubes

TOTAL: 45 PERIODS

TEXT BOOKS

1. Vishu Shah, "Handbook of Plastics Testing Technology", John Wiley, NY, 1998.
2. ASTM: 8.01 & 8.04; 9.01 & 9.02,2000

REFERENCES

1. Testing of Polymers, interscience, New York, 1965.
2. G. C. Ives & J. A. Mead, and N. M. Riley "Handbook of Plastics Test Methods", ILIFEE, London, 1971
3. Roger P. Brown, "Physical Testing of Rubber", interscience, New York, 1966.
4. Nicholas P.Cheremisinoff, "Product Design and Testing of Polymeric Materials", Marcel Dekker, inc, New York, 1990

PT2354 PROCESS CONTROL & INSTRUMENTATION L T P C
3 0 0 3

AIM

To understand the concepts of process control and instrumentation

OBJECTIVES

To study the basic concepts of instrumentation and control systems covering measurement of temperature, pressure, flow and level.To understand process control systems with related examples

UNIT I GENERAL CONCEPTS OF MEASUREMENTS 9

Variables and their measurements signals, the three stages of generalized measurement system, some common terms used in the measurement systems, mechanical loading, impedance matching, frequency response. Factors considered in selection of instruments – error analysis and classification, source of error. Transducer: classification, displacement & velocity transducers, potentiometer, LVDT, variable reluctance transducers, capacitive transducers, tachometer. Types of electric strain gauges – strain gauge bridges. Calibration of strain gauges

UNIT II TEMPERATURE MEASUREMENT 9

Platinum resistance thermometers, thermistors, thermocouple, total radiation pyrometers, optical pyrometer, temperature measuring problems in flowing fluids.
Pressure measurement: Manometers, Elastic transducers, elastic diaphragm transducers, McLeod gauge, thermal conductivity gauges, calibration of pressure gauge using dead weight tester, dynamic characteristics of pressure measuring systems.

UNIT III FLOW & MISCELLANEOUS MEASUREMENTS 9

Venturi, Orifice & nozzle meters, Pitot tube, turbine type meters, hot wire anemometer, magnetic flow meters. Level measurement: float level meters & electrical conductivity meters.

UNIT IV CONTROL SYSTEMS 9

Open loop and closed loop controls, elements of closed loop control systems. Mathematical models for mechanical & electrical systems, transfer function, block diagram representation, signal flow graphs, control system components.

UNIT V PROCESS CONTROL 9

Automatic speed control of drives – process control, closed loop control systems – pneumatic two step controller, control of chain grate boilers, feed water control – machine tool control, hydraulic operation, automatic positioning profile generation by coordinate setting and copying – inductosyn measuring systems – electro optical displacement measuring systems.

TOTAL : 45 PERIODS

TEXT BOOKS

1. T.G. Beckwith and N.L. Buck, Mechanical measurements, Addition Wesley Publishing company ltd. 1995
2. Ernest O Doebelin, Measurements systems Application & design, McGraw-Hill Publishing, 1990

REFERENCES

1. Rangan, Mani & Sharma, Instrumentation, Tata McGraw-Hill, New Delhi, 1997.
2. I.J. Nagarath and M. Gopal, Control systems engineering, 2nd Ed. New Age International Pvt. Ltd., 1982.
3. R. K. Jain, Mechanical & Industrial measurements, Khanna Publishing.

PT2355 PROCESSING TECHNOLOGY– II L T P C
3 0 0 3

AIM

To learn the various processing methods for plastics and composites.

OBJECTIVES

To study different plastic processing techniques such as extrusion, compression moulding, transfer moulding, calendaring, rotational moulding, FRP processing etc.

UNIT I 9

Extrusion – Principle – Types of Extruders – Single screw and twin-screw extruders – Metering – Screw design - process control variables – Types of dies – Viscoelastic properties and die swell.

UNIT II 9

Extrusion of Pipes- Extrusion profiles – Extrusion line for cable industry – Blown films – Flat film- Cast film - sheet film – Filament – Fibre extrusion – Coating & lamination – Extrusion of elastomers.

UNIT III **9**

Compression moulding – types and procedure machinery and equipment moulding of thermoplastics – moulding of thermosets and rubber, Advantages & limitations, type of compression mould, Automatic compression molding- Transfer moulding advantages – Limitations.

UNIT IV **9**

Rotational moulding – types of machines moulds – materials – part design – Calendaring types of calendars - powder coating – manufacturing methods – Application methods. Types of powder coating

UNIT V **9**

FRP - reinforcements, preforms, compounds & prepregs – Processes - benefits – Designing for spray up, hand layup, finishing and machining of plastics

TOTAL : 45 PERIODS

TEXT BOOKS

1. Edited by Michael L. Berlin "Plastics Engineering", Handbook. Society of the plastic Industries Chapman & Hall NY 1991.
2. James L. Throne, "Technology of Thermoforming", Hanser, Publisher Munmich 1996.

REFERENCES

1. M.J. Stevens and J.A. Covas, "Extruder Principle and Operation", Chapman & Hall UK, 2nd Edition 1995.
2. D.V. Rosato & D.V. Rosato, "Blow Moulding Hand Book", Hanser Published 1998.

PT2356 RUBBER ENGINEERING **L T P C**
4 0 0 4

AIM

To learn about the chemistry, manufacture, and applications of various elastomers

OBJECTIVES

To understand the chemistry and manufacturing technology of elastomers, compounding and vulcanization, properties and application

UNIT I NATURAL RUBBERS **12**

Tapping latex, Processing of Latex - Dry rubber production (Smoked sheet, air dried sheet, Crepe etc.) - Grading of rubbers - Modified natural rubber, Reclaimed rubber - process of reclamation – applications.

UNIT II COMPOUNDING DESIGN AND VULCANIZATION **12**

Sulphur vulcanization and non-sulphur vulcanization, vulcanization systems - accelerators, activators, promoters, antioxidants, antiozonants, processing aids, fillers and effect of fillers, Blowing agents etc.

UNIT III SYNTHETIC ELASTOMERS **12**

Manufacturing, structure, properties, compounding, curing and applications - Polyisoprene, Polybutadiene, SBR, EPDM, Butyl rubber, Neoprene, Nitrile rubber, Silicone rubber, Fluoro elastomer, Polysulphide rubber, polyurethane rubber, Acrylic rubber.

UNIT IV THERMOPLASTIC ELASTOMERS 12

Basic structure, Manufacture, Morphology, Commercial grades and Applications – Thermoplastic styrene block copolymers, Polyester thermoplastic elastomers, polyamide thermoplastic elastomer, Polyurethane thermoplastic elastomers

UNIT V RUBBER PRODUCT MANUFACTURING 12

Belting, Hoses, Footwear, Rubber metal bonded items, sports goods, cellular rubber

TOTAL : 60 PERIODS

TEXT BOOKS

1. C.M.Blow and Hepburn, - Rubber Technology and Manufacture, 2nd edition, 1982.
2. Hoffman, Rubber Technology Handbook -, Hanser Pub. Munich - 1996

REFERENCES

1. Anil .K. Bhowmic, Howard L. Stephens (Edt), Handbook of Elastomers - New Developments & Technology, Marcel Decker Inc. New York 1988.
2. Maurice Morton, Rubber Technology

PT2357 POLYMER TESTING LAB – I L T P C
0 0 3 2

AIM

To learn about the various testing methods employed for polymers

OBJECTIVES

- To familiarizes the students with standards and methodology in
- Preparing the various polymers specimen
- Testing raw materials and components for evaluating various properties
- Testing products for predicting product performance

LAB REQUIREMENT

MFI tester	1 No
Carbon black content apparatus	1 No
Air oven	1 No
Muffle furnace	1 No
Soxhlet extraction set up	2 No
Oswald Viscometer	5 No
Stop watch	3 No
Magnetic stirrer	2 No

Determination of molecular weight of polymers by viscosity method.
Determination of epoxy equivalent.
Determination of acid value of polyester resin.
Determination of K – value of PVC resin.
Determination of apparent density and bulk density of polymers.
Determination of moisture and volatile content in plastics / rubbers.
Determination of water absorption.
Determination gel time and peak exothermic temperature for thermosetting resins.
Determination melt flow index.
Determination of soluble fraction of phenolics by acetone extraction.
Determination carbon black content in plastics / rubber.

Determination of non carbon black filler content in plastics / rubber.
Determination of total solid content of NR latex.
Determination dry rubber content of NR latex.
Determination of total alkalinity of NR latex.
(Any twelve experiments from the above)

TOTAL : 45 PERIODS

REFERENCES

1. Billmeyer, Experiments in polymer Science, John Wiley & Sons, NY.ASTM – 8.01, 8.04, 9.02.
2. ISO Handbook. on Plastics.

PT2358 PROCESSING TECHNOLOGY LAB L T P C
0 0 3 2

AIM

To learn the various processing methods for plastics and composites

OBJECTIVES

To study different plastic processing Techniques such as extrusion, compression moulding, Transfer moulding, calendaring rotational moulding, FRP processing etc.

LAB REQUIREMENT

EQUIPMENT FOR THERMOPLASTIC PROCESSING:

Hand injection moulding machine	3 No
Semi Automatic injection moulding machine	1 No
Fully automatic injection moulding machine	1 No
Extruder for compounding of thermoplastics	1 No
Hand blow moulding machine	1 No.
Fully automatic blow moulding machine	1 No
Air compressor	1 No
Scrap grinder	1 No
Crane for mould handling	1 No
Bench grinding and buffing machine	1 No
Bench vise	1 No
Sheet cutter	1 No
Moulds for hand injection moulding	5 No
Mould for automatic injection moulding	1 No
Mould for semiautomatic injection moulding	1 No
Mould for hand blow moulding	1 No
Mould for fully automatic blow moulding	1 No
Thermo Forming Unit	1 No

EQUIPMENTS FOR THERMOSETS AND RUBBER PROCESSING:

Compression moulding machine	1 No
Two roll mill for rubber mixing	1 No
Filament winding machine lab model	1 No

Moulds for rubber processing:

Moulds for sheet moulding	2 No
Moulds for M/C sheet moulding	1 No
Moulds for play ball moulding	1 No
Moulds for flex specimen moulding	1 No
Electronic balance	1 No

1. Compounding and Moulding of Rubbers
   NR, SBR, CR, BR and NBR as per ASTM standard
2. Preparation of dry rubber products
   Play ball, Hawai sheet, M. C sheet, sponge, hand made hose and rubber to metal bonded articles
3. Preparation of latex products
   Gloves and thread and adhesives
4. Preparation of Blow moulded products
5. Compression moulding of phenolic resin and SMC& BMC
6. Injection moulding of thermoplastics
7. Extrusion of thermoplastics
8. Compounding of plastics
9. Preparation of FRP laminates
10. Post Processing techniques.

TOTAL : 45 PERIODS

PT2401 POLYMER REACTION ENGINEERING L T P C
3 1 0 4

AIM

To know about the kinetics of reactions and design of polymer reactors

OBJECTIVES

To study the kinetics of different types of chemical reaction and design the reactors for chemical and polymer industries

UNIT I **9**

Introduction to chemical kinetics. Representation of expression for reaction rate, Temperature dependent and concentration dependent Interpretation of Batch Reactor data for various types of reactions taking place in constant volume and variable volume batch reactors

UNIT II **9**

Reactor design – performance equations for batch and flow reactors – design for single reactions – multiple reactions. Heat effects in reactors – conversions – equilibrium – non-ideal flow in reactors

UNIT III **9**

Batch, CSTR and Plug Flow Reactors Reactor choices for single and multiple reactions Viz. Series and parallel reactions.Residence time distribution in non-ideal flow reactors

UNIT IV **9**

Heterogeneous reacting systems – models for reaction controlled – diffusion controlled mechanisms – application to design – solied catalysed reactions – experimental methods for rates – application to design.

UNIT V **9**

Polymerisation reactors – by free radical mechanism – characterization of mixtures of polymers – mechanism – rate equations – design of reactors for free radical polymerisation – stepwise addition and condensation polymerisation and copolymerisation – analysis of rate equation – polymerisation in batch reactors – flow reactors.

TOTAL: 60 PERIODS

TEXT BOOKS

1. J .M. Smith, “Chemical Engineering Kinetics”, McGraw-Hill, 1975.
2. H. Scott Fogler, “Elements of Chemical Reaction Engineering, PHI, 1992.

REFERENCES

1. M.Kh. Karapetyants, “Chemical Thermodynamics”, Mir Publications, USSR, 1978.
2. G.N.Pandy, J.C.Chaudari, “Chemical Engg. Thermodynamics”, Khanna Publishers.
3. L.H.Sperling, “Introduction to Physical Polymer Science”, John Wiley & Sons. London.Octave Levenspiel, “Chemical Reaction Engineering”, Wiley Eastern Ltd.
4. C.D. Holland & G. Rayboard Anthony, “Fundamentals of Chemical Reaction Engineering”.

PT2402 POLYMER BLENDS AND COMPOSITES L T P C
4 0 0 4

AIM

To learn about polymer blends and composites

OBJECTIVES

- To understand the miscibility of polymers, characteristics of blends and mechanism of toughening
- To understand the basic concept of composites, matrix, reinforcement, properties of composites, fabrication methods and application

UNIT I **12**

Classification – study of polymer blends and alloys on the basis of miscibility – Criteria for selection of polymer - Thermodynamics of miscibility – Mechanical compatibility – Phase morphology, Phase separation behavior – morphology of blends and its determination- electron microscopy.

UNIT II **12**

Principles and methods involved in preparation of different Polymer blends– introduction to Rheology of polymer blends - its relevance in processing – Rheology – phase morphology relationships and their relevance –micro Rheology- rheological models-solution, and suspension models-IPN’s – synthesis, morphology, properties and applications – enhancement of polymer miscibility – utilization of miscible polymers.

UNIT III **12**

Toughening of polymers- mechanism of toughening of thermoplastics and thermosets. Specific examples for toughened thermoplastics and thermosets- influence of processing on toughness. Industrial applications Composites

Types of composites – reinforced thermoplastics & thermosets – different types of reinforcements and their effects on the properties of the composites, mechanism of reinforcement. Fibrous reinforcement : Glass fibers – carbon fibers – aramid fibers – boron fibers. Particulate fillers - Coupling agents.

UNIT IV **12**

Composition of composites – property correlation - Mechanical, Electrical, Thermal properties of composites. Processing of reinforced thermosets and thermoplastics: Techniques for processing such as hand lay-up, Spray up, Continuous sheet manufacturing, Pultrusion – resin transfer molding – filament winding – vacuum bag moulding

UNIT V **12**

Manufacture of structural and decorative laminates – preparation of sandwich structure Troubleshooting related to the above techniques. Processing of short fibers reinforced thermoplastics. Designing with composites Post processing of composite products - Application of composites

TOTAL: 60 PERIODS

TEXT BOOKS

1. D R Paul and S Newman, “Polymer Blends Vol. I & II”, Academic Press Inc, 1978.
2. M O W Richardson “Polymer Engineering Composite” – Applied Science.

REFERENCES

1. Olabisis, I W Rubison and M T Shaw Polymer – Polymer Miscibility Academic Press – New York 1979.
2. Utracki, “Polymer Blends and Alloys”, Hanser Publisher.
3. G. Lubin, “Hand Book of Composites”, 2nd Ed., Van Nostrand Reinhold, NY, 1982.
4. S.M.Lee, “Dictionary of Composites Materials Technology”, Technomic Lancaster, Pa, 1989.
5. B.T. Astrom, “Manufacturing of Composites”, Chapman & Hall, 1997.

MG2351 **PRINCIPLES OF MANAGEMENT** **L T P C**

(Common to all Branches) **3 0 0 3**

UNIT I OVERVIEW OF MANAGEMENT **9**

Organization - Management - Role of managers - Evolution of Management thought - Organization and the environmental factors - Managing globally - Strategies for International Business.

UNIT II PLANNING **9**

Nature and purpose of planning - Planning process - Types of plans – Objectives - - Managing by objective (MBO) Strategies - Types of strategies - Policies - Decision Making - Types of decision - Decision Making Process - Rational Decision Making Process - Decision Making under different conditions.

UNIT III ORGANIZING **9**

Nature and purpose of organizing - Organization structure - Formal and informal groups / organization - Line and Staff authority - Departmentation - Span of control - Centralization and Decentralization - Delegation of authority - Staffing - Selection and Recruitment - Orientation - Career Development - Career stages – Training - - Performance Appraisal.

UNIT IV DIRECTING **9**

Creativity and Innovation - Motivation and Satisfaction - Motivation Theories Leadership - Leadership theories - Communication - Hurdles to effective communication - Organization Culture - Elements and types of culture - Managing cultural diversity.

UNIT V CONTROLLING **9**

Process of controlling - Types of control - Budgetary and non-budgetary control techniques - Managing Productivity - Cost Control - Purchase Control - Maintenance Control - Quality Control - Planning operations.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Stephen P. Robbins and Mary Coulter, 'Management', Prentice Hall of India, 8th edition.
2. Charles W L Hill, Steven L McShane, 'Principles of Management', Mcgraw Hill Education, Special Indian Edition, 2007.

REFERENCES

1. Hellriegel, Slocum & Jackson, ' Management - A Competency Based Approach', Thomson South Western, 10th edition, 2007.
2. Harold Koontz, Heinz Weihrich and Mark V Cannice, 'Management – A global & Entrepreneurial Perspective', Tata Mcgraw Hill, 1^{2th} edition, 2007.
3. Andrew J. Dubrin, 'Essentials of Management', Thomson Southwestern, 7th edition, 2007.

PT2404	POLYMER PRODUCT DESIGN	L	T	P	C
		3	1	0	4

AIM

To design polymer products with knowledge of polymer properties and end use

OBJECTIVES

- To learn physical properties of polymers required for product design
- To design plastic parts such as static and dynamic loaded parts for electrical, optical and mechanical applications (gears, bearings, pipes, seals, couplings and vibration dampers)

UNIT I **9**

Introduction to structure and physical properties of polymers, stress – strain behaviour of polymers, effect of fillers on properties of polymers, stress analysis of polymers, structural design of beams, plates and other structural members.

UNIT II **9**

Dynamic load response of polymers, effects of cyclic loading, other forms of stress applied to polymer parts, design for stiffness, processing limitations on polymers product design. Material and process interaction and the effects on the performance of plastic parts and the resulting design limitations, performance in service and environmental exposure.

UNIT III **9**

Design procedure for plastic parts, design of plastic structural parts for static loads, design of dynamically loaded plastic parts, design of plastic parts for electrical applications, design of plastic parts for optical applications.

UNIT IV **9**

Gear Design materials strength and durability, moulded V/s cut plastic gearing inspection assembly and operation.

Bearings: Self lubricated plastic materials rubber bearing, type of bearings, designers check list.

PVC piping: Raw materials, pipe design, specification and test procedure, manufacturing process.

UNIT V **9**

Elastomeric ring seals Basic configurations, design method, design consideration static and dynamic seals. Vibration dampers: Basic vibration damping relations, Octave rule for damped systems, Estimating damping in structures, controlling resonant peaks with damping, response of damped structures to shock. Flexible Coupling – Vibration of two mass system, specification and selection of couplings, types of couplings.

TOTAL: 60 PERIODS

TEXT BOOKS

1. H. Belofsky, "Plastics Product Design and Process Engineering", SPE, Hanser Publication, Munich Vienna NY, 1995.
2. S.Levy & J.H.Dubois, "Plastic Product Design Engineering Hand Book", Van Nostrand Reinhold Co., New York, 1977.

REFERENCES

1. Robert A. Malloy, "Plastic Part Design for Injection Moulding", Hanser Pub., Munich Vienna NY, 1994.
2. Edward Miller, "Plastics Products Design Hand Book", Marcel Dekker,
3. P.K.Freekly & A. R. Payne, "Theory and Practice of Engineering with Rubber".
   B. Hepburn and R.J.W. Raynolds, Elastomers, "Criteria for Engineering Design".
4. R.D.Beck, "Plastic Product Design", Van Nostrand Reinhold Co.

PT2407 DESIGN AND ANALYSIS PRACTICE USING CAD, CAE **L T P C**
0 0 3 2

LAB REQUIREMENT

1.	Computers with LAN	- 8 Nos.
2.	Software packages	
	Auto cad	- 1 No
	Pro-E	- 1 No
	Mould flow	- 1 No
3.	Printer	- 1 No.
4.	CNC Lathe	- 1 No.
5.	CNC Milling machine	- 1 No

Design Procedure, Dimensioning Mould Drawing, Fits & Tolerance, Allowances, Shrink Allowances.

A) Injection mould design using CAD.

Design calculations: No. of cavities, Selection of injection moulding machine, shot capacity, plasticizing rate, Clamping force, Injection pressure &Tool strength calculations related to -

1. Two - plate mould.
2. Three - plate mould.
3. Split mould.
4. Hot - runner mould.

UNIT I CNC PROGRAMME 7

CNC Programme for the Machining of Core & Cavity using CNC Lathe and CNC Milling of simple profiles.

UNIT II SEMI - AUTOMATIC COMPRESSION MOUL 7

Design calculations: Economic determination of no. of cavities, flash thickness allowances, design of mould cavity, design of loading chamber, bulk factor, loading chamber depth & heat requirement for heating the mould related to –

1. Open-flash type compression mould.
2. Semi-positive horizontal and vertical type.
3. Fully positive type compression mould.

UNIT III TRANSFER MOULD DESIGN USING CAD 7

Design calculations: Pot calculation, runner & gate dimensions, bulk factor & shrinkage allowances for thermo set plastics & Minimum moulding pressure related to –

1. Pot transfer mould.
2. Plunger transfer mould.

UNIT IV BLOW MOULD DESIGN USING CAD 7

Design calculations: Clamping force, pinch-off, head die design and parison diameter calculations.

UNIT V EXTRUSION DIE DESIGN USING CAD 8

1. For pipes.
2. For profiles.

UNIT VI PART DESIGNS FOR AN INJECTION MOULDED COMPONENT USING MOULDFLOW 9

1. 3D Modeling using MOULD – FLOW / view, Flow analysis, Cooling analysis, Shrink / Wrap analysis, Stress analysis.
2. Application of MOULD - FLOW Part Adviser.

TOTAL: 45 PERIODS

TEXT BOOKS

1. R.G.W.Pye, Injection Mould Design, SPE Publication.
2. P.S.Cracknell and R.W.Dyson, Hand Book of thermoplastics injection mould design, Chapman & Hall, 1993.

REFERENCES

1. Herbert Rees, Mould Engineering, Hanser publishers, Munich, Vienna N.Y. 1994.
2. Technical Directory on Design and Tooling for plastics, CIPET, Guindy, Chennai.
3. Design calculations for Compression moulds, Machinery publications, Yellow series,
4. U.K.
5. Mould Flow Manual & Part - Adviser Manual - MOULD FLOW
6. Laszco Sors and Imre Blazs, Design of Plastic Moulds and Dies, Elsevier, Amsterdam - Oxford - Tokyo - NY, 1989.

PT2408	POLYMER TESTING LAB – II	L	T	P	C
		0	0	3	2

AIM

To learn about the various testing methods employed for polymers

OBJECTIVES

- To familiarize the students with standard and methodology in
- Preparing various polymers specimen
- Testing raw materials and components for evaluating various properties
- Testing products for predicting product performance.

LAB REQUIREMENT

Universal tensile testing machine (UTM)	1 No
Humidity Chamber	1 No
Shore – A hardness tester	1 No
Shore – D hardness tester	1 No
Rockwell hardness tester	1 No
Izod and charpy impact tester	1 No
Falling dart impact tester	1 No
Din Abrader	1 No
Rebound Resilience tester	1 No
De-Mattia Flex Resistance tester	1 No
Vicat softening point tester (VSP)	1 No
HDT Tester	1 No
Dial gauge	1 No
Volume and surface resitivity tester	1 No
Arc resistance tester	1 No
Dielectric Strength tester	1 No
Refractometer tester	1 No
Environmental stress crack resistance tester (ESCR)	1 No

UNIT I TESTING OF MECHANICAL PROPERTIES OF PLASTICS AND RUBBERS **9**

Tensile strength
Compression strength
Flexural strength
Tear strength.
Izod and Charpy impact strength.
Falling dart impact strength,
Hardness – Rockwell and Shore
Abrasion resistance,
Rebound resilience
Flex resistance.

(Any six experiments)

UNIT II TESTING OF THERMAL PROPERTIES **9**

Vicat softening point
Heat distortion temperature

UNIT III TESTING OF ELECTRICAL PROPERTIES **9**

Volume and surface resistivity
Arc resistance

Comparative tracking index
Dielectric strength
Dielectric constant

(Any three experiments)

UNIT IV TESTING OF OPTICAL PROPERTIES 9

Refractive index.
Haze.
Gloss

(Any one experiment)

UNIT V TESTING OF MISCELLANEOUS PROPERTIES 9

Environmental stress crack resistance
Chemical resistance.
Thermal ageing resistance.
Flammability.
Mould shrinkage

(Any three experiments)

TOTAL: 45 PERIODS

TEXT BOOKS

1. Vishu Shah, Hand Book of Plastics Technology, John Wiley Intersciencs Inc., New York.1998
2. G. C. Ives, J. A. Mead, and M. M. Riley, Hand Book of Plastics Test Methods, I4FFE Books London, 1971.

REFERENCE

1. ASTM – Vol. 8.01 - 8.04, Vol.

PT2021 POLYMER RECYCLING L T P C
3 0 0 3

AIM

To learn the various methods employed for recycling of polymers.

OBJECTIVES

To learn need for polymer recycling, plastic and rubber waste management, various methods of recycling technologies and the applications of recyclates.

UNIT I 9

Plastics production and consumption- Plastic wastes generation source and types – Plastic waste composition, quantities - Plastics identification methods physical, chemical and instrumental – sorting and separation technologies - disposal alternatives – Recycling methods – Primary, Secondary and tertiary recycling of plastics

UNIT II 9

Size reduction of recycled plastics – cutting / shredding, densification, pulverization and chemical size reduction processes- municipal solid waste and composition – recycling of plastics from urban solid wastes - household waste – industrial sector – rheology, density and mechanical properties of recyclable plastics and need for compatibilization – Processing of commingled / mixed plastic waste – super wood, plastic lumber

UNIT III **9**

Recycling of polyolefins – polyethylene films – Polypropylene battery recyling- Recycling of HDPE fuel tanks - PET recycling methods – PET film recycling - Applications of polyolefin and PET recyclate – PVC recycling

UNIT IV **9**

Engineering thermoplastics and their major areas where engineering polymers are recycled – major recyclers of engineering plastics – GE/ Bayer/ MRC Polymers – PC, PBT, Nylon, PPO, ABS and polyacetals and their blends

UNIT V **9**

Recycling of Polymer thermoset composites – regrind processes - SMC scrap – pyrolysis and energy recovery –Types of rubber products – rubber grinding methods – tyre grinding – rubber crumb applications – Reclaiming and de-vulcanization processes tyre derived fuel and energy recovery – Pyrolysis of scrap tyres.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Polymer recycling, “Science, Technology and Applications, John Scheirs, John Wiley & Sons, England 1988
2. “Recycling of Plastic Materials (Ed)”, Francesco Paolo La Mantia, Chem Tec Publishing.

REFERENCES

1. Degradeable polymers, Recycling and Plastic Waste Management (Eds) Ann – Christine Albertson and Samuel J. Huang, Marcel Dekker, New York.
2. “Plastics Waste Management (Ed)”, Nabil Mustafa, Marcel Dekker, New York

PL2023 PLASTICS PACKAGING TECHNOLOGY **L T P C**
3 0 0 3

AIM

To learn about the materials and processing methods in packaging

OBJECTIVES

To understand the concepts of materials used in packaging, machinery in packaging and testing of packaging material.

UNIT I **9**

Introduction to plastics packaging: functions of packaging, advantages of plastic packaging, distribution hazards, special requirements of food and medical packaging, packaging legislation and regulation. Packaging as a system: Elements, approach, package, design, relation criteria for packaging materials, packaging equipment checklist, case histories Major packaging plastics

Introduction – PE, PP, PS, PVC, polyesters, PVA, EVA, PA, PC, ionomers & fluoro polymers.

UNIT II **9**

Conversion process – Compression & transfer for moulding, Injection moulding, Blow moulding, Extrusion, roto moulding, thermoforming, Lamination, metallizing, decoration process, Shrink wrapping, Pallet & stretch wrapping, sealing methods, Plasma barrier coatings. Energy requirement for conversion

UNIT III **9**

Extrusion, film and flexible packaging – extrusion, cast film & sheet, Blown film, Multi layer film & sheet coatings, laminations & coextrusions, stretch and shrink wrap, pouching, sealing, evaluation of seals in flexible packages, advantages of flexible packaging – flexible packaging products. Specialized packaging for food products.

UNIT IV **9**

Thermoformed, moulded and rigid packages, Thermoforming packages: Position & thermoforming & wrap forming, variations in thermoforming and solid phase pressure forming, scrabbles, twin sheet & melt – to- mold thermoforming, skin packaging, thermoforming moulds, thermoforming fill- real, Aseptic thermoforming, advantages & disadvantages of moulding foams, other cushioning materials & distribution packaging – Polystyrene & other foams systems cushioning, Design of molded cushioning systems, plastic pallets, drums & other shipping containers.

UNIT V **9**

Testing of plastic packages, Barrier, Migration & compatibility, Printing, labeling & pigmenting, Sterilization systems and health care products.
Packaging hazards and their controls. Environmental considerations.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Susan E.M. Seleke, "Understanding Plastic Packaging Technology", Hanser publications – Munich
2. A.S. Altalye, "Plastics in Packaging", Tata McGraw–Hill publishing Co. Ltd., New Delhi.

PT2023 **FIBRE TECHNOLOGY** **L T P C**
3 0 0 3

AIM

To understand the production and technology of fibre manufacture

OBJECTIVES

- To learn Production technologies of synthetic fibres such as nylon6, PET, PP and acrylic fibres
- Melt spinning, wet spinning, dry spinning, texturing and stretching methods; colouration techniques of fibres.
- Modification for low filling, flame retardant and hollow fibres

UNIT I **9**

Development of synthetic – commercial synthetic fibres, Raw materials manufacture. DMT, TPA, MEG, caprolactum, adipic acid, hexamethylene diamine, acrylonitrile, polymerisation – types of polymers – criteria for fibre forming polymers – production of polyethylene terephthalate polymer – polyamides – production of nylon 66 polymer – nylon 6 polymer.

UNIT II **9**

Polymer production for acrylic fibres – polypropylene – production of other fibres - PVC fibres – PVA fibres – Aramid fibres - Melt spinning – Polymer feed – melt spinning equipment – high speed spinning – spin draw processes – crystallization method – melt spinning of PET & PP stable fibres – wet and dry spinning comparison.

Spin finishes – functions of spin finish – methods of application of spin finish – spin finish for polyester staple fibres – spin finish for texturing process – effect of spin finish on dyeing.

UNIT III **9**

Stretching or drawing – conditions of drawing – machines for draw warping – texturing – false twist process – draw texturing– staple fibre production, melt spinning – drawing, heat setting – crimping in fibre line – production of melt spin staple fibre – polyester tops for wool blending – Mass coloration and tow dyeing of polyester, nylon, acrylic – polypropylene – dyeing in loose fibre and yarn forms of polyester, nylon, acrylic, PP, other synthetic fibres – loose fibre dyeing.

UNIT IV **9**

Modified synthetic fibres – modified polyester, Nylon, PP, acrylics – Hydrophilic – Hollow – Low pilling – flame retardant- bicomponent fibres - Dyeability of synthetic fibres

UNIT V **9**

Quality control – testing raw material – testing polymers – testing yarns & fibres – waste utilisation of polyester – nylon 6 – 66 – acrylics – PP- Energy conservation – pollution control.

TOTAL : 45 PERIODS

TEXT BOOK

1. A.A. Vaidya, Production of synthetic fibres, Prentice Hall of India Pvt. Ltd., New Delhi, 1988.

PT2024 **TYRE TECHNOLOGY** **L T P C**
3 0 0 3

AIM

To learn about design and fabrication of tyres

OBJECTIVES

- To understand various components used and their function of tyres.
- To design and suitable compounding formulation for various tyre components
- To know the building & curing of tyres.

UNIT I **9**

A historical introduction on the design and development of tyres of various kinds and types. The current status of tyre industry in India and its future prospectus. Tyre sizing and marking on the tyres. Different types of tyres – bias, bias belted radial, tube type abd tubeless tyres their basic features and performance comparison. Different components of a tyre, its geometry, basic functions. Functions of a pneumatic tyre – load carrying, vibration and noise reduction, the tyre function as a spring, contribution to driving control and road adhesion, the tyre friction contribution to driving control, steering control and self aligning torque.

UNIT II **9**

Cord- rubber composites and its properties and failure mechanism of cord reinforced rubber. Mechanics of tyre pavement interaction. Tyre forces on dry and wet road surface. Traction forces on dry, wet, ice, snow and irregular pavements, Breaking and traction of tyres.

UNIT III **9**

Tyre wear, rubber friction and sliding mechanism, various factors affecting friction and sliding. Tyre stresses and deformation, tyre noise, mechanism of noise generation, effect of tread pattern, vehicle speed etc., on noise level, Tyre in plane dynamics. High frequency properties, basic yaw and camber analysis.

UNIT IV **9**

Manufacturing techniques of various tyres like two wheeler and car tyres, truck tyres, OTR, Farm tyres, aircraft tyres. Principles of designing, formulations for various rubber components. Tyre reinforcement materials (Textile, steel, glass etc.). Criteria of selection, different styles and construction, textile treatment. Tyre mould design, green tyre design principles, methods of building green tyres for bias, bias belted, radial and tube-less tyres, green tyre treatments. Tyre curing methods, post cure inflation, quality control tests, Tyre related products, their design and manufacturing techniques, tubes, valves, flaps and bladders. Different types, their feature and operation of tyre building machines, bead winding machine, wire/glass processing machines, bias cutters, curing presses.

UNIT V **9**

Measurement of tyre properties, dimension and size-static and loaded, Tyre construction analysis, Endurance test wheel and plunger tests, traction, noise measurements. Force and moment characteristics, cornering coefficient aligning torque coefficient, load sensitivity and load transfer sensitivity, Rolling resistance, non uniformity dimensional variations, force variations- radial force variation, lateral force variation concentricity and ply steer. Type balance, mileage, evaluations, tyre flaws and separations, X-ray holography etc., Foot print pressure distribution.BIS standards for tyres, tubes and flaps

TOTAL : 45 PERIODS

TEXT BOOKS

1. Samuel K. Clark, “Mechanics of pneumatic Tires”, National Bureau of standards, Monograph, US Govt. printing office, 1971.
2. Tom French, “Tyre Technology”, Adam Hilger, New York, 1989.

REFERENCES

1. F.J. Kovac, “Tire Technology”, 4th edition, Good year Tire and Rubber Company, Akron, 1978.
2. E. Robecchi, L.Amiki, “Mechanics of Tire”, 2 Vols, Pirelli, Milano, 1970.

PL2026 BIODEGREDABLE POLYMERS L T P C
3 0 0 3

AIM

To understand the mechanism of biodegradation and development of biodegrable polymers

OBJECTIVES

To understand the method of development of biodegradable polymers; the need of biodegradable and testing methods used for analyzing the biodegradability

UNIT I CHEMISTRY AND BIOCHEMISTRY OF POLYMER DEGRADATION 9

Introduction, enzymes – enzyme nomenclature – enzyme specificity – physical factors affecting the activity of enzymes – enzyme mechanism, Chemical degradation initiates biodegradation, Hydrolysis of synthetic biodegradable polymers.

UNIT II PARTICULATE STARCH BASED PRODUCTS 9

Development of Technology, Current objectives, relative starch technology, Manufacture of master batch, Conversion technology – processing precautions – moisture and temperature – rheological considerations, cyclic conversion process, physical properties of products – sample preparation – physical testing methods – test results, Quality control testing of degradation – auto oxidation measurement – biodegradation assessment – soil burial test.

UNIT III BIOPOLYESTERS 9

Introduction, History, biosynthesis, Isolation – solvent extraction - sodium hypo chloride digestion, enzymatic digestion, Properties – crystal structure – nascent morphology, degradation - Intracellular biodegradation - extra cellular biodegradation – thermal degradation – hydrolytic degradation – environmental degradation – effects of recycling, applications, economics, future prospects.

UNIT IV RECYCLING TECHNOLOGY FOR BIODEGRADABLE PLASTICS 9

Introduction, conventional recycling – economic incentive – recycling problems, degradable complicate recycling – polyethylene/starch film, reprocessing polyethylene/corn starch film scrap – learning to reprocess PE/S - Calcium oxide moisture scavenger – temperature control – accounting for pro-oxidant – handling PE/S repro – economics of in-plant recycling, Using PE/S repro – comparative study of PE/S repro on film properties, recycling other degradables.

UNIT V TEST METHODS & STANDARDS FOR BIODEGRADABLE PLASTICS 9

Introduction, defining biodegradability, criteria used in the evaluation of biodegradable polymers, tiered systems for evaluating biodegradability, choice of environment, choosing the most appropriate methodology, description of current test methods – screening test for ready biodegradability, tests for inherent biodegradability, tests for simulation studies, other methods for assessing biodegradability – petri dish screen – environmental chamber method – soil burial tests, Test method developments for the future.

TOTAL : 45 PERIODS

TEXT BOOKS

1. G.J.L Griffin Blackie(ed.), Chemistry & Technology of Biodegradable Polymers Academic & Professional London 1994.
2. Yoshiharu Doi, Kazuhiko Fukuda (ed.) Biodegradable Plastics & Polymers Elsevier 1994.

REFERENCES

1. Abraham J.Donb & Others (ed.) Handbook of Biodegradable polymers.
2. Harvard Academic Publishers Australia 1997.

PL2027 **SPECIALTY POLYMERS** **L T P C**
3 0 0 3

AIM

To understand the properties and applications of specialty polymers

OBJECTIVES

To learn properties and applications of special polymers such as high performance flame resistance, conducting and high temperature resistant polymers

UNIT I **9**

High temperature and fire resistant polymers improving low performance polymers for high temperature use – polymers, for low fire hazards – polymers for high temperature resistance – Fluoropolymers. Aromatic polymers, polyphenylene sulphide, polysulphones, polyesters, polyamides, polyketones, Heterocyclic polymers

UNIT II **9**

Polymers with electrical and electronic properties Conducting polymers, conducting mechanisms, polyacetylene, polyparaphenylene polypyrrole, organometallic polymers, photo conducting polymers, polymers in non-linear optics, polymers with piezoelectric pyroelectric and pyroelectric properties, photoresists for semi conductor fabrication – liquid crystalline polymers.

UNIT III **9**

Ionic Polymers, synthesis, physical properties and applications, Ion-exchange, Hydrophilicity, Ionomers based on polyethylene, elastomeric ionomers. Ionomers based on polystyrene, ionomers based on PTFE, ionomers with polyaromatic backbones, polyelectrolytes for ion exchange, polyelectrolytes based on carboxylates, polymers with integral ions, polyelectrolyte complexes. Biological and inorganic ionic polymers

UNIT IV **9**

Polymer concrete, polymer impregnated concrete ultra high modulus fibres, polymers for biomedical applications, polymeric binders for rocket propellants, polymer supported reagents.

UNIT V **9**

Polymers in telecommunications and power transmission, polymers as insulators – electrical breakdown strength – capacitance, dielectric loss and cable alteration, polymers in telecommunications – submarine, cable insulation, low fire risk materials, polymers in power transmission – Optical fibre telecommunication cables.

TOTAL: 45 PERIODS

TEXT BOOKS

1. H.F.Mark, (Ed), “Encyclopedia of polymer Science & Engineering”, John Wiley & Sons, New York, 1989.
2. Matrin.T.Goosey, “Plastics for Electronics”, Elsevier, Applied Science, 1985**.**

REFERENCES

1. R.W. Dyson, “Specialty Polymers”, Chapman & Hall, 2nd edition, 1998.
2. Manas Chanda, Salil.K.Roy, “Plastics Technology Hand book”, 2nd edition, Marcel Dekker, New York, 1993.

PL2033 **SPECIALITY ELASTOMERS** **L T P C**
3 0 0 3

AIM

To understand the properties and applications of specialty elastomers

OBJECTIVES

To understand special properties of elastomers with respect to structure.

To study the manufacturing, compounding and processing of specialty elastomers such as silicone rubber, fluoro elastomers, acrylic rubber, EPDM etc.

UNIT I **9**

Introduction of speciality Rubbers – Silicones (Q) – Introduction, Manufacture – Structure and its influence on properties – Compounding – Fabrication – Curing – General properties – Applications – Copolymers – PMQ, PVLQ, FMQ, FVMQ – Silicones Rubber for medical use.

UNIT II **9**

Chlorosulphonated polyethylene – Introduction – Manufacture – Structure and its influence on properties – Compounding – Curing – Properties – Applications

Epichlorohydrin – (CO, ECO, ETIR) – Introduction – Manufacture – Structure and its influence on properties – Compounding and Curing Properties and application

Fluoro Elastomers (FKM) – Introduction – Manufacture – Structure and its influence on properties – Compounding – Curing – Properties and applications.

UNIT III **9**

Polysulphides (TM) - Introduction, Manufacture – Cross linked Polyethylene (XLPE) – Polyurethane Rubbers – Introduction Manufacture – Structure and its influence on properties – Compounding – Curing – Properties and applications.

Thermoplastic Polyurethanes – Introduction – Manufacture – Structure and its influence on Properties – Compounding – Curing – Properties and applications

UNIT IV **9**

Acrylic Rubber (ACM), Ethylene acrylic copolymers, Introduction, Manufacture – Structure and its influence on Properties – Compounding – Curing – Properties and applications

Ethylene Vinyl Acetate – Copolymer – Introduction, Manufacture – Structure and its influence on Properties – Compounding – Curing – Properties and applications

UNIT V **9**

Chlorinated Polyethylene – Introduction – Manufacture – Structure and its influence on Properties – Compounding – Curing – Properties and applications

EPM, EDPM – Introduction, Manufacture – Structure and its influence on Properties – Compounding – Curing - Properties and applications.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Hoffmann, “Rubber Technology Hand Book”, Hanser Publishers Munich– 1989.
2. Anil. K., Bhowmick, Howard L. Stephens (ed.) Hand Book of Elastomers, New Development & Technology, Marcel Decker Inc., New York, 1988.

PL2029	POLYURETHANE TECHNOLOGY	L T P C
		3 0 0 3

AIM

To learn the production technology of polyurethanes

OBJECTIVES

To understand the basic variation between the raw materials used for polyurethane production, methods of polyurethane production and analysis of the raw materials products.

UNIT I **9**

Introduction to polyurethane- chemistry and materials of polyurethane manufacture: basic reaction, cross linking in polyurethane, important building blocks for polyurethane (isocynates, polyols, amines and additives) - The manufacturer of polyurethanes (the process, parameters and controls).

UNIT II **9**

Polyurethane processing-basic design principles of polyurethane processing equipment steps in the polyurethane processing Flexible foams-(production, properties and application slab stock foam, carpet backing, flexible molded foams & semi rigid molded foams.Reinforced RIM – trends in the use of RIM and RRIM.

UNIT III **9**

Rigid polyurethane foams-chemistry of raw materials, manufacturing of rigid polyurethane (manufacturing of buns, panels, foaming of applications, molded rigid foams), properties, relationship between production methods and properties- application of rigid polyurethane Polyurethane skin integral foam- production, properties and applications

UNIT IV **9**

Solid polyurethane materials- polyurethane casting systems (cast elastomers and casting resins)-thermoplastic polyurethane elastomers: productions / processing, properties and applications, polyurethane, pains, technique and coatings, adhesives builders, elastomers fibers, manufacture / processing and applications.

UNIT V **9**

Determination of composition and testing of polyurethane-chemical compositions, detection methods, identification of functional groups, determinations of properties materials and products (Characterization, physics/mechanical, temp dependence, chemical performance, combustibility) polyurethane and environment health and safety: making and using polyurethane safety.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Dr. Gumter Oertal (ed.), Polyurethane Hand Book, Hanser Publication Munich.
2. George woods, The ICI Polyurethane book -published journls by ICI, John Wiley and sons NY

PT2031 **PRODUCT DESIGN USING CAD** **L T P C**
3 0 0 3

AIM
To design plastic products using CAD

OBJECTIVES
To learn CAD and NC programming; FEA, CAE for plastics and rapid prototyping

UNIT I **9**
Plastics Product Design : Material Selection - Properties – Mouldability - Fits and Tolerance – Shrinkage – Warpage - Wall Thickness – Fillets - Sharp Corners - Ribs and Bosses - Holes- Moulded Threads - Inserts and Fasteners – Integral hinge – Lettering on Moulded Products.
Surface finish – Functional / Aesthetic aspects of part shape-Safety aspects of part shape - Safety aspects if the part should burn - Safety aspects if the part should fail - Use of color and design to promote safety.

UNIT II **9**
Introduction to CAD – Computer Aided Drafting – Operating Systems – Wire frame, Surface and Solid Modeling – Using Auto CAD, Unigraphics, Ideas and Pro-E – NC Machines – NC Part Programming – Manual part programming – Computer assisted part programming – APT Language – Manual data input – NC Programming using CAD/CAM Computer automated part programming.

UNIT III **9**
Finite element analysis - introduction, types of analysis - need for approximation Weight residual, Ritz and Galerkin method - Variational. Procedure for finite element analysis - stiffness matrix, solution procedure, details of finite element analysis package, model building, post processing, simple problems in 2D&3D Analysis and applications of FEM for plastic components.

UNIT IV **9**
Introduction to CAE for plastics – MOLDFLOW Software – Design principles for part design, 3D Modelling using MF/view. Flow analysis, Cooling analysis, Shrink/Warp analysis, Stress analysis. Case studies – Interpretation of results.
Identification of Uneconomical design and redesign for manufacture.

UNIT V **9**
Rapid Prototyping – Streolithography – Laminated Object Manufacturing, Selective Laser Sintering – Solider – Vacuum Casting – Resin injection – Application of rapid prototyping.Rapid Tooling – Cast – IT Epoxy Tooling System, Parts in Minutes – Vacuum grade Polyurethanes, Composite tooling board.

TOTAL : 45 PERIODS

TEXT BOOKS
1. R.D.Beck Plastics Product Design,
2. C-B & Liv C.N.K. Computer aided design & manufacture, East West Press.

REFERENCES
1. Durvent W.R. The Lithographic Hand book, Narosa Pub., 1995.
2. Paul F. Jacob. Rapid Prototyping and manufacture Fundamentals of Stereolithography, 1985
3. MOLD FLOW Users Manual.

PT2032 **INFORMATION TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVES

To learn understand data structure, sorting techniques, operating system and their functions, software engineering – planning and cost information, software design concepts and guidelines and computer networks.

UNIT I **9**

Data Structures **-** Introduction, Storage Structures for arrays, Stacks, Application of stacks, Queues, Pointers and linked allocations, Linked linear list, Operations, Circularly and doubly linked list, Applications. Sorting Techniques - Selection sort, Bubble sort,Exchange sort. Searching Techniques - Sequential searching, Binary Searching.

UNIT II **9**

Operating Systems **-** Generation and history of operating systems, Multiprogramming and time-sharing concepts, Process states, Transition, PCB, Interrupt Processing, Job and process scheduling. Disk scheduling - Seek optimization, Rotational optimization.

UNIT III **9**

Software Engineering - Planning and Cost estimation: Importance of software, Defining the problem, Developing a solution strategy, Planning, Development Process, Organizational Structure.

Software Cost Estimation **-** Introduction, Software cost factors, Cost estimation techniques, Staffing level estimation.

UNIT IV **9**

Software Design Concepts - Introduction, Fundamental design concepts, Modules and Modularization Criteria, Design notations and techniques, Detailed Design Consideration, Real time and Distributed system design, Test plans, Milestone, Walkthroughs and Inspections, Design guidelines. Computer Security - Fundamental concepts of Cryptosystems.

UNIT V **9**

Computer Networks **-** Introduction, Uses of computer networks, Network hardware & software, Reference models, Network topologies, Examples of network. Internet Programming - HTML, DHTML, Front page, Introduction to Dream Weaver. E-Commerce - Introduction, Applications in business, E-Commerce framework.

TOTAL: 45 PERIODS

TEXT BOOKS

1. Jean-Paul Tremblay& Paul.G.Sorenson, “An Introduction to Data Structures with Applications”, McGraw-Hill, II edition, 1984.
2. Harvey. M. Detail, “An Introduction to Operating Systems”, Addison Wesley Publication Company, 1998.

REFERENCES

1. James.L.Peterson, Abraham Silberschatz, “Operating System Concepts”, Addison Wesley Publication Company, 1985.
2. Richard Fairley, “Software Engineering Concepts”, McGraw-Hill, 1985.
3. Pressman R.S., “Software Engineering”, McGraw-Hill, II edition, 1987.
4. Man Young Rhee, “Cryptography & Secure Communications”, McGraw-Hill, 1994.
5. Andrew.S.Tanenbaum, “Computer Networks”, III edition, PHI, 1997.
6. Reilly, O’, “Internet in a Nutshell”, Shroff Publishers, Mumbai, 1998.
7. Reilly, O’, “Html”, Shroff Publishers, Mumbai, 1998.
8. Ravi Kalakata, Andrew Whinston, “Frontiers of Electronics Commerce”, Addison Wesley, 1998.

PL2043 POLYMER DEGRADATION AND STABILISATION L T P C
3 0 0 3

AIM

To learn about the degradation and stabilization of polymers

OBJECTIVES

To understand the various modes of thermal, mechanical, photo degradation & chemical degradation of polymers of the mechanism of degradation and stabilization of the degradation process

UNIT I INTRODUCTION AND THERMAL DEGRADATION 9

Definition - Modes of Polymer Degradation - Mechanistic Aspects - Single Step Process and Chain Reactions - Auto Oxidation - Random and Specific Site Attack - Thermal Degradation: Introduction - Methods for Evaluation of Heat Resistance (DTA, DSC, TGA, TMA) - Mechanistic Aspects - Heat Resistance Polymers - Ablation –Stabilization – Thermal Degradation and Recycling - Heat Effect in Bio Polymers.

UNIT II MECHANICAL DEGRADATION AND ULTRASONIC DEGRADATION 9

Introduction - Mechanistic Aspects Degradation Studies - Polymer Degradation in Solution Ultrasonic Degradation - Importance - Experimental Methods - Mechanism of Ultrasonic Degradation (Cavitations and Direct Effects) - Degradation Studies (Detection of Transient Species and Molecular Weight Distribution) Application of Mechanical Degradation: Stress - Induced Chemical Alterations of Polymers- Mastication of Natural and Synthetic Rubber - Mechano Chemical Synthesis of Block and Craft Copolymers.

UNIT III PHOTO DEGRADATION 9

Introduction - Mechanistic Aspects (Excited States, Free Radicals and Ionic Species, Energy Transfer and Energy Migration) - Degradation in the Absence of Oxygen (Norrish Types I & II Reactions) - Photo Oxidation (Auto Oxidative Process, Sensitized Degradation) - Stabilization - Application: Polymers with Predictable Life Time, Photo resists.

UNIT IV DEGRADATION BY HIGH ENERGY RADIATION AND BIODEGRADATION 9

Introduction - Aspects of Radiation - Mechanistic Aspects - Simultaneous Cross Linking and Degradation - Radiation Stability and Protection Radiation Effects in the Bio Polymers - Application: Lithography, X - ray Resists in Contact Microscopy- Graft and Block Copolymerisation Bio degradation - Modes of Biological Degradation - Enzymatic Degradation in Bio Polymers (Polysaccharides, Proteins, Malice Acids) - Microbial Degradation of Synthetic Polymers - General Applications of Bio Degradable Plastics - Examples of Biodegradable Polyesters and Polyamides.

UNIT V CHEMICAL DEGRADATION 9

Introduction - Solvolysis - Polymer Characterization by Solvolysis - Stability of Polymer Against Solvolytic Agents - Commercial Applications - Ozonisation - Oxidative Degradation - Auto Oxidation of Polymers. Ionic Degradation: Alkaline Degradation of Poly Saccharides Acidic Degradation of Polyaldehydes and Polyacetals and Cationic Degradation of Polypropylene Sulphide and Polyesters.

TOTAL: 45 PERIODS

TEXT BOOKS

1. W. Schnabel, Polymer Degradation - Principles and Practical Applications Hanser Publishers, New York, 1992.
2. Ann - Christine Albertsson, Samuel J. Huang, "Degradative Polymers Recycling and Plastic Waste Management" Marcel Dekker, New York, 1995.

PL2034 ADHESIVES AND SURFACE COATINGS L T P C
3 0 0 3

AIM

To learn the technology of adhesives and coatings

OBJECTIVES

To understand the following

- Adhesives – concepts of terminology, theories of adhesion
- Types of specialty adhesives and their application
- Adherend surfaces and joint design
- Surface coatings – constituents and classification
- Evaluation of properties of surface coatings

UNIT I **9**

Adhesives – concepts and terminology, functions of adhesives, advantages and disadvantages of adhesive bonding, theories of adhesion-mechanical theory, adsorption theory, electrostatic theory, diffusion theory, weak-boundary layer theory, Requirements for a good bond, criteria for selection of adhesives.

UNIT II **9**

Types of adhesives, structural adhesives, Urethane structured adhesives, Modified acrylic structural adhesives, phenolic adhesives and modifiers, anaerobic adhesives, cyanoacrylate adhesives, Hot melt adhesives, pressure sensitive adhesives, RTV Silicone adhesives, sealants, water based adhesives. Specialty adhesives, adhesives in aerospace, adhesive in automobile industry, conductive adhesives, adhesives in building construction, adhesive in electrical industry.

UNIT III **9**

Joint design, stress, types of joints, selection of joint detail, joint criteria, surface preparation of adherends-metals, plastics and rubbers. Adhesive bonding process-methods for adhesives application and bonding equipment, adhesives for specific substrates, testing of adhesives, adhesive specifications and quality control.

UNIT IV **9**

Introduction to surface coatings –Components of paints. Pigments, pigment properties, different types, extenders, solvents, oils, driers, diluents, lacquers, varnishes, paint preparation, formulation, factors affecting pigment dispersion, preparation of pigment dispersion. Different types of paints- classification based on polymeric resin, emulsion, oil and alkyd paints, acrylic paints, epoxy coatings, polyurethane, silicones, formaldehyde based resins, chlorinated rubbers, hydrocarbon resins. Classification based on application, fluropolymers, vinyl resins, appliance furnishes, automotive finishes, coil coatings, can coatings, marine coatings, aircraft coatings.

UNIT V **9**

Surface preparation and paint application. Paint properties and their evaluation – mechanism of film formation, factors affecting coating properties, methods used for film preparation – barrier properties, optical properties, ageing properties, rheological properties and adhesion properties of coatings.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Gerald L. Schreberger, “Adhesive in Manufacturing”, Marcel Dekker Inc., New York, 1983
2. W.C. Wake, “Adhesion and the Formulation of Adhesives”, Applied Science Publishers, London, 1976.

REFERENCES

1. Swaraj Paul, “Surface Coatings”, John Wiley & Sons, NY, 1985.
2. George Mathews, “Polymer Mixing Technology”, Applied Science Publishers. Shields, “Hand Book of Adhesives”, Butterworths,1984

PT2035 FIBRE REINFORCED PLASTICS L T P C
3 0 0 3

AIM

To learn about the raw materials and processing of fibre reinforced plastics.

OBJECTIVES

To understand the basic materials in FRP system covering series of matrix resins and reinforcements, various processing methods of composites, post processing operations, various applications of composites and testing of FRP materials

UNIT I MATRIX SYSTEM AND REINFORCEMENT MATERIALS 9

Basic Materials -Polymeric Matrix System- Polyester And Vinyl Ester Resins - Epoxy Resins- High Temperature Resins- Bismaleimides- Cyanide Esters- Benzyl Cyclo Butene- Acetylene Terminated- Bisnodimide- Aryethynyl Resins- Thermoplastic Resins. Fibre Reinforcements - Glass, carbon, aramide, natural fibres, Boron, Ceramic Fibers- Particulate Fillers.

UNIT II PROCESSING METHODS OF COMPOSITES 9

Prepregs, SMC, DMC etc. - Hand Lay-Up; Spray- Up; Bag Molding; Compression Molding, Injection molding, Resin Transfer Molding (RTM); Filament Winding; Pultrusion Auto Clave Molding; Processing of Thermoplastic Composites.

UNIT III POST PROCESSING METHODS 9

Cutting, Trimming, Machining, Water Jet Cutting, Abrasive Jet Cutting, Laser Cutting, Joining, Mechanical Fastening and Adhesive Bonding, Painting And Coating.

UNIT IV APPLICATION OF COMPOSITES 9

Land Transportation- Marine Application- Air Craft Applications-Aero Space Applications-Composites in Sports Goods- Composite Bio Materials-Composites In Scientific, Industrial And Commercial Applications. Composites in Construction

UNIT V TESTING OF COMPOSITES 9

Non- Destructive Evaluation Methods For Composites Visual, Tap Test, Ultrasonic Methods, X-Ray Imaging, Thermography, Neutron Radiography, Infrared Thermal Testing, Laser Shear -O- Graphy, Holography And Micro Wave Testing. Mechanical Tests: Tension And Compression Testing, Shear, Torsion, Bending- A Mention About Special Test Methods.

TOTAL : 45 PERIODS

TEXT BOOKS

1. G Lubin, “Hand Book of Composites”, 2nd Ed, Van Nostrand Reinhold, New York, 1982.
2. L.Holloway “Hand Book of Composites for Engineers”, Technomic, Lancaster, Pa, 1994.

REFERENCES
1. S.M. Lee, “Dictionary of Composites Materials Technology”, Technomic Lancaster, Pa, 1989.
2. G.Shook, “Reinforced Plastic for Commercial Composites”, Source Book, Asm, 1986.
3. Kevin Potter, “An Introduction to Composites Products”, Chapman and Hall Madras India 1997.
4. S.T.Peter, “Hand Book of Composites”, Chapman and Hall Chennai 1998.
5. Lin / Pearce, “High Performance Thermosets”, Hanser Publishers, Munich, New York, 1993.
6. Harold Belofsky, “Plastics: Product Design And Process Engineering”, Hansen Publisher Munich, New York, 1995.

PL2036 BIOMEDICALS PLASTICS L T P C
3 0 0 3

AIM

To learn the requirement properties of polymers to be used for biomedical applications

OBJECTIVES

- To understand tissue and blood compatibility of polymeric materials intended to use in biological systems
- To study various applications of polymeric biomaterials in biomedical areas like cardio vascular, ophthalmic, dental, orthopedic etc

UNIT I BIOMATERIALS 9

Biomaterials, Biocompatibility, Stabilization, Inflammation And Wound Healing, Blood Clotting System, kinn System, Biological response to Implants, Implant Design And Applications.

UNIT II BIOMEDICAL POLYMERS 9

Criteria for the Selection of Biomedical Polymers, Physicochemical Aspects of the Blood Compatibility of Polymeric Surface

Biomedical Polymers from biological source, Poly hydroxy Alkanoic Acids, Microbial polysaccharides, Silk, Collagen , Microbial Cellulose, Hyaluronic Acid, Synthetic Polymers such as PMMA, Silicon Rubber, Polyethylene, Natural Rubber, Hydrogels

UNIT III BIOMEDICAL APPLICATIONS OF POLYMERS 9

Permanent Implants For Function- Orthopedics, Cardio Vascular, Respiratory Patches And Tubes, Digestive System, Genitourinary System, Nervous System, Orbital (Corneal And Lens Prosthesis) –Permanent Implant For Cosmoses, Other Applications Of Engineered Material In Clinical Practices, Silicone Implants. Polymer Membranes, Polymer Skin, Polymeric Blood.

UNIT IV POLYMERIC LENSES 9

Contact Lenses, Hard Lenses, Gas Permeable Lenses, Flexible Lenses, Soft Lenses, Hydro gels, Equilibrium Swelling, Absorption and Desorption, Oxygen Permeability, Types of Soft Lenses, Manufacture, Cleaning And Disinfection.

UNIT V DENTAL POLYMERS 9

Dental applications, denture bases, dentate reliners, crown and bridge resins, plastic teeth, mouth protectors, maxillofacial prosthetic materials, restorative material, polyelectrolyte based restoratives, sealants, adhesives, dental impression and duplicating materials, agar, algmater elastomers.

TOTAL: 45 PERIODS

TEXT BOOKS

1. H.F. Mark (Ed), "Encyclopedia of Polymer Science and Engineering", John Wiley and Sons New York, 1989.
2. Galin and M. Ruben Ed., "Soft Compact Lenses Clinical and Applied Technology", John Wiley and Sons, Inc. New York, 1978.

REFERENCES

1. Comprehensive Polymer Science Vol.7
2. Alcock, Contemporary Polymer Chemistry
3. Second Ed. Manas Chanda, Salil K. Roy (Ed) Plastic Technology Hand Book Marcel Dekker, Inc. New York, 1993.
4. (Ed) David Byrom, "Bio-Material" Macmillan Publishers Ltd. and ICI Biological products Business, 1991.
5. Wilfred Lynch, Hand book of Silicone rubber fabrication, Van Nostrand Reinhold Company, 450 west 33 rd Street, New York 1000.
6. B.Sedlacek, C.G.Overberger, J.F.Mark (ed.) Medical polymers: Chemical problems. Proceedings of the 17th Prague IUPAC micro-symposium on macromolecules, Prague, Czechoslovakia 15-18, August 1977
7. J.Polym.Sci, Polymer Symposium Vol. 66, 1979

GE2022 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

UNIT I INTRODUCTION 9

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

UNIT II TQM PRINCIPLES 9

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

UNIT III TQM TOOLS & TECHNIQUES I 9

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

UNIT IV TQM TOOLS & TECHNIQUES II 9

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

UNIT V QUALITY SYSTEMS 9

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

TOTAL : 45 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, Third Edition (2003).
3. Suganthi,L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd. (2006)
4. Janakiraman,B and Gopal, R.K, "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd. (2006)

PT2037 CONDUCTING POLYMERS L T P C
3 0 0 3

AIM

To learn the mechanism, synthesis, characterization of conducting polymers

OBJECTIVES

To understand the basic concepts on conducting polymers, conduction mechanism, various methods of synthesis and characterization of conducting polymers and their applications

UNIT I **9**

Introduction to conducting polymers – discovery of polyacetylene – concept of doing and n-type – polarons and bipolarons – conduction mechanism – redox type polymers (electro – active polymers)

UNIT II **9**

Synthesis of conducting polymers – Chemical synthesis – electrochemical synthesis – template synthesis – precursor synthesis – soluble polymers (colloids and dispersions) – advantages and disadvantages of various synthesis methods.

UNIT III **9**

Characterization methods – elemental analysis for dopants – IR – UV (electro chemical) scanning electro microscopy (SEM) – electro chemical characterization – cyclic voltometry – electrochemical quartz crystal microbalance (EQCM) – probe beam deflection (PBD) – Langmuir – blodgett technique.

UNIT IV **9**

Applications tested – rechargeable batteries, lights emitting diodes – gas sensors – bio sensors – photo voltaic energy devices – micro electronics (PCB fabrications) electro catalysis – applications – proposed – antistatic coatings – electro chem. Mechanical devices – super capacitors

UNIT V **9**

Recent trends in conducting polymers – functionalised conducting polymers (second generation polymers) – super conductors (inorganic – organic hybrid structures) – conducting polymers based on nano composites.

TOTAL: 45 PERIODS

TEXT BOOKS

1. R. G. Linford, Electro Chemical Science and Technology of Polymers – 1&2, ed., Elsevier applied sciences, London, 1987 and 1990.
2. M. Schlvxinger and M. Paunovic, (eds.) Modern Electro Plating, john Wiley and sons Inc., New York, 2000.

REFERENCES

1. Hari Singh Nalwa (ed.), Hand Book of Organic conductive molecules and polymers, 4 – volume set, John wiley & sons, England, 1997.
2. T.Asaka, S. Komabe and T. Momma, Conductive Polymers.

PT2038 NYLON TECHNOLOGY L T P C
3 0 0 3

AIM

To learn about the various the raw materials, manufacturing, preparation and properties of various nylons

OBJECTIVES

To understand Methods of manufacturing, properties and applications of commercial nylons such as Nylon 6, Nylon 6, 6, Nylon 6, 10, Nylon 4, 6, Nylon 11, Nylon 12 etc.
Crystal structure and property relationship of nylons.Modified nylons through blends and alloys

UNIT I **9**

Historical development of nylons – commercial nylons; Polyamidation – Principle of polyamidation – chemistry, polycondensation and equilibria – kinetics – molecular mass; Polycondensation process techniques – hydrolytic, ionic and solid phase polymerization

UNIT II **9**

Commercial nylons – nylon 6, nylon 66, nylon 6, 10, nylon 4 6, nylon 11, nylon 12 – raw materials, method of manufacturing, properties and important applications – chemical attack and degradation of nylons – oxidative, thermal and hydrolytic degradation

UNIT III **9**

Structure - property relationship in nylons – crystallization of nylons and crystal structure effect on molecular weight - melting temperature, Tg – crystallization growth, orientation, morphology Characterization of nylons – identification of nylons and their hydrolysis products for composition and moisture content by HPLC, DSC, Karl Fischer method, IR, NMR and X ray; Molecular weight and distribution by GPC and End group analysis method, solution viscosity method

UNIT IV **9**

Processing of nylons - Rheology, PVT relationship – Effect of moisture, molecular mass, shear, temperature, additives on melt processing; Melt Processing techniques- extrusion into film and tube, injection moulding – RIM, blow moulding; other process techniques such as solution coating, powder coating, blending

UNIT V **9**

Modification of nylons – transparent, toughened, flame retardant, plasticized and lubricated nylons, filled and reinforced grades; blends and alloys nylon with other polymers – nylon 66 –PPO (Noryl), nylon 6 – LDPE, EPDM
Introduction to fibre technology – nylon 6 melt spinning, drawing into yarns - dye ability

TOTAL: 45 PERIODS

TEXT BOOKS

1. Malvin I. Kohan (ed.) “Nylon Plastics Hand Book”, Hanser Publisher, 1995.
2. Nicholar P. Chermisinof (ed.) “Hand Book of Engineering Polymeric Materials Marcel Dekker Inc. N.Y. 1997

GE2023 FUNDAMENTALS OF NANOSCIENCE L T P C
3 0 0 3

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.