ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

R - 2008

B.TECH. PLASTIC TECHNOLOGY

II TO 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					
MA 2211	Transforms and Partial Differential Equation	3	1	0	4
GE 2211	Environmental Science and Engineering	3	0	0	3
PT 2201	Materials Engineering	3	0	0	3
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
	TOTAL	**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
PL 2251	Rubber Materials	4	0	0	4
PRACTICALS					
PT 2257	Chemical Engineering 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					
MA2264	Numerical Methods	3	1	0	4
PL2301	Polymer Rheology & Fluid Mechanics	3	0	0	3
PL2302	Polymerization Engineering	3	0	0	3
PL2303	CAD/CAM/CAE for Plastic Engineering	3	0	0	3
PL2304	Plastics Materials & Applications – I	3	0	0	3
PL2305	Plastics Processing Technology – I	3	0	0	3
PRACTICALS					
GE2321	Communications Skills Laboratory	0	0	4	2
PL2307	Design & Mould Flow Analysis Practice using CAD/CAM/CAE	0	0	4	2
PL2308	Polymer Engineering Lab	0	0	4	2
	TOTAL	**18**	**1**	**12**	**25**

SEMESTER – VI

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
PL2351	Fundamentals of Plastics and Mould / Die Design	3	0	0	3
PL2352	Plastics Materials & Applications – II	4	0	0	4
PL2353	Plastics Testing Techniques – I	3	0	0	3
PL2354	Process Control & Instrumentation	3	0	0	3
PL2355	Additives & Compounding	3	0	0	3
PL2356	Plastics Processing Technology – II	3	0	0	3
PRACTICALS					
PL2358	Plastics Processing Lab – I	0	0	4	2
PL2359	Plastics Testing Lab – I	0	0	4	2
	TOTAL	**19**	**1**	**8**	**23**

Summer Training in the Semester Break
(15 days during Semester Break)

SEMESTER – VII

CODE NO.	COURSE Title	L	T	P	C
THEORY					
PL2401	Polymer Composite Technology	3	0	0	3
PL2402	Plastics Testing Techniques – II	3	0	0	3
PL2403	Industrial Management & Costing	3	0	0	3
PL2404	Plastics Product Design	3	0	0	3
E1	Elective - I	3	0	0	3
E2	Elective - II	3	0	0	3
PRACTICALS					
PL2408	Plastics Processing Lab - II	0	0	4	2
PL2409	Plastics Testing Lab – II	0	0	4	2
PL2410	Comprehension	0	0	2	1
	TOTAL	**18**	**0**	**10**	**23**

SEMESTER – VIII

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
E3	Elective – III	3	0	0	3
E4	Elective – IV	3	0	0	3
PRACTICAL					
PL2451	Project Work	0	0	12	6
	TOTAL	**6**	**0**	**12**	**12**

LIST OF ELECTIVES

ELECTIVE – I

CODE NO.	COURSE Title	L	T	P	C
PL2021	Advanced Plastic Processing Techniques	3	0	0	3
PL2022	Plastic Waste Management and Recycling Techniques	3	0	0	3
PL2023	Plastics Packaging Technology	3	0	0	3
PL2024	Fibre Technology	3	0	0	3

ELECTIVE – II

CODE NO.	COURSE TITLE	L	T	P	C
PL2026	Biodegradable Polymers	3	0	0	3
PL2027	Specialty Polymers	3	0	0	3
PL2033	Specialty Elastomers	3	0	0	3
PL2029	Polyurethane Technology	3	0	0	3
PL2035	Analysis and Characterisation of Polymers	3	0	0	3

ELECTIVE – III

CODE NO.	COURSE TITLE	L	T	P	C
PL2041	Plastics Product Design Using CAD/CAM/CAE	3	0	0	3
PL2042	Polymer Nanocomposites	3	0	0	3
PL2043	Polymer Degradation and Stabilisation	3	0	0	3
PL2034	Adhesives and Surface Coatings	3	0	0	3
PL2045	Nylon Technology	3	0	0	3
PL2036	Biomedical Plastics	3	0	0	3

ELECTIVE – IV

CODE NO.	COURSE TITLE	L	T	P	C
PL2051	Statistical Quality Control Techniques	3	0	0	3
GE2022	Total Quality Management	3	0	0	3
PL2053	Industrial Safety & Hazard Management	3	0	0	3
PL2054	Entrepreneurship	3	0	0	3
PL2055	Human Resource Management	3	0	0	3
PL2056	Marketing Management	3	0	0	3
PL2057	Risk Assessment in Plastics Industry	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 BOOK

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.Owen, ’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 – HCI 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 CIRCUIT 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

MA2211 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATION L T P C
(Common to all branches of BE / B.Tech Programmes) 3 1 0 4

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 BOOKS

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).

GE2211 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C

(Common to EEE, EIE, ICE, Biotech, Chemical, Textile Tech. (Fashion Tech) / Fashion Tech., Plastic Tech., Polymer Tech. and Textile Tech. Branches) **3 0 0 3**

AIM

The aim of this course is to create awareness in every engineering graduate about the importance of environment, the effect of technology on the environment and ecological balance and make him/her sensitive to the environment problems in every professional endeavour that he/she participates.

OBJECTIVES

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

UNIT I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 9

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 9

Concepts 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 and Birds - Field Study of Simple Ecosystems – Pond, River, Hill Slopes, etc.

UNIT III ENVIRONMENTAL POLLUTION 9

Definition – Causes, Effects and Control Measures of:- (A) Air Pollution (B) Water Pollution (C) Soil Pollution (D) Marine Pollution (E) Noise Pollution (F) Thermal Pollution (G) Nuclear Hazards – Soil Waste Management:- Causes, Effects and Control Measures of 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 9

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 Production 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 9

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. Masters, G.M., “Introduction to Environmental Engineering and Science”, Pearson Education Pvt., Ltd., 2nd Edition, 2004.
2. Miller, T.G. Jr., “Environmental Science”, Wadsworth Pub. Co.
3. Townsend C., Harper, J. and Begon, M., “Essentials of Ecology”, Blackwell Science, 2003.
4. Trivedi, R.K., and Goel, P.K., “Introduction to Air Pollution”, Techno- Science Publications.

REFERENCES

1. Erach, B., “The Biodiversity of India”, Mapin Publishing Pvt. Ltd., Ahmedabad, India.
2. Trivedi, R.K., “Handbook of Environmental Law’s, Rules, Guidelines,Compliances and Standards”, Vol - I and II, Envio Media.
3. Cunningham., Cooper, W.P. and Gorhani, T.H., “Environmental Encyclopedia”, Jaico Publishing House, Mumbai, 2001.
4. Wages, K.D., “Environmental Management”, W.B. Saunders Co., Philadelphia, USA, 1998.

PT2201 **MATERIALS ENGINEERING** **L T P C**
3 0 0 3

(Common to Plastic & Polymer 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.

PT 2202 ORGANIC CHEMISTRY & TECHNOLOGY L T P C
3 1 0 4

(Common to Plastic & Polymer Technology)

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.

PT 2203 PHYSICAL CHEMISTRY OF POLYMERS L T P C
3 0 0 3

(Common to Plastic & Polymer 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**

(Common to Plastic & Polymer Technology) **4 0 0 4**

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 II **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”,
3. 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 to Plastic & Polymer 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

PT 2208 **ORGANIC CHEMISTRY LABORATORY** **L T P C**
0 0 3 2

(Common to Plastic & Polymer 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

REFERENCE

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

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
(Common to Plastic & Polymer Technology) 3 0 0 3

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

(Common to Plastic & Polymer Technology) **3 0 0 3**

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 **9**

Mass transfer

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.

PT 2254 STRENGTH OF MATERIALS L T P C
3 0 0 3

(Common to Plastic & Polymer 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.

PL 2251 **RUBBER MATERIALS** **L T P C**
4 0 0 4

UNIT I **10**

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

UNIT II **10**

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

UNIT III **16**

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

UNIT IV **8**

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

UNIT V **16**

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

TOTAL : 60 PERIODS

REFERENCES

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

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

(Common to Plastic & Polymer 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
With the present development of the computer technology, it is necessary to develop efficient algorithms for solving problems in science and engineering. This course gives a complete procedure for solving different kinds of problems occur in Engineering numerically.

OBJECTIVES
At the end of the course, the students would be acquainted with the basic concepts in numerical methods. The uses of numerical methods are summarized as follows:

- The roots of nonlinear (algebraic or transcendental) equations which arise in engineering applications can be obtained numerically where analytical methods fail to give solution. Solutions of large system of linear equations are also obtainable using the different numerical techniques discussed. The Eigen value problem is one of the important concepts in dynamic study of structures.
- When huge amounts of experimental data are involved in some engineering application, the methods discussed on interpolation will be useful in constructing approximate polynomial to represent the data and to find the intermediate values.
- The numerical differentiation and integration find application when the function in the analytical form is too complicated or the huge amounts of data are given such as series of measurements, observations or some other empirical information.
- Many physical laws are couched in terms of rate of change of quantity. Therefore most of the engineering problems are characterized in the form of nonlinear ordinary differential equations. The methods introduced in the solution of ordinary differential equations will be useful in attempting any engineering problem.
- When the behavior of a physical quantity is expressed in terms of rate of change with respect to two or more independent variables, the problem is characterized as a partial differential equation. The knowledge gained may be used in solving any problem that has been modeled in the form of partial differential equation.

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 9+3

Linear interpolation methods (method of false position) – Newton's method - Fixed point iteration: x=g(x) method - Solution of linear system by Gaussian elimination and Gauss-Jordon methods- Iterative methods: Gauss Jacobi and Gauss-Seidel methods- Inverse of a matrix by Gauss Jordon method – Eigenvalue of a matrix by power method.

UNIT II INTERPOLATION AND APPROXIMATION 9+ 3

Lagrangian Polynomials – Divided differences – Interpolating with a cubic spline – Newton's forward and backward difference formulas.

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9+ 3

Derivatives from difference tables – Divided differences and finite differences –Numerical integration by trapezoidal and Simpson's 1/3 and 3/8 rules – Romberg's method – Two and Three point Gaussian quadrature formulas – Double integrals using trapezoidal and Simpson's rules.

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

Single step methods: Taylor series method – Euler and modified Euler methods – Fourth order Runge – Kutta method for solving first and second order equations – Multistep methods: Milne's and Adam's predictor and corrector methods.

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

Finite difference solution of second order ordinary differential equation – Finite difference solution of one dimensional heat equation by explicit and implicit methods – One dimensional wave equation and two dimensional Laplace and Poisson equations.

L : 45 T :15 TOTAL : 60 PERIODS

TEXT BOOKS

1. Gerald, C.F, and Wheatley, P.O, "Applied Numerical Analysis", Sixth Edition, Pearson Education Asia, New Delhi, 2002.
2. Balagurusamy, E., "Numerical Methods", Tata McGraw-Hill Pub. Co. Ltd., New Delhi, 1999.

REFERENCES

1. Kandasamy, P., Thilagavathy, K. and Gunavathy, K., "Numerical Methods", S.Chand Co. Ltd., New Delhi, 2003.
2. Burden, R.L and Faires, T.D., "Numerical Analysis", Seventh Edition, Thomson Asia Pvt. Ltd., Singapore, 2002.

PL2301 POLYMER RHEOLOGY & FLUID MECHANICS L T P C
3 0 0 3

UNIT I **3**

State of Aggregation and phase states of matter Molecular motion in Polymers Transition relaxation processess in Polymers.

UNIT II **6**

Glass Transition, Theories to determine the glass transition i.e. Dillatometric, Heat capacity, measurement, Thermomechanical, Measurement of modulus of elesticity, effect of Tg on molecular mass, kinetic chain flexbility and chemical constituent, Importance of Tg and Tm, HDT.

UNIT III **9**

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

UNIT IV **9**

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, Dependance of viscosity with temp, shear stress, shear rate fluid through channel, characteristic parameter during shear deformation.

UNIT V **9**

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

UNIT VI **9**

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

TOTAL : 45 PERIODS

REFERENCES

1. The Flow of Highpolymers, 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).

PL2302 POLYMERIZATION ENGINEERING L T P C
3 0 0 3

UNIT I **9**

Industrial methods of polymerization such as a bulk, solution, emulsion, suspension. Layout and arrangement of polymer plant. Stereochemistry of polymers and stereo-specific polymerization. Catalysts-their utility in polymers and stereo-specific polymerizations.

UNIT II **9**

Catalysts-their utility in polymer manufacture, Zieglar-Natta, Metallocene and others.

UNIT III **9**

Manufacturing processes of basic raw materials and intermediates of synthetic polymers. Production technology, properties and application of important plastics such as polyethylene, polypropylene, polystyrene and polyvinyl chloride.

UNIT IV **9**

Brief introduction of copolymers based on the common monomers such as ethylene, vinyl chloride, styrene, acrylates and methacrylates etc.

UNIT V **9**

Formaldehyde and its reaction products with phenol, urea and melamine. Preparation of moulding powders.

TOTAL : 45 PERIODS

REFERENCES

1. Principles of Polymerization by George Odian.
2. Kuran; Witold, Principles of Cordination Polymerization, John Wiley & Sons Ltd., Chishester (2001).
3. Polymer Science & Technology of Plastics & Rubbers by P Ghosh.
4. Polymer Science by Gowriker-Viswanathan-Sreedhar.
5. Odian; George, Principles of Polymerization, McGraw-Hill Book Co., New York (1970).
6. Polymerization Process Modeling, N A Dotson, R Galvan, R L Laurence and M Tirrell, VCH Pub., Ind., 1996.
7. Reaction Engineering of Step Growth Polymerization, S K Gupta and Anil Kumar, Plenum Press, 1987.

PL2303 CAD/CAM/CAE FOR PLASTICS ENGINEERING L T P C
3 0 0 3

UNIT I COMPUTER AIDED DESIGNING **9**

Fundamentals: Output primitives (pints, lines, curves, etc.,) 2-D Transformation, Translation, Scaling, Rotation, windowing, View ports clipping transformation.

CAD Software: Interactive programs w.r.t design problems and production of drawing using any languages like Autocad , Auto LISP/C/C++., creation of surface, solids etc., using solid modeling package (prismatic and revolved parts), Data exchange, customizing.

Computer Graphics: Representation of curves – Bezier curves – Cubic spline curve – B Spline curves – Rational curves – Surface Modeling Technique – surface patch – coons patch - bi-cubic patch – Bezier and B-spline surfaces – Volume modeling – Boundary models – CSG other modeling techniques.

UNIT II VISUAL REALISM **9**

Hidden – Line – Surface – sold removal algorithms shading – coloring. Introduction to parametric and variation geometry based on soft wares and their principles creation of prismatic and lofted parts using these packages. Graphics and computing standards

GKS – Bitmaps – Open Gl – Data Exchange standards – IGES – STEP – CALS – DXF-Communication standards - WAN – LAN. CAD/Graphics integration
2D Representation – Development of surfaces – Integration of design analysis and Cad - Graphical aid for preprocessing in FEA – mesh generation techniques – post processing – Machine from 3D Model – Generative machining – cutter location - gouge deletion – tool path generation from solid models.
Assembly of parts, tolerance analysis mass property calculations, mechanism simulation, Integration of design, analysis and CAD graphical aid.

UNIT III COMPUTER AIDED MANUFACTURING 9

Introduction to CAD / CAM software packages, Automation strategies in production process – G - Codes & M – Codes - NC system – Computer assisted part programming – APT language – DNC-CNC and Adaptive Control. Accuracy, repeatability, End effectary, sensors, control systems & type of programming, post processing.
Linear Feed back control system – process model formulation, Transfer function and block diagram, Laplace Transforms, Control Actions – Linear System analysis – system Design, Optimal Control – Structural Model of a Manufacturing Process, Steady state optimal control, Adaptive Control, on-line search strategies.

UNIT IV CAD / CAM INTERFACE FUNDAMENTALS OF CNC MACHINES 9

Manufacturing methods for fabrication of moulds & dies - Design FMS workstations – analysis methods – automated Materials Handling – Types –Computer Integrated Production Planning System – Computer Processes interface – Process Monitoring – Supervisory Computer Control – Computer Monitoring – Types & Strategies.

UNIT V COMPUTER AIDED ENGINEERING 9

Computer modeling for polymer processing: Models of Material Behaviour, Model simplifications, Finite difference, Finite element techniques for field problems, Simulation of viscoelastic fluid flow, computer implementation of Process models. Advanced computational techniques, Supercomputing and Visualization of Results.
Concept of A.I. and knowledge based systems in selection and processing of polymers.
CAE in Mould Manufacture: Computerized numerical control. Flexible manufacturing.

TOTAL : 45 PERIODS

REFERENCES

1. Braun; Dietrich, Cherdron; Harald and Ritter; Helmut, Polymer Synthesis: Theory and Practice-Fundamentals, Methods, Experiments, 3rd Edition, Springer Verlag, Berlin (2001).
2. Computer Integrated Manufacturing Paul G. Ranky (Prentice Hall, 1990).
3. CAD/CAM/CIM Radhakrishnan, P. & Subramanyan. S. (Wiley Eastern Ltd., 1994).
4. An Introduction to Automated Process Planning Chang. T.C. & Wysk(Prentice Hall Inc., Englewood Cliffs - New Jersey).
5. Computer Integrated Manufacturing Systems Yoram Koren(McGraw Hill, 1983).
6. Automation, Production and Systems and Computer - Integrated Manufacturing Mikell P. Groover,(Prentice Hall of India Pvt. Ltd., 1998).
7. Computer Graphics- Donald Hearn and M.Pauline Baker (Prentice Hall, Inc., 1992).
8. CAD/CAM – Theory and Practice- Ibrahim Zeid (*McGraw Hill,* International Edition, 1998).
9. CAD/CAM principles, practice and manufacturing management - By Chris McMohan and Jimmi (Browne Pearson Education Asia,Ltd.,2000).
10. CAD/CAM/CIM - By Radhakrishnan, P. and Subramanyan. S. (Wiley Eastern Ltd., 1994).
11. Automation, Production and Systems and Computer - Integrated Manufacturing By Mikell P. Groover (Prentice Hall of India Pvt. Ltd., 1998).
12. An Introduction to Automated Process Planning - By Chang. T.C. & Wysk, (Prentice Hall Inc., Englewood Cliffs - New Jersey).
13. Computer Integrated Manufacturing Paul G. Ranky(Prentice Hall, 1990).
14. Computer Integrated Manufacturing Systems Yoram Koren (McGraw Hill, 1983).

PL2304 PLASTICS MATERIALS & APPLICATIONS – I L T P C
3 0 0 3

UNIT I HISTORY 6

Basic chemistry of polymers-nomenclature of polymers sources for raw materials- Natural Polymers - Shellac resin and natural rubber - Cellulosics -Cellulose nitrate, cellulose acetate, cellulose acetate butyrate, Ethyl cellulose & others.

UNIT II COMMODITY THERMOPLASTICS & ITS APPLICATIONS 12

Methods of manufacturing - general properties - processing behavior and applications of the following:

Polyolefin - Polyethylene, LDPE, HDPE, LLDPE, HMHDPE, Polypropylene - Homo-polymers- Copolymers - Polytyrene & Styrene copolymers - Polystyrene, HIPS, ABS, Styrene - Acrylonitrile Vinyl plastics - Polyvinyl chloride, Polyvinyl Acetate, Polyvinylidene chloride, Polyvinyl alcohol & others.

UNIT III ENGINEERING PLASTICS & ITS APPLICATIONS 12

UHMHDPE -EPDM – EVA - Polyamides - Nylons 6, 66, 6 10, 11, 12 etc. Acrylic plastics - Polymethyl Methacrylate, Polyacrylonitrile - Polyesters - Polyethylene terephthalate, polybutylene terephthalate - Polycarbonate - Polyacetals

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UNIT IV HIGH PERFORMANCE PLASTICS 10

Aromatic ether - Polypheneylene oxide, Aromatic thioether - Polyphenylene sulphide, Polysulfone, Polyimides – Polyimidazoles, Polyurethane, luoropolymers - Polyvinyl fluoride, Polyvinylidene fluoride, Polytetrafluoroethylene, Polychlorotrifluoroethylene.

UNIT V THERMOSET MATERIALS & ITS APPLICATIONS 5

Phenol formaldehyde - Urea formaldehyde - Melamine formaldehyde – Unsaturated polyesters, Alkyd resins - Epoxides - Polyurethane – Silicones - End use applications - case studies on applications – Moulding Powders

TOTAL : 45 PERIODS

TEXT BOOKS

1. Plastic Materials Ed 7 - By Brydson, J A.
2. Hand Book of Plastics Materials & Technology - By Rubin, Irwin, J
3. Plastics Materials Hand Book - By Athalye, A.S
4. Polymer Science - By Gowariker, V.R & Others
5. Text Book of Polymer Science-By Billmeyer, F.W.

REFERENCES

1. Plastics Engineering Hand Book Ed. 5 & Society of the Plastic Industry Inc - By SPI.
2. Plastics Materials and Processing - By Schwartz & Goodman.
3. Plastics Materials (Properties & Application) - By Birley & Scott.
4. Modern Plastics Hand Book - By Harper.
5. Bikales; Norbert M. and Segal; Leon (Eds.), Cellulose and Cellulose Derivatives, Part IV (Volume V), Wiley- Interscience, New York (1971).
6. Birley; Arthur W. and Scott; Martyn J., Plastics Materials: Properties and Applications, Leonard Hill, Blackie and Sons Ltd., (1982).
7. Biron; Michel, Thermoplastics and Thermoplastic Composites: Technical Information for Plastics Users, Elsevier, Amsterdam (2007).
8. Davidson; Theodore, Polymers in Electronics, ACS Symposium Series 242, American Chemical Society, Washington D. C. (1984).
9. DuBois; P., Plastics in Agriculture, Applied Science Publishers Ltd., London (1978).

PL2305 PLASTICS PROCESSING TECHNOLOGY – I L T P C
3 0 0 3

UNIT I INTRODUCTION 9

Basic principles of processing - shape and size – Effect of polymer property and processing – Newtonion ands Non-Newtonion fluids - Rheology of polymer melts .

UNIT II COMPRESSION MOULDING & TRANSFER MOULDING 9

Fundamental principles-Meaning of terms-Bulk factor and flow properties as applied to moulding materials-The methods adopted for estimating these properties and their limitations Process variables-Inter relation between flow properties-Curing time-Mould temperature and Pressure requirements-Preforms and preheating-Techniques of preheating-Machines used-Common moulding faults and their correction-Finishing of mouldings.

Fundamental principles of transfer moulding-advantages over compression moulding-Equipment used-Press capacity-Integral moulds and auxiliary ram moulds-Moulding cycles-Tool costs-Moulding tolerances-Materials Theoretical calculation of pressures-Line pressures- Injection ram pressure-clamping-Heating requirements-Finishing of moulded parts—Moulding faults - causes and remedies.

UNIT III INJECTION MOULDING 9

Principles processing outline - Process variables - Mould cycle - Machinery used – Parts and functions –Specifications - Construction and maintenance - Start-up and shut down procedures -Cylinder nozzles - Press capacity projected area -Shot weight Basic theoretical concepts and their relationship to processing - Interaction of moulding process aspect effects in quoted variables - Introduction to trouble shooting.

UNIT IV EXTRUSION 9

Basic principles of extrusion – Types of extruders, general features of extruders viz. barrel, screw, types of screws, drive mechanism, specifications, heating & cooling systems, flow mechanism, die entry effects and exit instabilities. Melt fracture & Bam-booing. Factors affecting the output of an extruder, process variables in extrusion

Extrusion processes and the downstream equipments for the production of films, blown film, cast film/slot film, BO film, co extruded film. Tube/pipe-sizing take off equipment, extrusion coating, wire & cable covering – pre treatment of conductor, cooling, takeoff equipment constructional features of dies for the above processes and trouble shooting. Applications of extrusion and new developments.

UNIT V BLOW MOULDING 9

Basic principles and definitions- Processer – viz, Injection Blow moulding, extrusion blow moulding, Accumulation blow moulding, Merits & Demerits - Development of blow moulding industry Processing Parameters-Temperature-Pressure and cycle time Components – Materials requirements related to process and product performance-Materials used-Limitations in product design presented by process characteristics-Design guide lines for optimum product performance and appearance-Equipment used-Hand and power operated equipment. Screw and Plunger Systems-Cross head and die design-Blow moulding machine features and operation including hydraulic and electrical control systems-faults, causes and remedies.

Parison programming, blow mould construction, cooling methods, mould venting, blow moulding of difficult articles like fuel tanks, odd shaped containers with handles, limitation in blow moulding, decoration of blow moulding products, hot stamping-multi colour printing-faults, causes and remedies.

TOTAL : 45 PERIODS

TEXT BOOKS

1. Allen; W. S. and Baker; P. N., Hand Book of Plastic Technology, Volume-1, Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors, New Delhi (2004).Injection Molding Theory & Practice By Rubin, Irvin.

2. Injection Molding Hand Book By Rusto, D.V & Rosato, D.V Plastic Engineering Hand Book & D – 5 By Society of Plastic Industry Inc.
3. Plastics Material & Processing By Strong, A, Brent ,Blow Molding Hand Book By Rosato, D.V & Rosato, D.V ,Plastic Extrusion Technology By Hensen.
4. Extrusion of Plastics By Fisher
5. Plastics Extrusion Technology By Grief
6. Plastic Engineering Hand Book By S P I
7. Plastics Extrusion Technology By Henson

REFERENCES

1. A Guide to Injection Molding of Plastics By Bolur, P.C.
2. Development in Injection Molding By Whelan, A & Craft, J.L.
3. Technician's Hand Book & Plastics By Grandilli, P.A.
4. Plastics Materials & Processing By Schwartz & Goodman.
5. Injection Molding By Athalye, A.S.
6. Injection Molding Technology By V.D.I.
7. Innovation in Polymer Processing By Stevenson.
8. Extrusion The definitive Processing Guide and Hand Book By Giles, H.H & Others.
9. Compression Molding By Iyesew, A.I.
10. Polymer Extrusion By Rauwedaal, Chris.
11. Thermoforming By James & Throne.
12. Basic Principle of rotational molding By Crawford, R.J & Throne, J.L.
13. Basic Principle of Rotational Molding By Bruins.
14. Basic Principle of Thermoforming By Brycle, D.M.
15. Plastics Injection Molding By Brycle, D.M.
16. Injection molding of Plastics component By Bown John.
17. Plastics forming By Beadle.
18. Plastics Forming By Figher.
19. Calendering of Plastics By Elden & Swan..
20. Welding of Plastics By New Man Plastics Technology MchrawBy Milby.
21. Allen; W. S. and Baker; P. N., Hand Book of Plastic Technology, Volume-1, Plastic Processing Operations [Injection, Compression, Transfer, Blow Molding], CBS Publishers and Distributors, New Delhi (2004).
22. Bikales; Norbert M., Extrusion and other Plastics Operations—Encyclopedia of Polymer Science and Technology Reprints, John Wiley and Sons Inc., (1971).
23. Fenner; Roger T., Principles of Polymer Processing, The MacMillan Press Ltd., London (1979).
24. Micheli; Walter, Plastics Processing: An Introduction, Hanser Publishers, Munich (1995).

GE2321 COMMUNICATION SKILLS LABORATORY L T P C
0 0 4 2

Globalisation 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.

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.

PL2307 DESIGN & MOULD FLOW ANALYSIS PRACTICE USING CAD/CAM/CAE

L T P C
0 0 4 2

I. 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.

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

II. Semi - Automatic Compression Mould.
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.

III. Transfer mould design using CAD.

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.

IV. Blow mould Design using CAD.

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

V. Extrusion Die Design using CAD.

1. For pipes.
2. For profiles.

VI. Part design for an Injection Moulded Component-using MOULDFLOW.

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

TOTAL: 60 HOURS

S.No.	Description of Equipment	Quantity required
1.	Computer Systems	30 Nos.
2.	Softwares for C++ and Java	

REFERENCES

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

PL2308 POLYMER ENGINEERING LAB L T P C
0 0 4 2

LIST OF EXPERIMENTS

1. To study kinetics of reaction by differential / integral method of analysis / IR N UV
2. To find activation energy and frequency factor
3. Performance of batch reactor
4. Performance of C.S.T.R.
5. Performance of tubular reactor
6. Bulk Polymerisation technique
7. Emulsion Polymerisation technique
8. Suspension Polymerisation technique
9. R.T.D. Studies in mixed vessel
10. R.T.D. Studies in tubular flow
11. To study kinetics of Polycondensation
12. To study kinetics of Addition Polymerisation by dilatometer.

TOTAL: 60 PERIODS

S.No.	Description of Equipment	Quantity required
1.	Magnetic stirrer	10 Nos.
2.	Thermostatic water bath	2 Nos.
3.	Vacuum pump	1 No.
4.	Heating Mantle	10 Nos.
5.	Water distillation set up	1 No.
6.	Bunsen burner	15 Nos.
7.	Electronic balance	2 Nos.
8.	Air Oven	1 No.
9.	Melting point apparatus	1 No.
10.	Retard stand	15 Nos.

PL2351 FUNDAMENTALS OF PLASTICS AND MOULD / DIE DESIGN L T P C
3 0 0 3

UNIT I **9**

Orthographic projection-Projection of solids—vertical and horizontal surfaces-Inclined Surfaces-Curved Surfaces-Sectional views and assembly drawing.

UNIT II **9**

Basic Principles-Shrinkage-Flash lines-Undercuts-suggested Wall thickness-Draft-Tolerance-Moulded holes-threads-radius- moulded hinges-integral hinge-snap fits - product design thumb rules - case studies and product design.

UNIT III **9**

Parting line-Construction of core and cavity-types of gate-types of ejection-Mould temperature control - cooling - Mould alignment Mould anciliary parts.

UNIT IV **9**

Types of moulds-two plate - three plate - split moulds - Machine selection-Principles of shrinkage allowances-materials for mould parts-life of mould-mould maintenance-case studies on mould design.

UNIT V **9**

Extrusion -- extruder parts - extrusion screw - design features - design variables.
Injection Moulds for threaded components – automatic unscrewing – various unscrewing methods

TOTAL: 45 PERIODS

REFERENCES

1. Plastic Design & Processing - By Sharma, S.C.
2. Plastics Moulds & Dies - By Sors, & Others.
3. Injection Mould Design Fundamentals (Vol. I& II) - By Glanvill & Denton.
4. Injection Mould -By VDI.
5. Injection Mould Design for Thermoplastic - By Pye, R.G.W.
6. Injection Mould & Molding - By Dym.
7. Injection Moulds – 130 Proven Design - By Gastrow, H.
8. Plastics Product Design Engineering Hand Book - By Dubois, H.
9. Plastics Product Design & Process Engineering - By Belofsky, Harold.

PL2352 PLASTICS MATERIALS & APPLICATIONS – II L T P C
4 0 0 4

UNIT I **12**

Thermoplastic Elastomers
Speciality polymers viz.PEEK, polyimides, PAI & Ionomer
Liquid Crystalline Polymers
Metallocene Polymers
High tech-areas for applications of plastics. High & Low Temperature Polymers. Interpenetrating Polymers Networks. Ultra-high modulus fibres. Polymeric foams.

UNIT II **12**

Reinforced Plastics – principles of composite reinforcement, effect of reinforcement on strength of plastics, Role and nature of binders and coupling agents, properties and applications of fibres in reinforcement (glass and carbon), Properties and applications of FRP's (Thermoset & Thermoplastics: un-saturated polyesters, epoxies, PU, nylon) End use applications - case studies on applications

UNIT III **12**

Definition, advantages of polymers, blends and alloys, role of composition, properties and applications of parameters for compability, PVC – Nitrile rubber, ABS-PVC and PP-EPDM

UNIT IV **12**

Polyolephines, Nylons & Polycarbonates with fillers like Glass, Mica, Talc, Caco, etc
Polymer Concretes & Advanced ceramics.

UNIT V **12**

Preleminary concepts of new materials such as electrically active polymers, Optoelectronic plastics, Bio-polymers, membrane plastics in bio medical applications.

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

REFERENCES

1. Plastics Engineering Hand Book Ed. 5 & Society of the Plastic Industry Inc - By SPI.
2. Plastics Materials and Processing - By Schwartz & Goodman.
3. Plastics Materials (Properties & Application) - By Birley & Scott.
4. Folkes; M. J. and Hope; P. S., Polymer Blends and Alloys, Blackie Academic & Professional, London (1993). [CN334].
5. Paul; D. R. and Newman; Seymour (Eds.), Polymer Blends, Volumes I and II,Academic Press (1978).
6. Plastic Materials Ed 7 - By Brydson, J.A.
7. Hand Book of Plastics Materials & Technology - By Rubin, Irwin, J.
8. Plastics Materials Hand Book - By Athalye, A.S.
9. Polymer Science -By Gowariker, V.R & Others.
10. Text Book of Polymer Science-By Billmeyer, F.W.

PL2353 **PLASTICS TESTING TECHNIQUES – I** **L T P C**
3 0 0 3

UNIT I **9**

Consideration of importance of testing for identification of plastics-Determination of necessary manufacturing conditions-Assessment of properties of finished products in relation to service requirements.

UNIT II **9**

Standard and specifications-National and International standards-BIS, ASTM, ISO & NABL.

UNIT III **9**

Identification of common plastics materials by simple tests e.g., visual inspection, density, effects of heat, combustion and solvents, analysis with common solvents.

UNIT IV **9**

Preconditioning and test atmosphere - Testing of Mechanical properties.
Thermal properties.,Optical properties.

UNIT V **9**

Testing of Electrical properties, Permeability Properties and Rheological properties.

TOTAL: 45 PERIODS

REFERENCES

1. Allen; W.S and Baker; P.N, Hand Book of Plastics Technology, Volume 2, Identification Testing & Recycling of Plastics, CBS Publishers and distributors, New Delhi 2004).
2. Brown; Roger P (Ed.), Hand Book of Polymer Testing, Marcel Dekker, Inc, New York (1999).

3. Brown; Paul F (Ed), Hand Book of Plastics Test Methods, Longman Scientific and Technical, Harlow (1988).
4. Shah, Vishnu, Hand Book of Plastics Testing Technology, John Wiley and Sons, SPE Monograph (1984).
5. Blythe; A. R., Electrical Properties of Polymers, Cambridge University Press, Cambridge (1979).
6. Blythe; Tony and Bloor; David, Electrical Properties of Polymers, 2nd Edition, Cambridge University Press, Cambridge (2005).
7. Plastics Testing Technology Hand book By Shah, Vishu
8. Hand Books of Plastics Test Methods By Brown, R.P
9. Testing and Evaluation of Plastics By Mathur, A.A & Bhardwaj, I.S
10. Hand Book of Plastics Test Method By Jamead, G.C.I & Riley, M.M.
11. Hand Book of Plastics Technology 2 vol. By Allen, W.S & Baker P.N
12. Simple Methods for Identification of Plastics By Brawn, R.B
13. Analysis of Plastics By Crompton, J
14. Plastic Engineering Hand Book & D-5 By Society of Plastics Industry Inc
15. Identification & Analysis of PlasticsBy Haslam & Others

PL2354 PROCESS CONTROL & INSTRUMENTATION L T P C
3 0 0 3

UNIT I **9**

Elements of measurement, functions and general classifications of measuring instruments Indicating and recording type of instruments. Elements of measuring instruments, static and dynamic characteristics of measuring instruments.

UNIT II **9**

Principle of operation, construction and application of important industrial instruments for the measurement of temperature, flow, liquid level and composition

UNIT III **9**

Dynamic behavior of first order, second order and two or more first order systems in series.

UNIT IV **9**

Block and physical diagrams of control system. Open and closed loop control systems. Characteristics of measuring elements, controllers and final control elements Mods of control actions.

UNIT V **9**

Response of closed loop control systems for various kind of control actions and measurement lag.

TOTAL: 45 PERIODS

REFERENCES

1. Stephenopolos, S., “Chemical process control”, Prentice Hall of India, New Delhi, 1984.
2. Luyben, W.L., “Process modelling, simulation, and control for Chemical Engineers”, McGrawHill, 1989.
3. Considine, D.M., “Process / Industrial Instruments and Controls Handbook”, McGraw Hill, 1993.
4. Oggunaika B.A. and Ray W.H., “Process Dynamics, Modeling and control”. Oxford University Press, U.K. 1994.
5. Alciatore D.G. and Histand M.B., “Introduction to Mechatronics”, Tata McGraw Hill.
6. Bolton W. “Mechatronics”, Pearson Education Singapore.

PL2355 ADDITIVES & COMPOUNDING L T P C
3 0 0 3

UNIT I **9**
Fillers-Antioxidants-Thermal Stabilisers, Lubricants-Plasticisers, Toughening-agents-Colourants-Fire retardants-Coupling agents-blowing-agents-Ultraviolet stabilizer.

UNIT II **9**
Antistatic agents-Anti blocking agents-Slip and antislip agents-processing aids-mould releasing agents.

UNIT III **9**
Compounding - Selection of polymers and compounding-ingredients-general objectives-possibilities and limitation of additives into polymer matrices. Mixing and mixing equipments.

UNIT IV **9**
Machine construction - specifications - temperature control system - operating characteristics - house keeping and maintenance of compounding machines.

UNIT V **9**
Case studies on preference of one plastics to other and co-relation of properties of conventional materials and blends and alloys - case studies on application of blends and alloys.

TOTAL: 45 PERIODS

REFERENCES

1. Al – Malaika; S. Golovoy; A and Wilkie (Eds), Chemistry and Technology of Polymer Additives, Black well Science Ltd, Oxford (1999).
2. Matthews; F.L. and Rawlings; R.D, Composite Materials, Engineering and Science Chairman and Hall, London (1994).
3. Plastics Testing Technology Hand Books by Vishu Shah.
4. Hand Book of Plastics Test Methods by Brown R.P.
5. Mascia; L.,The Role of Additives in Plastics, Edward Arnold Publishers Ltd., U. K. (1974).
6. Murphy; John, Additives for Plastics Handbook, 2nd Edition, Elsevier Advanced Technology, Oxford.

PL2356 PLASTICS PROCESSING TECHNOLOGY – II L T P C
3 0 0 3

UNIT I **9**

Thermoforming

Basic principles & types of thermoforming processes, Thermoforming moulds-processing parameters—faults, causes and remedies.

Calendering

Principle and process description, types of calender units 2, 3 and 4 rolled calenders, Design of calender roll, Heating and temp control, roll crown, roll crossing and roll bending, materials for calendering, calendering sheets and films, embossing, coating and lamination by calender, comparison between calendering and extrusion.

UNIT II **9**

Rotational moulding - Introduction-principle-process-machinery used-materials-moulds process parameters-merits & demerits of roto moulding.

FRP & Laminates - Introduction, FRP Processing methods-contact moulding-hand lay up, Spray up method-vacuum bag & pressure bag moulding, filament welding Centrifugal casting, pultrusion, pulforming matched die moulding – Laminates, definition of terms-high, medium and low pressure laminating process, types of machinery, impregnation systems – decorative and industrial laminates, continuous high pressure laminating process, application.

UNIT III **9**

Cellular plastics - Introduction-process to create foam in resins-mechanical foaming, chemical foaming, physical foaming-processes to shape and solidify foams – low Pressure foam moulding, high pressure foam moulding, RIM Casting foams, steam chest moulding structural foam moulding–applications – Foamed extrusion.

Casting Processes - Introduction – casting processes viz:Mould casting, Empedding/potting, Encapsulation –Dipcasting-slush casting Roto casting, cell casting, static powder casting, continuous casting, solvent casting, operation and control of above csting processes plastisol processing.

Coating Process - Introduction-Roller coating methods, powder coating-fluidaised bed coating, Electro static spray coating-Equipment, process and applications.

UNIT IV **9**

Machining & Joining of Plastics_(10 hours) - Introduction-Importance of machining – methods viz; cutting, drilling, blending, filling etc., joining-principles-cohesion principle, adhesion principle – solvent cementing. Dop cementing, welding of plastics-viz high frequency welding thermal sealing, spin welding, vibration welding, hot plate welding, ultrasonic welding, Adhesive ponding-examples: Mechanical fasteners.

UNIT V **9**

Other Secondary Processes

Printing, painting, Hot slamping, In mould decoration, Electro plating and vacuum metallising.

TOTAL: 45 PERIODS

REFERENCES

1. A Guide to Injection Molding of Plastics - By Bolur, P.C.
2. Development in Injection Molding - By Whelan, A & Craft, J.L.
3. Technician's Hand Book & Plastics - By Grandilli, P.A.
4. Plastics Materials & Processing - By Schwartz & Goodman.
5. Injection Molding - By Athalye, A.S.
6. Injection Molding Technology - By V.D.I.
7. Innovation in Polymer Processing - By Stevenson.
8. Extrusion The definitive Processing Guide and Hand Book - By Giles, H.H & Others.
9. Compression Molding - By Iyesew, A.I.
10. Polymer Extrusion - By Rauwedaal, Chris.
11. Thermoforming - By James & Throne.
12. Basic Principle of rotational molding - By Crawford, R.J & Throne, J.L.
13. Basic Principle of Rotational Molding - By Bruins.
14. Basic Principle of Thermoforming - By Brycle, D.M
15. Plastics Injection Molding - By Brycle, D.M.
16. Injection molding of Plastics component - By Bown John.
17. Plastics Mold Design Vol.1 Compression & Transfer Moulds - By Bebb.
18. Plastics forming - By Beadle.
19. Plastics Forming - By Figher.
20. Calendering of Plastics - By Elden & Swan.
21. Welding of Plastics - By New Man.
22. Plastics Technology Mchraw -By Milby.
23. Injection Molding Theory & Practice - By Rubin, Irvin.
24. Injection Molding Hand Book - By Rusto, D.V & Rosato, D.V.
25. Plastic Engineering Hand Book & D – 5 - By Society of Plastic Industry Inc.
26. Plastics Material & Processing- By Strong, A, Brent.
27. Blow Molding Hand Book - By Rosato, D.V & Rosato, D.V.

28. Plastic Extrusion Technology - By Hensen.
29. Hand Book of Plastics Technology 2 Vol. - By Allen, W.S & Baker, P.H.
30. Extrusion of Plastics - By Fisher.
31. Plastics Extrusion Technology - By Grief.
32. Plastic Engineering Hand Book - By S P I..
33. Plastics Extrusion Technology - By Henson.
34. Lecture Notes for Risk Assessment.

PL2358 PLASTICS PROCESSING LAB – I L T P C
0 0 4 2

Sl. No	Name of M/c/ Equipment/ Mould	Description of Practical Exercise to be done*
1.	Hand operated Injection Moulding Machine	(i) Study of Machine in **Idle-Run Observation (IRO)**, Parts & functions, operating principle, Free sketch of Machine-parts eg. Nozzle, Torpedo, Hopper, Rack & Pinion Barrel etc., shot capacity definition (ii) Operation practice to produce moulding on different hand injection moulds. Recording the observation and results in practical record books.
2.	Injection Moulding Semi Automatic	(i) Study of Semi Automatic Injection Moulding M/cs of all types in IRO. Comparative study of Pneumatic type & Hydraulic type of M/cs, Operating Principle of M/cs. Line-diagrams of M/cs with nomenclature of parts, M/cs specifications. (ii) Operation of Pneumatic & Hydraulic type of Semi automatic Injection moulding M/cs, to produce components in different moulds. Cycle-time analysis, observations of Process- Parameters & Procedure to be recorded
3.	Extrusion Processes on Extruders	(i) Study of Extruders in IRO, Free sketch of machines, their parts and parts-function, List of products manufactured by Extrusion-Process. Study of different types of extrusion process. (ii) Operation-Practice by Trainee on setting up of Process-parameter to produce Blown-Film on Film-plant, observations on extruder output, size of film produced and technical specifications of machines to be recorded.
4.	Compression moulding – Hand Operated	(i) Study of Hand compression M/c in IRO Free sketch of parts & study of part-function, comparison of compression moulding M/c with Injection Moulding M/c. Compression moulding processes. (ii) Operating Principle of Hand Compression Press, mould setting-procedure & parameter setting, operation practice on different compression moulds, M/c specification observations and recording
5.	Blow Moulding Hand Operated	(i) Study of Hand Blow Moulding M/cs, Free-sketch of M/c with parts & study of part-function, Specification of M/c, Study of Parison-die with sketch. (ii) Die-centering practice by Trainees, operation of Hand Blow Machines, to produce components observations, cycle-time analysis Procedure of operation and observations.

6.	Scrap Grinding	(i) M/c Study in IRO, specification of M/c, study of parts & function, Line Diagram of M/c. (ii) Operation-practice with different materials and output study in Kg/hour for different materials.
7.	Injection Moulding M/c.- Automatic	Study of M/c Parts & function, Study of clamping systems in M/cs, Technical specification of Machine, study of process sequence in Machine, Study & definitions of terms related to M/c operation e.g. M/c Day light, Locating -Ring Dimensions, ejector-stroke, Tie-Bar distance, M/c Platen sizes & mould clamping arrangements. Definitions of all Processing Parameters & study of controls in M/cs.
8.	Compression & Transfer Moulding-Semi Automatic	Technical specification of M/c, Mould clamping on M/c, Parameter setting, operation-practice on different compression & Transfer Moulds, Cycle-time analysis, observation & Procedure of start-up & shut down of M/c.
9.	Blow-Moulding Semi Automatic	Technical specification of M/c, Mould clamping on M/c, operation Practice with different moulds, Familiarisation with control-switches/ valves on the M/c, cycle-time analysis & procedure of operation of M/c.
10.	Introduction to Maintenance	Basic knowledge of Hydraulic & Pneumatic systems, Electrical system, Definition of terms- Hydraulic fluid, viscosity Directional Valves, Resistance, Current, Voltage, Power, Hydraulic Pumps - Types & function, electrical heaters, thermocouples and teperature control parameters and timers, electrical Motors - Types & function.
11.	** Introduction to Moulds, Tool Room Machines & Drawing Practice	Studty of Different Types of Moulds & its Parts and function, free hand drawing practice, exposure to tool room machines.

TOTAL: 60 PERIODS

PL2359 **PLASTICS TESTING LAB – I** **L T P C**
0 0 4 2

Sl. No.	**Experiment/Exercise**
1)	Determination of Melt flow index of plastics materials
2)	Study of Mechanical properties of plastics & test methods
3)	Study of Weathering properties.
4)	Determination of Burst strength & tear strength of films
5)	Determination of Hardness(rockwell, shore A&D, Barcol
6)	Specimen preparation by Injection moulding, contour cutting, compression moulding, contour punching, etc.
7)	Testing of Electrical and Optical properties of Plastics materials
8)	Introduction to product testing

TOTAL: 60 PERIODS

PL2401 POLYMER COMPOSITE TECHNOLOGY L T P C
3 0 0 3

UNIT I **9**

Introduction of composite material, comparison of different materials with composites-advantages and disadvantages. Principles of composite reinforcement. Effect of fibrous reinforcement on composite strength.

UNIT II **9**

Types of reinforcement such as natural, glass, carbon/graphite, aramid fibers, high strength and high modulus fibers. Surface treatment and various forms of fibers.

UNIT III **9**

Thermosetting and thermoplastic materials for the composites and their selection for a particular application

UNIT IV **9**

Processing and production techniques like hand-lay-up, spray-up, bag moldings, filament winding and pultrusion.

UNIT V **9**

Prepares their manufacture and characterization. Sheet moulding and dough moulding compounds and their processing, perform and resin transfer moldings. Hybrid and sand witch type composites.

TOTAL: 45 PERIODS

REFERENCES

1. Astrom; B.T, Manufacture of Polymer Composites, Chapman and Hall, London (1997).
2. Bunsell; A. R. and J. Renard, Fundamentals of Fibre Reinforced Composite Materials, Institute of Physics Publishing Ltd., Bristol (2005).
3. Hollaway; Leonard (Ed.), Handbook of Polymer Composites for Engineerrs, Woodhead Publishing Ltd., Cambridge (1994), Reprint (2007).
4. Macosko; Christopher W., RIM: Fundamentals of Reaction Injection Moulding, Society of Plastics Engineer, Hanser Publisher, Munich (1989).
5. Miller; Edward, Introduction to Plastics and Composites, Marcel Dekker, Inc., New York (1996).

PL2402 PLASTICS TESTING TECHNIQUES – II L T P C
3 0 0 3

UNIT I **9**

Consideration of the importance of testing-Identification of plastics-Determination of necessary manufacturing conditions-Assessment of properties of finished products in relation to service requirements-Standard and specification-National and International standards-Test specimen preparation-Preconditioning and test atmosphere.

UNIT II **9**

Mechanical Properties: Density and dimensions-Hardness-tensile strength-compressive strength-shear strength-flexural strength-heat strength-impact strength-dynamic stress-strain properties-creep-relaxation and set tests-friction and wear-abrasion test-fatigue-burst strength-and folding endurance

UNIT III **9**

Thermal Properties: Specific heat and thermal conductivity thermal dependant properties-thermal endurance-glass transition temperature-thermal yield tests-Heat deflection

temperature-Vicat softening temperature-Marten's heat resistance test-low temperature brittle point and flexibility test-coefficient of thermal expansion-shrinkage-Thermal stability-Thermal ageing and flammability.
Permanance Properties: Water absorption-soluble and insoluble matter-chemical resistance environmental stress cracking resistance-ageing-gas permeability-water vapour permeability and weathering.

UNIT IV **9**

Optical Properties -Refractive index-light transmission-haze-clarity-gloss-colour guard and microscope.
Electrical Properties (4 hours)-Insulation resistance-power factor-permitivity – dielectric strength-tracking resistance-arc resistance and antistatic test.
Application of national and international standards (BIS-ASTM-ISO) for testing and their significance, Knowledge and exposure on Sectorial Testing Standards.

UNIT V **9**

Product testing-Pipe and fittings-film and sheets-container testing and FRP based products.
Factors for designing tests for newer products
Factors affecting the quality of materials and products
Analysis of failure and its measurements
Techniques of characterisation-Principles and application of DSC- TGA AND FTIR
Concepts of non-destructive testing

TOTAL: 45 PERIODS

REFERENCES

1. Simple Methods for Identification of Plastics By Brawn, R.B.
2. Analysis of Plastics By Crompton, J.
3. Plastic Engineering Hand Book & D-5 By Society of Plastics Industry Inc Identification & Analysis of PlasticsBy Haslam & Others..
4. Allen; W.S and Baker; P.N, Hand Book of Plastics Technology, Volume 2, Identification Testing & Recycling of Plastics, CBS Publishers and distributors, New Delhi 2004).
5. Brown; Roger P (Ed.), Hand Book of Polymer Testing, Marcel Dekker, Inc, New York (1999).
6. Brown; Paul F (Ed), Hand Book of Plastics Test Methods, Longman Scientific and Technical, Harlow (1988).
7. Shah, Vishnu, Hand Book of Plastics Testing Technology, John Wiley and Sons, SPE Monograph (1984).
8. Mitcheli Jr.; John, Applied Polymer Analysis and Characterization-Recent Development in Techniques, Instrumentation, Problem Solving, Hanser Publishers, Munich.
9. Plastics Testing Technology Hand book By Shah, Vishu.
10. Hand Books of Plastics Test Methods By Brown, R.P.
11. Testing and Evaluation of Plastics By Mathur, A.A & Bhardwaj, I.S.
12. Hand Book of Plastics Test Method By Jamead, G.C.I & Riley, M.M.
13. Hand Book of Plastics Technology 2 vol. By Allen, W.S & Baker P.N.

PL2403 INDUSTRIAL MANAGEMENT & COSTING **L T P C**
3 0 0 3

UNIT I PRINCIPLES OF MANAGEMENT ORGANISATION **9**

Planning, organization, staffing, coordination, directing, controlling, communicating, organization as a process and a structure: types of organizations.

UNIT II PRODUCTION MANAGEMENT **9**

Method study; work measurement techniques; basic procedure; motion study; motion economy; principles of time study; elements of production control; forecasting; planning; routing; scheduling dispatching; cost and costs control, inventory and inventory control.

UNIT III ENTREPRENEURSHIP 9

Entrepreneur – qualities of entrepreneur – entrepreneurship – need of EDP- achievement – motivation training - project report preparation – evaluation – planning for starting an unit – requirements, conducting market survey

UNIT IV TOTAL QUALITY MANAGEMENT 9

- TQM concepts – overview
- Quality tools & techniques used in TQM
- TQM Principles

Six sigma 9

- Concepts & Terminology of Six Sigma
- Tool Kit to Deploy
- Six Sigma improvement process using DMAIC
- Tools for Six Sigma

UNIT V COSTING 9

Basic principles of costing-direct cost-indirect cost-labour costing-stores organisation-factory overhead costs-Costing methods.

Standard and marginal costing-break-even-point control functions-cost reduction-value analysis-cost audit-costing as related to mould and mouldings-capital expenditure-reports and statistics.

Proforma for cost estimation – product cost-mould cost-Processing cost-project costing-direct cost-indirect cost-break even point.

TOTAL: 45 PERIODS

REFERENCES

1. Management By Koontz, Herold & Others.
2. Essentials of Management By Koontz, Herold & Weihrich.
3. Industrial Engineering and Management By Ravi Shankar.
4. Cost accounting: principles and Practice By Nigam, Lall & Jain, J.C.
5. Cost Accounting By Bhar, B.K.
6. Personnel Management and Industrial Relations By Davor, R.S.
7. Mechanical Estimating & Costing By Banga & Sharma.
8. Cost and Management Accountancy for Students By Batty J.
9. Production Planning, Control and Industrial Management By Jain & Agarwal.
10. Principles of Business Organization and Management By Reddy, P.N. & Gulshan, S.S.
11. Organizational Behaviour By Khanna.
12. Industrial Engineering &Management By Khanna, O.P.
13. Joel E. Rose, Total Quality Management, 2nd edn. Kogan page Ltd., USA, 1993.
14. John Bank, TQM, Prentice Hall of India Pvt. Ly\td., New Delhi, 1993.
15. Zeri, 'Total Quality Management for Engineers', Wood Head Publishers, 1991.
16. J ames R Evans& William M Lindsay, "The Management & Control of Quality" (5th edition) South-Western (Thomas learning), 2002 (ISBN 0324-06680-5).
17. Feigen baum A V "Total Quality Management" McGraw Hill, 1991.
18. Oakland J S, "Total Quality Management", Butterworth-Heinemann Ltd., Oxford, 1999.

PL2404 PLASTICS PRODUCT DESIGN L T P C
3 0 0 3

UNIT I **9**

Product Design -Concepts - size, shape and function - form and function - Aesthetics, Ergonomics - shrinkage, Flash lines. Undercuts - External & Internal - Wall thickness - variances in wall thickness - suggested wall thickness for thermoplastics and thermosetting materials - Emphasize on designing with engineering plastics. Taper or draft. Fits & Tolerances. Designing with plastics for load bearing applications like gears, bearing, sandwich laminates. Design of radii, fillets, ribs and bosses. Design for flow and shape.
Moulded Holes - through holes - blind holes - threaded holes - side holes - holes parallel to draw - nearness of holes to each other and side wall - moulding holes not parallel to draw - drilled and tapped holes.
Design of integral hinges, hinges and snap fits for boxes and assembly of moulded parts.

UNIT II **9**

Moulded threads—thread pieces—threaded holes
Inserts-Materials-Selection of metal for inserts-minimum wall thickness of material around inserts-anchorage-relieving moulding stresses around inserts-location of inserts in the part-moulded in inserts-pressed in inserts

UNIT III **9**

Quality and economy-tooling aspects on product design-process variables vs product design-product design appraisal.
Product design limitations-shrinkage vs tolerance-minimum wall thickness-mechanical properties-creep properties-end use requirements with case studies.
Prototype development – rapid prototyping techniques – stereolithography.

UNIT IV **9**

Composite product design - Concepts of composite product design-Design requirements-functional-safety-reliability –cost effectiveness
Design constraints-use of factor of safety for uncertainities in design-design failure criteria-optimisation in design.

UNIT V **9**

Design date-physical, mechanical and functional properties of composites-code of practice of loading on structures-structure properties relation of composites-failure criteria and design.
Design of simple structural elements-tension bars-columns-beams-pipes-plates and shells.
Design of joints-bolted joints-bonded joints etc.

TOTAL: 45 PERIODS

REFERENCES

1. Robert A. Malloy, “Plastic Part Design for Injection Moulding”, Hanser Publishers, Munich Vienna, New York, 1994..
2. Paul A. Tres, “Designing Plastic Parts for Assembly”, 2nd Revised Edition, Hanser Publishers, Munich Vienna New York, 1994.
3. N G Mc Crum, Principles of Polymer Engineering, Oxford Science Publications, New York, 1997.
4. Belofsky, H., “Plastics Product Design and Processing Engineering, Hanser Publishers, Munich Vienna New York, 1994.
5. Plastics Product Design Engineering Hand Book- By Dubois, H.
6. Plastics Product Design & Process Engineering -By Belofsky, Harold.

PL2408 PLASTICS PROCESSING LAB – II L T P C
0 0 4 2

Sl. No.	Name of M/c/ Equipment/ Mould	Description of Practical Exercise to be done*
1.	Automatic Injection Moulding M/C	Idle-run observation (IRO) & study of Injection Unit, Clamping Unit, Process- Control knobs, safety precautions, start-up Procedure, Shut-down Procedure, Sketch of Machine Platens, Clamping system, type of nozzle used in M/c etc., study of Hydraulic System used in the M/c. M/c Operation-Practice, Process parameter setting for a particular mould on the Machine, Operation of Machine in Hand, Semi Automatic & Automatic-mode to produce components, observations of all parameters, cycle-time analysis, use of different plastics material for moulding & comparison, Moulding faults analysis for causes and remedies.
2.	MICRO-PROCESSOR Controlled Injection Moulding M/C	Study of Basic concepts of Micro processor control, Comparison of Micro Processor- Controlled M/cs with Conventional M/Cs, Machine Setting Procedure, Procedure for Process-Parameter-setting on monitor or control Panel. Operation of M/c with Mould fixing & setting on the M/c with different plastics materials, cycle-time analysis, Analysis of Product defects, causes & remedies during M/c operation, listing of important operating procedure points, safety precautions through M/C Instruction/Manual operating.
3.	EXTRUSION-PROCESS on Blown Film Extruder Pipe/Tube Extruder	Procedure for setting up of Process-parameters eg. Temperature on different zones, Screw-Speed, Nip-roller speed, Winder Speed, Blow-ratio, control of cooling-Air on bubble, Methodology & practice by trainees to fix the Blown Film die on M/C familiarization of Die-parts & their function, Technical specification of M/cs, defects, causes & remedies, Practice of operating M/c to produce different sizes of Blown Film. Study of the Machine-parts & function from Screw drive to the Cater pillar. Practice of Die setting on the machine, SIZING TECHNIQUES, Procedure for setting up of parameters & operation practice in running the Machine to produce pipe/ Tube/ film.
4.	Compression & Transfer Moulding(Semi-Automatic)	Setting up procedure for operation of M/c, safety precautions, Type of Mould Clamping arrangement available on M/c-Platen, Mould Clamping procedure on M/c, Operation of M/c by setting the optimum Temperature, curing time, clamping force, ejector-stroke etc. on continuous basis, Analysis of Product defects & remedies, Analysis of Cycle-time, Practice on operation of compression & Transfer moulds with thermoset materials.
5.	Automatic Blow Moulding Machine	Machine-setting Procedure, Parameter-setting Procedure, Method of Mould fixing & parison-die setting on the M/c, Practice by trainees to remove& fix the parison die to produce on appropriate Parison for blowing, type of blowing systems, operation-practice on different moulds, cycle-time analysis, process-faults & remedies.
6.	Thermoforming (Vacuum forming)	Study of Process Principle, type of moulds & material used, Familiarisation with the M/c controls for operation, Operation Practice by trainee, observation on Cycle-time, processing-defects & remedies.
7.	Rotational Moulding	Machine-study in IRO, Process Principle & sequence of operation, Raw materials used, Mould-clamping practice on the M/c, operation practice to produce Roto moulded components, Cycle-time analysis, Comparison of process with other processing processes.
8.	Plastics-coating. Sealing, Welding & Screen-Printing	Principle of coating equipments, Process-method, type of material used, sequence of Operation in Coating. Principle of Operation of Heat-Sealing equipments, High frequency Welding & Hot stamping operation. Familiarisation of screen printing process, methodology for screen preparation, type of inks used.

9.	Moulds Study	Study of different types of moulds injection moulds, Mould maintenance & storage
10.	FRP Demonstration Facility	Study of types of Resin, fibres used in the process, sequence of Process operation in Hand-lay up process, operation Practice for Hand-lay up Process for producing FRP-products, Precautions during the process, Process-defects & analysis for the remedies.
11.	Maintenance Work on Processing M/cs.\	Practical exposure to the preventive maintenance check-points for all processing M/cs. Daily startup and shut down maintenance checks, housekeeping checking hydraulics and electrical circuit for safety, routine flaut and remedies.

TOTAL: 60 PERIODS

PL2409 PLASTICS TESTING LAB – II L T P C
0 0 4 2

Sl. No.	Experiment/Exercise
1)	Compounding, Blending using Two Roll Mill and Specimen preparation
2)	Determinations of Carbon Black Content and Dispersion of Olefinic Plastics
3)	Determination of environmental stress cracking resistance for Polyethylene
4)	Testing of HDPE/RPVC Pipes
5)	Testing of Water Storage Tanks/Containers
6)	Testing of Films/Sheets
7)	Testing of HDPE/PP Woven Sacks/Tapes
8)	Testing of Bottles/Vanaspati, Ghee, Milk Packing
9)	Testing of Plastics Products for Determination of Mechanical,

TOTAL: 60 PERIODS

PL2021 ADVANCED PLASTIC PROCESSING TECHNIQUES L T P C
3 0 0 3

UNIT I INJECTION MOULDING 9

Thin wall product moulding, multi material and multi colour moulding, sandwich moulding, thermoset injection moulding. Micro Processor Controlled Injection moulding operation. Statistical quality control and process control. All electric injection moulding - Merits & Demerits

UNIT II SPECIALISED PROCESSES 9

Gas Assist Moulding, Water Assist molding, Reaction Injection molding, Liquid Injection Molding, Lost Core molding, Thermoset Injection molding,

UNIT III STRUCTURAL FOAM MOLDING 9

Structural foam molding: a) Low pressure Foam b) High pressure Foam, In – mold Decoration/ Reaction Transfer Molding, Filament Winding, Metal/Ceramic Powder Molding,

UNIT IV ADVANCED BLOW MOULDING 9

Classification of Advanced Blow Moulding Process, Deep draw Double Wall Blow Moulding, Press Blow Moulding, Stretch Blow Moulding – Injection Stretch Blow Moulding, Extrusion Stretch Blow Molding Merits & Demerits

UNIT V ADVANCED EXTRUSION 9

Profile Extrusion Process, Multi layer film, Co- extruder Sheets & Pipes, – Process, Process Control, Process Optimization, Application, Merits & Demerits

TOTAL: 45 PERIODS

REFERENCE

1. Cheremisinoff; Nicholas P. and Cheremisinoff; Paul N. (Eds.), Handbook of Applied Polymer Processing Technology, Marcel Dekker Inc., New York (1996)

PL2022 PLASTIC WASTE MANAGEMENT & RECYCLING TECHNIQUES L T P C
3 0 0 3

UNIT I 9

Plastic & environment value additions, global policy, regulations, waste energy management. Recycling & recovery of various plastic items/materials their effect on environment.

UNIT II 9

Waste treatment of various plastic plants, estimations of power requirement & efficiency of size reduction operation of plastics, environment pollution.

Need for recycling – Sorting and segregation of waste – Plastics identification- Plastics production and composition – Plastics waste – Composition, quantities and disposal alternatives.

UNIT III 9

Primary recycling – Equipments for primary recycling. Specific recycling techniques – PE films, PP battery case – Crushing and separation – PET films.

UNIT IV 9

Recycling of plastics from urban waste – rheology, density, mechanical behavior. Secondary recycling Plastics wastes containing paper – hydrolytic treatment – processing methods – processing of mixed plastics waste – household waste – industrial sector – TPO based materials.

UNIT V **9**

Use of recyclable plastics in motor vehicles – recoverable materials – disposal of residuals – recyclable plastic components – virgin and recycled HDPE – Fluorinated and unfluorinated HDPE – fuel tanks. Tertiary recycling – Reactors used – Advantages – Dry method wet method - use of recyclable plastics in automobiles.

TOTAL: 45 PERIODS

REFERENCES

1. Plastic Waste Management" Marcel Dekker, New York, 1995.
2. Edited by Nabil Mustafa, Plastic waste management, 1st edition, Marcel Decker, New York,1993.
3. John Schiles, Polymer Recycling.
4. Edied by Dr.J.S.Anand, Recyclic & Plastics Waste Management, CIPET, Journal of India, 1997.

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

3 0 0 3

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, PVDE, vinyl acetate, PVA, EVA , PV Alcohol, PA,PC ionomers & fluro polymers.

UNIT II **9**

Conversion process – Compression & transfer for moulding, Injection moulding, Blow moulds, Extrusion, roto Moduling, 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, Blow film, Multi layer film & sheet coatings, laminations & co-extrusions , 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, molded 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 plastic packages, Barrier, Migration & compatibility, Printing, labeling & pigmenting, Sterlisation systems and health care products.

Packaging hazards and their controls. Environmental considerations.

TOTAL: 45 PERIODS

REFERENCES

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.
3. Briston; John H. and Katan; Leonard L., Plastics in Contact with Food, Food Trade Press Ltd., London (1974).
4. Briston; John, Advances in Plastics Packaging, Pira International, Leatherhead (1992).

PL2024 FIBRE TECHNOLOGY L T P C
3 0 0 3

UNIT I **9**

Introduction to natural and synthetic polymers. Essential characteristics and molecular architecture of fibre forming polymers.

UNIT II **9**

Concept of order in polymers, crystallinity, orientation, physical structure of natural and man-made fibers.

UNIT III **9**

Physical methods for investigating fiber structure. Optical properties of oriented polymers and fibres, refractive index and birefringence.

UNIT IV **9**

Melt spinning, dry and wet spinning of fibers. Fiber drawing, heat setting, texturing and mechanical properties of fibers based on viscose, cellulose acetate, polyamides.

UNIT V **9**

Fiber drawing, heat setting, texturing and mechanical properties of fibers based on polyesters, acrylics, polypropylene, glass and carbon-fibres. General principles of finishing and dying of fibers. Common types of finishes applied to textile fibers.

TOTAL: 45 PERIODS

REFERENCES

1. Billmeyer Jr.; Fred W., Synthetic Polymers, Doubleday and Co. Inc., New York (1972).
2. Gupta, V.B., and Kothari, V.K., Manufactured Fibre Technology, Chapman & Hall, 1997.
3. Fourne, Franz, “Synthetic Fibres, Machines and Equipment, Manufacture, Properties”, Hanser Publishes, 1999.
4. Corbman, Bernard P, “Textiles fibre to fabric”, Sixth Edition, McGraw Hill, 1983.

PL2026 BIODEGRADABLE POLYMERS L T P C
3 0 0 3

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 BIO POLYESTERS 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

REFERENCES

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
3. Abraham J.Donb & others(ed.) Handbook of Biodegradable polymers Harvard academic publishers Australia 1997.

PL2027 SPECIALTY POLYMERS L T P C

3 0 0 3

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 piezpelectric 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

REFERENCES

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

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

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

REFERENCES

1. Hoffmann, Rubber Technology Hand Book, Hanser Publishers Munich– 1989.
2. Anil. K., Bhowmick, Howard L. Stephens (ed.) Hand Book of Elastomers, New
3. Development & Technology, Marcel Decker Inc. New York, 1988
4. Penn; W. S. (Ed.), Injection Moulding of Elastomers, MacLaren and Sons Ltd., London (1969).
5. Houwink; R. (Ed.), Elastomers and Plastomers: Their Chemistry, Physics and Technology, Volume-1 General Theory, Elsevier Publishing Co., Inc., New York (1950).

PL2029 POLYURETHANE TECHNOLOGY L T P C

3 0 0 3

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 slabstock foam, carpet backing, flexible molded foams & semirigid 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 application.

UNIT V **9**

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

TOTAL: 45 PERIODS

REFERENCES

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.
3. Bruins; Paul F. (Ed.), Polyurethane Technology, Interscience Publishers, New York (1969).

PL2035 ANALYSIS AND CHARACTERISATION OF POLYMERS L T P C
3 0 0 3

UNIT I IDENTIFICATION AND ANALYSIS 9

IDENTIFICATION OF 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, K – value. Thermosets – moisture analysis, particle size, apparent density, spiral flow, cupflow test, gel time and peak exothermic temperature. Resins – acid value, hydroxyl value, isocyanate index, epoxy equivalent.

UNIT II MOLECULAR CHARACTERISATION 9

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

UNIT III THERMAL ANALYSIS 9

Differential thermal analysis (DTA), Differential scanning calorimetry (DSC),
Thermogravimetric analysis (TGA), Thermomechanical analysis (TMA), Dynamic mechanical thermal analysis (DMTA).

UNIT IV SPECTROSCOPY 9

Infrared spectroscopy (IR & FTIR), Nuclear magnetic resonance spectroscopy (NMR),
GC – Mass spectrometer (GC –MS)

UNIT V X-RAY AND MICROSCOPY 9

X –ray diffraction (wide angle and small angle), Optical microscopy, Scanning electron microscopy (SEM) and Transmission electron microscopy (TEM)

TOTAL : 45 PERIODS

TEXT BOOKS

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

REFERENCES

1. ASTM – Volume: 8.01, 8.02 & 8.03, 2000
2. Kampff, Characterization of plastics using physical methods, Experimental techniques and practical applications.
3. D. Campbell & J.R. White, Polymer Characterization, Chapman & Hall, 1989.

PL2041 PLASTICS PRODUCT DESIGN USING CAD/CAM/CAE L T P C
3 0 0 3

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

REFERENCES

1. Technology of Computer Aided Design and Manufacturing, S Kumar & A K Jha, Danpatrai & Co, 1998.
2. Tucker III, C L, Fundamentals of Computer Modeling for Polymer Processing, Hanser, 1989.
3. R.D.Beck Plastics Product Design, C-B & Liv C.N.K. Computer aided design & manufacture, East West Press.
4. Durvent W.R. The Lithographic Hand book, Narosa Pub., 1995. Paul F. Jacob. Rapid Prototyping and manufacture Fundamentals of Stereolithography, 1985

PL2042 **POLYMER NANOCOMPOSITES** **L T P C**
3 0 0 3

UNIT I **9**

General introduction to nanocomposites; Basics of Inorganic Materials Chemistry and Nanochemistry Inorganic-Organic and Inorganic-Polymer Nanocomposite Materials

UNIT II **9**

Nanocomposites: particulate, clay, and carbon nanotube nanocomposites Nanocomposite: synthesis, characterization, properties, and applications

UNIT III **9**

Clay/Polymer Nanocomposites: Physical and chemical properties of clayl nanoparticles; Synthesis; Potential Applications

UNIT IV **9**

Metal/Polymer Nanocomposites: Physical and chemical properties of metal nanoparticles; Synthesis; Potential Applications Carbon Nanotubes Polymer Nanocomposites: Structure, Properties, Synthesis Methods; Potential Applications

UNIT V **9**

Rheology and processing ; Applications and economics

TOTAL: 45 PERIODS

REFERENCES

1. Polymer nanocomposites: synthesis, characterization, and modeling / Ramanan Krishnamoorti, editor; Richard A. Vaia, editor. Washington, D.C.: American Chemical Society: Distributed by Oxford University Press (2002)
2. Polymer-clay nanocomposites / edited by T.J. Pinnavaia and G.W. Beall, Chichester; New York: John Wiley (2000).3. Polymer-layered silicate nanocomposites: preparation, properties, and uses of a new class of Materials, M. Alexandre, P. Dubois, Mater. Sci. Eng., 28, 1-63 (2000).
3. Polymer matrix nanocomposites, processing, manufacturing, and application: An overview, F. Hussain, M.Hojjati, M. Okamoto, R.E. Gorga, J. Comp. Mater., 40, 1511-1575 (2006)

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

UNIT I **9**

Introduction and Thermal Degradation: 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 **9**

Mechanical Degradation and Ultrasonic Degradation: 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 **9**

Photo degradation: 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 **9**

Degradation By High Energy Radiation and Biodegradation: 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 **9**

Chemical Degradation: 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

REFERENCES
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
3. Plastic Waste Management" Marcel Dekker, New York, 1995.
4. Reich; Leo and Stivala; Salvatores, Elements of Polymer Degradation, McGraw-Hill Book Co., New York (1971).
5. Scott; Gerald and Gilead; Dan (Eds.), Degradable Polymers: Principles and Applications, Chapman and Hall, London (1995).
6. Bastioli, Catia (Ed.), Handbook of Biodegradable Polymers, Rapra Technology Ltd., Shawbury (2006).

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

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

REFERENCES
1. Handbook of Adhesives – Skeist, Irvind, Van Nistrand, New York, 1990, 3rd Edition 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.
3. Swaraj Paul, Surface Coatings, John Wiley & Sons, NY, 1985.
4. George Mathews, Polymer Mixing Technology, Applied Science Publishers.
   Sheilds, Hand book of adhesives, Butterworths, 1984.

PL2045 NYLON TECHNOLOGY L T P C
3 0 0 3

UNIT I **9**

History -Development and commercial Nylons Polyamidation-Principle of Polyamidation-Process Technologies-hydrolytic polymerisation-Ionic Polymerisation, Solid phase polymerisation and other polymerisation techniques. Chemistry-Polymerisation and equilibria, Kinetic molecular mass, deformation of chemical attack.

UNIT II **9**

Physical structure: Structure properties relationship-crystallizing, melting temperature, to solubility, molecular weight, melt viscosity, degradation and stabilization, Electrical and mechanical properties. Characterisation: Identification, composition/moisture analysis, separation techniques, BGGmolecular mass and distribution, IR, NMR and X-ray diffraction.

UNIT III **9**

Fundamentals of Melt Processing: Measurements of viscosity, PVT relationships, importance of moisture, effect of molecular mass, shear, temperature, additives and channel shape. Applications of Rheological data to flow situation.

Processing techniques of melt processing: Processing reagents, material handling and drying, injection moulding, extrusion, blow moulding and monomer processing.

Other processing Techniques: Powder coating, blending and solution coatings.

Secondary Treatments: Assembly, Moisture conditioning, mechanical surface clearing, and decorating.

UNIT IV **9**

Modification: Physical change- co-polymerisation-transparent nylons, filled and reinforced nylons, toughened nylons, fire retardant nylons, plasticized and lubricated nylons, additives for heat stabilization, processing and color and other modifications.

Polymer Blends Alloys And Composites: Properties-factors affecting the properties of nylons, mechanical, thermal electrical and optical properties, moisture absorption, dimensional stability and density, environmental resistances and impact, flammability and failure analysis.

UNIT V **9**

Commercial Nylon Blends And Their Applications: PA6, PA66, PA46, PA6/2,PA11 &PA12 Raw materials- preparation –polymerisation- Methods of manufacturing, modifications, processing (methods, procedure processing parameters etc.,)

Properties (material, tribological durability, water absorption dimension stability (immersion resistance, thermal/ electrical/optical properties, flammability resistance to permeation Applications)

TOTAL: 45 PERIODS

REFERENCES

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. 19

PL2036 BIO MEDICALS PLASTICS L T P C
3 0 0 3

UNIT I **9**

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

UNIT II **9**

BIOMEDICL POLYMERS: 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 **9**

BIOMEDICAL APPLICATIONS OF POLYMERS: 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 **9**

POLYMERIC LENSES: Contact Lenses, Hard Lenses, Gas Permeable Lenses, Flexible Lenses, Soft Lenses, Hydrogels, Equilibrium Swelling, Absorption And Desorption, Oxygen Permeability, Types of Soft Lenses, Manufacture, Cleaning And Disinfection.

UNIT V **9**

DENTAL POLYMERS: 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

REFERENCES

1. Bio-materials, An Introduction – J B Park, Pleneum Press.
2. Plastics Materials – J S Brydson.
3. H.F. Mark (Ed), Encyclopedia of polymer science and engineering, John Wiley and Sons New York, 1989.
4. Comprehensive Polymer Science Vol.7 Alcock., Contemporary Polymer Chemistry.
5. Second Ed. Manas Chanda, Salil K. Roy (Ed) Plastic Technology Hand Book Marcel Dekker, Inc. New York, 1993.
6. B.Sedlacek, C.G.Overberger, J.F.Mark, (ed.) Medical polymers: Chemical problems.
7. Boretos; John W., Concise Guide to Biomedical Polymers, Charles C. Thomas Publishers, Springfield (1973).
8. Chiellini; Emo, Sunamoto; Junzo, Migliaesi; Claudio, Ottebrite; Raphael and Cohn; Daniel (Eds.), Biomedical Polymers and Polymer Therapeutics, Kluwer Academic/Plenum Publishers, New York (2001).
9. Galaev; Igor and Mattiasson; Bo (Eds.), Smart Polymers; Applications in Biotechnology and Biomedicine, CRC Press, Boca Raton (2008).
10. Gebelin; Charles G. and Carraher Jr.; Charles E. (Eds.), Polymeric Materials in Medication, Plenum Press, New York (1985).[CN90]

PL2051 STATISTICAL QUALITY CONTROL TECHNIQUES **L T P C**
3 0 0 3

UNIT I **9**

Introduction to quality – Basic concepts – definitions – quality of design vs conformance costs of quality; variation concepts; Investigational methods; quality assurance functions and their evaluations.

UNIT II **9**

SQC Techniques and their applications – Organising for data collection; summarization of data, presentation if data in the form of pie diagrams; Histograms and frequency distributions,- Measures of central tendency and dispersion; their calculation and interpretation-Concept of distributions; Normal, Binomial and Poisson Mean and Variance of distributions – Concept of Sampling distribution; 't', 'F', and x} distributions.

UNIT III **9**

Introduction to tests of simple hypothesis; Single Mean, Standard Deviation; Two sample tests for means and variable and attribute type of data- Their interpretation; Special purpose charts;

UNIT IV **9**

Dominant systems, Process and Product check – Inspection, quality control & testing schemes: Concepts of Acceptance Sampling – Attribute charactersistics, Single, Double Sampling Plans – OC curves, Explanation of IS – 2500 Standard tables – Correlation and regression analysis; Introduction of Statistical design of experiments for product quality improvement.

UNIT V **9**

Organization for quality control, quality audit, concept of quality circles, ISO 9000 – concepts, procedures and documentations.

TOTAL: 45 PERIODS

REFERENCES

1. Banks, Jerry : Principles of Quality Control, John Wiley & Sons.
2. Agarwal B.L. : Basic Statistics, New Age International (P) Ltd., New Delhi.
3. Grant E.L. & Leavenworth R.S. : Statistical Quality Control : McGraw Hill Book Company, New Delhi.

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)

PL2053 INDUSTRIAL SAFETY & HAZARD MANAGEMENT L T P C

3 0 0 3

UNIT I 9

Industrial safety, industrial hygiene and safety aspects related to toxicity, noise, pressure, temperature, vibrations, radiation etc. explosions including dust, vapor, cloud and mist explosion.

UNITII 9

Elements of safety, safety aspects related to site, plant layout, process development and design stages, identification of hazards and its estimation, risk, risk analysis and assessment methods, fault free method, event free method, scope of risk assessment, controlling toxic chemicals and flammable materials.

UNIT III 9

Toxic substances and degree of toxicity, its estimation, their entry routes into human system, their doses and responses, control techniques for toxic substances exposure, use of respirators, ventilation systems.

UNIT IV 9

Prevention of losses, pressure relief, provision for fire fighting, release of hazardous materials from tanks, pipes through holes and cracks, relief system: types and location of relief's.

UNITV 9

Handling, transportation and storage of flammable liquids, gases, and toxic materials and wastes, regulation and legislation, government role, risk management routines, emergency preparedness, disaster planning and management.

Training practices on Basic First Aids

TOTAL: 45 PERIODS

REFERENCES

1. Safety Management in Industry by N.V. Krishnan, Jaico Publishing House, 1993.
2. Industrial Safety Management by L.M Deshmukh, TMH, 2006.
3. System Safety Engineering & Management by Harold, E. Roland, Brian Moriarty.
4. TOSHA Compliance & Management Hand Book by Charleston C. Wang.

PL2054 ENTREPRENEURSHIP L T P C
3 0 0 3

UNIT I ENTREPRENEURIAL DEVELOPMENT PERSPECTIVE 9

Concepts of Entrepreneurship Development, Evolution of the concept of Entrepreneur, Entrepreneur Vs. Intrapreneur, Entrepreneur Vs. Entrepreneurship, Entrepreneur Vs. Manager, Attributes and Characteristics of a successful Entrepreneur, Role of Entrepreneur in Indian economy and developing economies with reference to Self-Employment Development, Entrepreneurial Culture

UNIT II CREATING ENTREPRENEURIAL VENTURE 9

Business Planning Process, Environmental Analysis - Search and Scanning, Identifying problems and opportunities, Defining Business Idea, Basic Government Procedures to be complied with

UNIT III PROJECT MANAGEMENT 9

Technical, Financial, Marketing, Personnel and Management Feasibility, Estimating and Financing funds requirement - Schemes offered by various commercial banks and financial institutions like IDBI, ICICI, SIDBI, SFCs, Venture Capital Funding

UNIT IV ENTREPRENEURSHIP DEVELOPMENT AND GOVERNMENT 9

Role of Central Government and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants - Export Oriented Units - Fiscal and Tax concessions available

Role of following agencies in the Entrepreneurship Development - District Industries Centers (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB

UNIT V 9

Why do Entrepreneurs fail - The FOUR Entrepreneurial Pitfalls (Peter Drucker) Case studies of Successful Entrepreneurial Ventures, Failed Entrepreneurial Ventures and Turnaround Ventures

TOTAL: 45 PERIODS

REFERENCES

1. Entrepreneurship: New Venture Creation - David H. Holt.
2. Entrepreneurship - Hisrich Peters.
3. The Culture of Entrepreneurship - Brigitte Berger.
4. Project Management - K. Nagarajan.
5. Dynamics of Entrepreneurship Development - Vasant Desai.
6. Entrepreneurship Development - Dr. P.C.Shejwalkar.
7. Thought Leaders - Shrinivas Pandit.
8. Entrepreneurship, 3rd Ed. - Steven Brandt.
9. Business Gurus Speak - S.N.Char.
10. The Entrepreneurial Connection - Gurmit Narula.

PL2055 HUMAN RESOURCE MANAGEMENT L T P C
3 0 0 3

UNIT I HUMAN RESOURCE DEVELOPMENT STRATEGIES, DESIGN AND EXPERIENCE 9

Human Resource Development: HRD-An Overview, Line Managers and HRD, Task Analysis, Motivational Aspects of HRD, Developmental Supervision, Counselling and Mentoring , HRD for Health and Family Welfare in Select HRD Culture and Climate, HRD for Workers, HRD/OD Approach to IR Corporate Business,

UNIT II BASICS OF HUMAN RESOURCE PLANNING 9

Macro Level Scenario of Human Resource Planning, Concepts and Process of Human Resource Planning, Methods and Techniques-Demand Forecasting, Methods and Techniques-Supply Forecasting, Job Evaluation: Concepts, Scope and Limitations, Selection and Recruitment, Induction and Placement, Performance and Potential Appraisal, Transfer, Promotion and Reward Policies, Training and Retraining.

UNIT III WAGE AND SALARY ADMINISTRATION 9

Wage Concepts and Definition of Wages Under Various Labour Legislation, Norms for Wage Determination, Law relating to Payment of Wages and Bonus, Pay Packet Composition, Design of Performance-linked Reward System,

UNIT IV LABOUR LEGISLATION 9

Philosophy of Labour Laws, Labour Laws, Industrial Relations and Human Resource Management, Indian Constitution and Labour Legislations

UNIT V PERSONNEL OFFICE MANAGEMENT 9

Functions of the office, correspondence, O & M in personnel departments, Maintenance of Personnel records.

Time Management

Importance of Time factor, Time waster, Prioritizing Work Scheduling, Functions of the Time Office, Flexible Work arrangements.

TOTAL: 45 PERIODS

REFERENCES

1. Beardwell and Len Holder, Human Resource Management Macmillan India Ltd.,
2. Graham H.T., & R.Bennet, Human Resource Management – Pitman, London, (1995).
3. Edwin Flippo, Principles of Personnel Management – McGraw Hill.
4. Performance Appraisal, Theory and Practice – AIMA VIKAS Management Series, New Delhi, 1986.
5. C.B. Manmoria, Personnel Management – Himalayan Publishing Co., New Delhi.
6. Decenzo / Robbins: Personnel / Human Resource Management, PHI, 2002.
7. Pattanayak: Human Resource Management, PHI, 2002.
8. Nair, N.G. & Latha Nair : Personnel Management and Industrial Relations – S. Chand & Company Ltd., Ram Nagar, New Delhi.
9. Milkovich, G.T & Boudreav, J.W: Personnel Human Resource Management: A diagnostic approach, Ed5,: All India Traveller Book Seller, Delhi – 110 051.

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UNIT I **9**

Marketing and Its Applications

Introduction to Marketing, Marketing in a Developing Economy, Marketing of Services, Factors of Marketing, Levels of Marketing – Strategic Marketing and Operation Marketing, The four Ps of Marketing Plan : (Marketing Mix) - Product – Pricing – Promotion – Placement (or distribution)

UNIT II **9**

Marketing Planning and Organisation

Planning Marketing Mix, Market Segmentation, Marketing Organisations, Marketing Research and its Applications

UNIT III **9**

Understanding Consumers

Determinants of Consumer Behavior, Models of Consumer Behavior, Indian Consumer Environment

UNIT IV **9**

Product Management

Product Decisions and Strategies, Product Life Cycle and New Product Development, Branding and Packaging Decisions

Pricing and Promotion Strategy

Pricing Policies and Practices, Marketing Communications, Advertising and Publicity, Personal Selling and Sales Promotion

UNIT V **9**

Distribution and Public Policy

Sales Forecasting, Distribution Strategy, Managing Sales Personnel, Marketing and Public Cyber Marketing

Reasons for indirect selling methods, Reasons for using wholesalers, Reasons for bypassing wholesalers, Ways of bypassing wholesalers

Agents: Commission agents – Selling agents – Brokers – Factory representatives

Marketing communications – Advertising – Functions and advantages of successful advertising – Requirements of a good advertisement – Eight steps in an advertising campaign such as Market research – Setting out aims – Budgeting – Choice of media (TV, Newspaper, radio) – Choice of actors (New trend) – Design and wording – Coordination and Test results Personnel Sales – Sales promotion – Publicity – Customer focus – Product focus

Packing and Labeling, Trademarks, Brands, Pricinciples.

TOTAL: 45 PERIODS

REFERENCES

1. Philip Kotlet, Principles of Marketing, Prentice Hall of India, 1984.
2. Kotler & Armstrong: Principles of Marketing, Ed.9, Pearson Education Inc.
3. Kotler, Philip: Marketing Management – Analysis, Planning, Implementation and control, Ed.7, Printice Hallof India Pvt. Ltd., New Delhi – 110 001.
4. Berkoviz Kerin Hontelty Rudelivs, Marketing, 6th ed., New York, Mcgraw Hill, yr 2002.
5. Gony Amrstrong, Philip Kotler, Marketing an Introduction 11th ed, Pearson Education Asia.
6. Rajan Saxena Marketing Management 2nd edition, New Delhi, Tata Mcgraw Hill Publishing Co. Ltd, yr 2001.
7. V.S Ramasamy and S. Namakumari, Marketing Management, Planning, Implementation & Control, New Delhi, Macmillan, yr 2002.
8. Sirnivasan: Case Studied in Marketing, 2nd edition, PHI, 2002.

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UNIT I GENERAL INTRODUCTION 9

Risk Management Process – Developments in Risk Management Process – Roles and Responsibilities in Risk Management – Perception of risks - Uncertainty, variability and precaution.

UNIT II EXPOSURE ASSESSMENT 9

Emissions of plastics to environment – Transport accumulation and transportation process – Bioaccumulation – Biodegradation – Biotransformation – Bioavailability.

UNIT III ENVIRONMENTAL EXPOSURE ASSESSMENT 9

Air models – Water models – Soil models – Human exposure through environment – Consumer exposure assesment – occupational exposure.

UNIT IV EFFECTS ASSESMENT AND RISK CHARACTERIZATION 9

Toxicity testing for human risk assesment – Ecotoxicological effects – Human health hazard assesment – Risk characterization for human health.

UNIT V DATA AND PREDITION 9

Data needs Availability source and evoluation - Predicting fate Related physicochemical properties – Predicting toxicological and exotoxicological end points.

TOTAL : 45 PERIODS

REFERENCES

1. Risk Assessment of chemicals – An Intoduction. C.J Van leeuwen, T.G. Vermeire, Springer 2nd Edition 2007.
2. Toxicological Risk Assesment of Chemicals. A Practical Guide by Elsa Nealsen Grete Ostergaard.