ANNA UNIVERSITY, CHENNAI

AFFILIATED INSTITUTIONS

R - 2013

B. TECH. PLASTIC TECHNOLOGY

PROGRAMME OBJECTIVES:

Polymeric materials are advanced materials used in almost all areas of life. Polymers are employed with great success in the fields of construction, packaging, agriculture, household appliances, electrical and electronics, automotive sector, precision instruments, biomedical and aerospace. The ever increasing demand for the polymer materials is largely responsible for the growth of plastics and allied industries. This created a huge opportunity for the plastics professionals in production, quality control, product and mold design, processing machinery manufacturing, marketing etc. The under graduate program B.Tech. in plastics technology is mainly aimed to cater the need of man power in plastics and allied industries.

The main objectives of this Program are;

- To provide the students with overall knowledge on the manufacturing of plastic materials, their properties, applications, processing, product design, mold design, testing & quality control, and recycling through theory as well as practical training.
- To make the students competent to take up the challenging positions in Plastics material manufacturing industries, compounding industries, processing machinery manufacturing industries through offering specialized elective subjects and industry exposure.
- Apart from technical oriented subjects the students are also offered management subjects like TQM, Industrial costing and management, statistical quality control, and general subjects like professional ethics, environmental science to impart leadership qualities in the students.
- To meet the man power requirements of plastics and allied industries in India and overseas.

PROGRAMME OUTCOMES:

- This program could provide well trained professionals for the plastics and allied industries to meet the well trained manpower requirements.
- The graduates will get hands on experience in various aspects of plastics technology viz. plastic materials manufacturing, properties, applications, processing, product design, mold design, testing & quality control, and recycling.
- The program will help the graduates to take up responsibilities in production, testing, design and marketing in the plastics industries and contribute for the growth of industry.
- The graduates with B.Tech plastics technology can become entrepreneurs as they can easily start up processing, compounding, design and marketing units.

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B. TECH. PLASTIC TECHNOLOGY

I – VIII SEMESTERS CURRICULUM AND SYLLABUS

SEMESTER I

CODE	COURSE TITLE	L	T	P	C
THEORY					
HS6151	Technical English - I	3	1	0	4
MA6151	Mathematics – I	3	1	0	4
PH6151	Engineering Physics – I	3	0	0	3
CY6151	Engineering Chemistry – I	3	0	0	3
GE6151	Computer Programming	3	0	0	3
GE6152	Engineering Graphics	2	0	3	4
PRACTICAL					
GE6161	Computer Practices Laboratory	0	0	3	2
GE6162	Engineering Practices Laboratory	0	0	3	2
GE6163	Physics and Chemistry Laboratory - I	0	0	2	1
	TOTAL	**17**	**2**	**11**	**26**

SEMESTER – II

CODE	COURSE TITLE	L	T	P	C
THEORY					
HS6251	Technical English-II	3	1	0	4
MA6251	Mathematics-II	3	1	0	4
PH6251	Engineering Physics-II	3	0	0	3
CY6251	Engineering Chemistry-II	3	0	0	3
GE6252	Basic Electrical and Electronics Engineering	4	0	0	4
GE6253	Engineering Mechanics	3	1	0	4
PRACTICAL					
GE6261	Computer Aided Drafting and Modeling Laboratory	0	1	2	2
GE6262	Physics and Chemistry Laboratory - II	0	0	2	1
GE6263	Computer Programming Laboratory	0	1	2	2
		19	**5**	**6**	**27**

SEMESTER – III

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
MA6351	Transforms and Partial Differential Equations	3	1	0	4
GE6351	Environmental Science and Engineering	3	0	0	3
PT6301	Materials Engineering	3	0	0	3
PT6302	Organic Chemistry and Technology	3	1	0	4
CE6402	Strength of Materials	3	1	0	4
PT6303	Polymer Chemistry	3	0	0	3
PRACTICALS					
PL6311	Polymer Chemistry Laboratory	0	0	3	2
PL6312	Organic Chemistry Laboratory	0	0	3	2
	TOTAL	**18**	**3**	**6**	**25**

SEMESTER – IV

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
MA6468	Probability and Statistics	3	1	0	4
PT6401	Mould Manufacturing Engineering	3	0	0	3
PT6402	Polymer Structure and Property Relationship	3	0	0	3
PT6403	Principles of Chemical Engineering	3	0	0	3
PT6404	Physical Chemistry of Polymers	3	0	0	3
PL6401	Plastics Materials and Applications – I	3	0	0	3
PRACTICALS					
PT6411	Chemical Engineering Laboratory	0	0	3	2
PT6412	Mould Manufacturing Engineering Laboratory	0	0	3	2
	TOTAL	**18**	**1**	**6**	**23**

SEMESTER – V

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
MA6459	Numerical Methods	3	1	0	4
PL6501	Polymer Rheology	3	0	0	3
PL6502	Polymerization Engineering	3	0	0	3
PL6503	CAD/CAM/CAE for Plastics Engineering	3	0	0	3
PL6504	Plastics Materials & Applications – II	3	0	0	3
PL6505	Plastics Processing Technology – I	3	0	0	3
PRACTICALS					
GE6563	Communications Skills Laboratory Based	0	0	4	2
PL6511	Plastics Processing Laboratory - I	0	0	4	2
PL6512	Polymer Engineering Laboratory	0	0	4	2
	TOTAL	**18**	**1**	**12**	**25**

SEMESTER – VI

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
PL6601	Fundamentals of Plastics Mould and Die Design	3	0	0	3
PL6606	Rubber Technology	3	0	0	3
PL6602	Plastics Testing Techniques – I	3	0	0	3
PL6603	Process Control & Instrumentation	3	0	0	3
PL6604	Additives and Compounding	3	0	0	3
PL6605	Plastics Processing Technology – II	3	0	0	3
PRACTICALS					
PL6611	Plastics Processing Laboratory – II	0	0	4	2
PL6612	Plastics Testing Laboratory – I	0	0	4	2
	TOTAL	**18**	**0**	**8**	**22**

SEMESTER – VII

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
PL6701	Polymer Composites Technology	3	0	0	3
PL6702	Plastics Testing Techniques – II	3	0	0	3
PL6703	Industrial Management & Costing	3	0	0	3
PL6704	Plastics Product Design	3	0	0	3
	Elective - I	3	0	0	3
	Elective - II	3	0	0	3
PRACTICALS					
PL6711	Plastics Testing Laboratory – II	0	0	4	2
PL6712	Design and Mould Flow Analysis Practice using CAD / CAM / CAE	0	0	4	2
PL6713	Comprehension	0	0	2	1
	TOTAL	**18**	**0**	**10**	**23**

SEMESTER – VIII

CODE NO.	COURSE TITLE	L	T	P	C
THEORY					
	Elective – III	3	0	0	3
	Elective – IV	3	0	0	3
PRACTICALS					
PL6811	Project Work	0	0	12	6
	TOTAL	**6**	**0**	**12**	**12**

TOTAL NO OF CREDITS: 183

LIST OF ELECTIVES

B. TECH. PLASTIC TECHNOLOGY

ELECTIVE I

CODE NO.	COURSE TITLE	L	T	P	C
PL6001	Plastic Waste Management and Recycling Techniques	3	0	0	3
PT6003	Plastics Packaging Technology	3	0	0	3
PT6071	Fibre Technology	3	0	0	3

ELECTIVE – II

CODE NO.	COURSE TITLE	L	T	P	C
PL6003	Biodegradable Polymers	3	0	0	3
PL6004	Specialty Polymers	3	0	0	3
PL6005	Polyurethane Technology	3	0	0	3

ELECTIVE III

CODE NO.	COURSE TITLE	L	T	P	C
PL6006	Polymer Nanocomposites	3	0	0	3
PT6007	Adhesives and Surface Coatings	3	0	0	3
PL6008	Biomedical Plastics	3	0	0	3
GE6084	Human Rights	3	0	0	3

ELECTIVE – IV

CODE NO.	COURSE TITLE	L	T	P	C
PL6009	Statistical Quality Control Techniques	3	0	0	3
GE6757	Total Quality Management	3	0	0	3
GE6075	Professional Ethics in Engineering	3	0	0	3
GE6083	Disaster Management	3	0	0	3

HS6151 **TECHNICAL ENGLISH – I** **L T P C**
3 1 0 4

OBJECTIVES:

- To enable learners of Engineering and Technology develop their basic communication skills in English.
- To emphasize specially the development of speaking skills amongst learners of Engineering and Technology.
- To ensure that learners use the electronic media such as internet and supplement the learning materials used in the classroom.
- To inculcate the habit of reading and writing leading to effective and efficient communication.

UNIT I **9+3**

Listening - Introducing learners to GIE - Types of listening - Listening to audio (verbal & sounds); Speaking - Speaking about one's place, important festivals etc. – Introducing oneself, one's family / friend; Reading - Skimming a reading passage – Scanning for specific information - Note-making; Writing - Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Sentence completion - Autobiographical writing (writing about one's leisure time activities, hometown, etc.); Grammar - Prepositions - Reference words - Wh-questions - Tenses (Simple); Vocabulary - Word formation - Word expansion (root words / etymology); E-materials - Interactive exercises for Grammar & Vocabulary - Reading comprehension exercises - Listening to audio files and answering questions.

UNIT II **9+3**

Listening - Listening and responding to video lectures / talks; Speaking - Describing a simple process (filling a form, etc.) - Asking and answering questions - Telephone skills – Telephone etiquette; Reading – Critical reading - Finding key information in a given text - Sifting facts from opinions; Writing - Biographical writing (place, people) - Process descriptions (general/specific) - Definitions - Recommendations – Instructions; Grammar - Use of imperatives - Subject-verb agreement; Vocabulary - Compound words - Word Association (connotation); E-materials - Interactive exercises for Grammar and Vocabulary - Listening exercises with sample telephone conversations / lectures – Picture-based activities.

UNIT III **9+3**

Listening - Listening to specific task - focused audio tracks; Speaking - Role-play – Simulation - Group interaction - Speaking in formal situations (teachers, officials, foreigners); Reading - Reading and interpreting visual material; Writing - Jumbled sentences - Coherence and cohesion in writing - Channel conversion (flowchart into process) - Types of paragraph (cause and effect / compare and contrast / narrative / analytical) - Informal writing (letter/e-mail/blogs) - Paraphrasing; Grammar - Tenses (Past) - Use of sequence words - Adjectives; Vocabulary - Different forms and uses of words, Cause and effect words; E-materials - Interactive exercises for Grammar and Vocabulary - Excerpts from films related to the theme and follow up exercises - Pictures of flow charts and tables for interpretations.

UNIT IV **9+3**

Listening - Watching videos / documentaries and responding to questions based on them; Speaking - Responding to questions - Different forms of interviews - Speaking at different types of interviews; Reading - Making inference from the reading passage - Predicting the content of a reading passage; Writing - Interpreting visual materials (line graphs, pie charts etc.) - Essay writing – Different types of essays; Grammar - Adverbs – Tenses – future time reference; Vocabulary - Single word substitutes - Use of abbreviations and acronyms;

E-materials - Interactive exercises for Grammar and Vocabulary - Sample interviews - film scenes - dialogue writing.

UNIT V **9+3**

Listening - Listening to different accents, Listening to Speeches/Presentations, Listening to broadcast and telecast from Radio and TV; Speaking - Giving impromptu talks, Making presentations on given topics; Reading - Email communication - Reading the attachment files having a poem/joke/proverb - Sending their responses through email; Writing - Creative writing, Poster making; Grammar - Direct and indirect speech; Vocabulary - Lexical items (fixed / semi fixed expressions); E-materials - Interactive exercises for Grammar and Vocabulary - Sending emails with attachment – Audio / video excerpts of different accents - Interpreting posters.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

Learners should be able to

- speak clearly, confidently, comprehensibly, and communicate with one or many listeners using appropriate communicative strategies.
- write cohesively and coherently and flawlessly avoiding grammatical errors, using a wide vocabulary range, organizing their ideas logically on a topic.
- read different genres of texts adopting various reading strategies.
- listen/view and comprehend different spoken discourses/excerpts in different accents

TEXTBOOKS:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

REFERENCES:

1. Raman, Meenakshi & Sangeetha Sharma. Technical Communication: Principles and Practice. Oxford University Press, New Delhi. 2011.
2. Regional Institute of English. English for Engineers. Cambridge University Press, New Delhi. 2006.
3. Rizvi, Ashraf. M. Effective Technical Communication. Tata McGraw-Hill, New Delhi. 2005
4. Rutherford, Andrea. J Basic Communication Skills for Technology. Pearson, New Delhi. 2001.
5. Viswamohan, Aysha. English for Technical Communication. Tata McGraw-Hill, New Delhi. 2008.

EXTENSIVE Reading (Not for Examination)

1. Kalam, Abdul. Wings of Fire. Universities Press, Hyderabad. 1999.

WEBSITES:

1. http://www.usingenglish.com
2. http://www.uefap.com

TEACHING METHODS:

- Lectures
- Activities conducted individually, in pairs and in groups like self introduction, peer introduction, group poster making, grammar and vocabulary games, etc.
- Discussions
- Role play activities
- Short presentations

- Listening and viewing activities with follow up activities like discussion, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc.

EVALUATION PATTERN:

Internal assessment: 20%

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Reviews
- Creative writing
- Poster making, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual speaking activities, Pair work activities like role play, Interview, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded from simple to complex, from direct to inferential
- ✓ Writing assessment: Writing paragraphs, essays etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content.

End Semester Examination: 80%

MA6151	**MATHEMATICS – I**	**L T P C**
		3 1 0 4

OBJECTIVES:

- To develop the use of matrix algebra techniques this is needed by engineers for practical applications.
- To make the student knowledgeable in the area of infinite series and their convergence so that he/ she will be familiar with limitations of using infinite series approximations for solutions arising in mathematical modeling.
- To familiarize the student with functions of several variables. This is needed in many branches of engineering.
- To introduce the concepts of improper integrals, Gamma, Beta and Error functions which are needed in engineering applications.
- To acquaint the student with mathematical tools needed in evaluating multiple integrals and their usage.

UNIT I MATRICES 9+3

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

UNIT II SEQUENCES AND SERIES 9+3

Sequences: Definition and examples – Series: Types and Convergence – Series of positive terms – Tests of convergence: Comparison test, Integral test and D'Alembert's

ratio test – Alternating series – Leibnitz's test – Series of positive and negative terms – Absolute and conditional convergence.

UNIT III APPLICATIONS OF DIFFERENTIAL CALCULUS 9+3

Curvature in Cartesian co-ordinates – Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes - Evolute as envelope of normals.

UNIT IV DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES 9+3

Limits and Continuity – Partial derivatives – Total derivative – Differentiation of implicit functions – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.

UNIT V MULTIPLE INTEGRALS 9+3

Double integrals in cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves – Change of variables in double integrals – Area of a curved surface - Triple integrals – Volume of Solids.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- This course equips students to have basic knowledge and understanding in one fields of materials, integral and differential calculus.

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd., 2011.
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., 2011.
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
3. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.
5. Sivarama Krishna Das P. and Rukmangadachari E., "Engineering Mathematics", Volume I, Second Edition, PEARSON Publishing, 2011.

PH6151 ENGINEERING PHYSICS – I L T P C
3 0 0 3

OBJECTIVES:

- To enhance the fundamental knowledge in Physics and its applications relevant to various streams of Engineering and Technology.

UNIT I CRYSTAL PHYSICS 9

Lattice – Unit cell – Bravais lattice – Lattice planes – Miller indices – d spacing in cubic lattice – Calculation of number of atoms per unit cell – Atomic radius – Coordination number – Packing factor for SC, BCC, FCC and HCP structures – Diamond and graphite structures (qualitative treatment) - Crystal growth techniques –solution, melt (Bridgman and Czochralski) and vapour growth techniques (qualitative)

UNIT II PROPERTIES OF MATTER AND THERMAL PHYSICS 9

Elasticity- Hooke's law - Relationship between three modulii of elasticity (qualitative) – stress -strain diagram – Poisson's ratio –Factors affecting elasticity –Bending moment – Depression of a cantilever –Young's modulus by uniform bending- I-shaped girders

Modes of heat transfer- thermal conductivity- Newton's law of cooling - Linear heat flow – Lee's disc method – Radial heat flow – Rubber tube method – conduction through compound media (series and parallel)

UNIT III QUANTUM PHYSICS 9

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

UNIT IV ACOUSTICS AND ULTRASONICS 9

Classification of Sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies.

Production of ultrasonics by magnetostriction and piezoelectric methods - acoustic grating -Non Destructive Testing – pulse echo system through transmission and reflection modes - A,B and C –scan displays, Medical applications - Sonogram

UNIT V PHOTONICS AND FIBRE OPTICS 9

Spontaneous and stimulated emission- Population inversion -Einstein's A and B coefficients - derivation. Types of lasers – Nd:YAG, CO_2, Semiconductor lasers (homojunction & heterojunction)- Industrial and Medical Applications.

Principle and propagation of light in optical fibres – Numerical aperture and Acceptance angle - Types of optical fibres (material, refractive index, mode) – attenuation, dispersion, bending - Fibre Optical Communication system (Block diagram) - Active and passive fibre sensors- Endoscope.

TOTAL: 45 PERIODS

OUTCOMES:

- The students will have knowledge on the basics of physics related to properties of matter, optics, acoustics etc., and they will apply these fundamental principles to solve practical problems related to materials used for engineering applications.

TEXT BOOKS:

1. Arumugam M. Engineering Physics. Anuradha publishers, 2010
2. Gaur R.K. and Gupta S.L. Engineering Physics. Dhanpat Rai publishers, 2009
3. Mani Naidu S. Engineering Physics, Second Edition, PEARSON Publishing, 2011.

REFERENCES:

1. Searls and Zemansky. University Physics, 2009
2. Mani P. Engineering Physics I. Dhanam Publications, 2011
3. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009
4. Palanisamy P.K. Engineering Physics. SCITECH Publications, 2011
5. Rajagopal K. Engineering Physics. PHI, New Delhi, 2011
6. Senthilkumar G. Engineering Physics I. VRB Publishers, 2011.

CY6151 ENGINEERING CHEMISTRY - I L T P C
3 0 0 3

OBJECTIVES:

- To make the students conversant with basics of polymer chemistry.
- To make the student acquire sound knowledge of second law of thermodynamics and second law based derivations of importance in engineering applications in all disciplines.
- To acquaint the student with concepts of important photophysical and photochemical processes and spectroscopy.
- To develop an understanding of the basic concepts of phase rule and its applications to single and two component systems and appreciate the purpose and significance of alloys.
- To acquaint the students with the basics of nano materials, their properties and applications.

UNIT I POLYMER CHEMISTRY 9

Introduction: Classification of polymers – Natural and synthetic; Thermoplastic and Thermosetting. Functionality – Degree of polymerization. Types and mechanism of polymerization: Addition (Free Radical, cationic and anionic); condensation and copolymerization. Properties of polymers: Tg, Tacticity, Molecular weight – weight average, number average and polydispersity index. Techniques of polymerization: Bulk, emulsion, solution and suspension. Preparation, properties and uses of Nylon 6,6, and Epoxy resin.

UNIT II CHEMICAL THERMODYNAMICS 9

Terminology of thermodynamics - Second law: Entropy - entropy change for an ideal gas, reversible and irreversible processes; entropy of phase transitions; Clausius inequality. Free energy and work function: Helmholtz and Gibbs free energy functions (problems); Criteria of spontaneity; Gibbs-Helmholtz equation (problems); Clausius-Clapeyron equation; Maxwell relations – Van't Hoff isotherm and isochore(problems).

UNIT III PHOTOCHEMISTRY AND SPECTROSCOPY 9

Photochemistry: Laws of photochemistry - Grotthuss–Draper law, Stark–Einstein law and Lambert-Beer Law. Quantum efficiency – determination- Photo processes - Internal Conversion, Inter-system crossing, Fluorescence, Phosphorescence, Chemiluminescence and Photo-sensitization. Spectroscopy: Electromagnetic spectrum - Absorption of radiation – Electronic, Vibrational and rotational transitions. UV-visible and IR spectroscopy – principles, instrumentation (Block diagram only).

UNIT IV PHASE RULE AND ALLOYS 9

Phase rule: Introduction, definition of terms with examples, One Component System- water system - Reduced phase rule - Two Component Systems- classification – lead-silver system, zinc-magnesium system. Alloys: Introduction- Definition- Properties of alloys- Significance of alloying, Functions and effect of alloying elements- Ferrous alloys- Nichrome and Stainless steel – heat treatment of steel; Non-ferrous alloys – brass and bronze.

UNIT V NANOCHEMISTRY 9

Basics - distinction between molecules, nanoparticles and bulk materials; size-dependent properties. Nanoparticles: nano cluster, nano rod, nanotube(CNT) and nanowire. Synthesis: precipitation, thermolysis, hydrothermal, solvothermal, electrode position, chemical vapour deposition, laser ablation; Properties and applications

TOTAL :45 PERIODS

OUTCOME:

- The knowledge gained on polymer chemistry, thermodynamics. spectroscopy, phase rule and nano materials will provide a strong platform to understand the concepts on these subjects for further learning.

TEXT BOOKS:

1. Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010
2. Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009

REFERENCES:

1. Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010
2. Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3. Gowariker V.R. , Viswanathan N.V. and JayadevSreedhar, "Polymer Science", New Age International P (Ltd.,), Chennai, 2006.
4. Ozin G. A. and Arsenault A. C., "Nanochemistry: A Chemical Approach to Nanomaterials", RSC Publishing, 2005.

GE6151 COMPUTER PROGRAMMING L T P C
3 0 0 3

OBJECTIVES:

The students should be made to:

- Learn the organization of a digital computer.
- Be exposed to the number systems.
- Learn to think logically and write pseudo code or draw flow charts for problems.
- Be exposed to the syntax of C.
- Be familiar with programming in C.
- Learn to use arrays, strings, functions, pointers, structures and unions in C.

UNIT I INTRODUCTION 8

Generation and Classification of Computers- Basic Organization of a Computer –Number System – Binary – Decimal – Conversion – Problems. Need for logical analysis and thinking – Algorithm – Pseudo code – Flow Chart.

UNIT II C PROGRAMMING BASICS 10

Problem formulation – Problem Solving - Introduction to ' C' programming –fundamentals – structure of a 'C' program – compilation and linking processes – Constants, Variables – Data Types – Expressions using operators in 'C' – Managing Input and Output operations – Decision Making and Branching – Looping statements – solving simple scientific and statistical problems.

UNIT III ARRAYS AND STRINGS 9

Arrays – Initialization – Declaration – One dimensional and Two dimensional arrays. String- String operations – String Arrays. Simple programs- sorting- searching – matrix operations.

UNIT IV FUNCTIONS AND POINTERS 9

Function – definition of function – Declaration of function – Pass by value – Pass by reference – Recursion – Pointers - Definition – Initialization – Pointers arithmetic – Pointers and arrays- Example Problems.

UNIT V STRUCTURES AND UNIONS 9

Introduction – need for structure data type – structure definition – Structure declaration – Structure within a structure - Union - Programs using structures and Unions – Storage classes, Pre-processor directives.

TOTAL: 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Design C Programs for problems.
- Write and execute C programs for simple applications.

TEXTBOOKS:

1. Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India) Pvt. Ltd., Pearson Education in South Asia, 2011.
2. Pradip Dey, Manas Ghosh, "Fundamentals of Computing and Programming in C", First Edition, Oxford University Press, 2009
3. Yashavant P. Kanetkar. " Let Us C", BPB Publications, 2011.

REFERENCES:

1. Byron S Gottfried, "Programming with C", Schaum's Outlines, Second Edition, Tata McGraw-Hill, 2006.
2. Dromey R.G., "How to Solve it by Computer", Pearson Education, Fourth Reprint, 2007.
3. Kernighan,B.W and Ritchie,D.M, "The C Programming language", Second Edition, Pearson Education, 2006.

GE6152 ENGINEERING GRAPHICS L T P C
2 0 3 4

OBJECTIVES:

- To develop in students, graphic skills for communication of concepts, ideas and design of Engineering products.
- To expose them to existing national standards related to technical drawings.

CONCEPTS AND CONVENTIONS (Not for Examination) 1

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Size, layout and folding of drawing sheets – Lettering and dimensioning.

UNIT I PLANE CURVES AND FREE HAND SKETCHING 5+9

Basic Geometrical constructions, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of square and circle – Drawing of tangents and normal to the above curves, Scales: Construction of Diagonal and Vernier scales.

Visualization concepts and Free Hand sketching: Visualization principles –Representation of Three Dimensional objects – Layout of views- Free hand sketching of multiple views

from pictorial views of objects

PROJECTION OF POINTS, LINES AND PLANE SURFACES 5+9

Orthographic projection- principles-Principal planes-First angle projection-projection of points. Projection of straight lines (only First angle projections) inclined to both the principal planes - Determination of true lengths and true inclinations by rotating line method and traces Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by rotating object method.

UNIT III PROJECTION OF SOLIDS 5+9

Projection of simple solids like prisms, pyramids, cylinder, cone and truncated solids when the axis is inclined to one of the principal planes by rotating object method and auxiliary plane method.

UNIT IV PROJECTION OF SECTIONED SOLIDS AND DEVELOPMENT OF SURFACES 5+9

Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes

UNIT V ISOMETRIC AND PERSPECTIVE PROJECTIONS 6+9

Principles of isometric projection – isometric scale –Isometric projections of simple solids and truncated solids - Prisms, pyramids, cylinders, cones- combination of two solid objects in simple vertical positions and miscellaneous problems. Perspective projection of simple solids-Prisms, pyramids and cylinders by visual ray method .

COMPUTER AIDED DRAFTING (Demonstration Only) 3

Introduction to drafting packages and demonstration of their use.

TOTAL : 75 PERIODS

OUTCOMES:

On Completion of the course the student will be able to

- perform free hand sketching of basic geometrical constructions and multiple views of objects.
- do orthographic projection of lines and plane surfaces.
- draw projections and solids and development of surfaces.
- prepare isometric and perspective sections of simple solids.
- demonstrate computer aided drafting.

TEXT BOOK:

1. Bhatt N.D. and Panchal V.M., “Engineering Drawing”, Charotar Publishing House, 50th Edition, 2010.

REFERENCES:

1. Gopalakrishna K.R., “Engineering Drawing” (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
2. Luzzader, Warren.J. and Duff,John M., “Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production, Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
3. Shah M.B., and Rana B.C., “Engineering Drawing”, Pearson, 2nd Edition, 2009.
4. Venugopal K. and Prabhu Raja V., “Engineering Graphics”, New Age International (P) Limited, 2008.
5. Natrajan K.V., “A text book of Engineering Graphics”, Dhanalakshmi Publishers, Chennai, 2009.

6. Basant Agarwal and Agarwal C.M., “Engineering Drawing”, Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to University Examinations on Engineering Graphics:

1. There will be five questions, each of either or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.
3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.
4. The examination will be conducted in appropriate sessions on the same day

GE6161 COMPUTER PRACTICES LABORATORY L T P C
0 0 3 2

OBJECTIVES:

The student should be made to:

- Be familiar with the use of Office software.
- Be exposed to presentation and visualization tools.
- Be exposed to problem solving techniques and flow charts.
- Be familiar with programming in C.
- Learn to use Arrays, strings, functions, structures and unions.

LIST OF EXPERIMENTS:

1. Search, generate, manipulate data using MS office/ Open Office
2. Presentation and Visualization – graphs, charts, 2D, 3D
3. Problem formulation, Problem Solving and Flowcharts
4. C Programming using Simple statements and expressions
5. Scientific problem solving using decision making and looping.
6. Simple programming for one dimensional and two dimensional arrays.
7. Solving problems using String functions
8. Programs with user defined functions – Includes Parameter Passing
9. Program using Recursive Function and conversion from given program to flow chart.
10. Program using structures and unions.

TOTAL : 45 PERIODS

OUTCOMES:

At the end of the course, the student should be able to:

- Apply good programming design methods for program development.
- Design and implement C programs for simple applications.
- Develop recursive programs.

LIST OF EQUIPMENTS FOR A BATCH OF 30 STUDENTS:

Standalone desktops with C compiler 30 Nos.

(or)

Server with C compiler supporting 30 terminals or more.

GE6162 ENGINEERING PRACTICES LABORATORY L T P C
0 0 3 2

OBJECTIVES:

- To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.

GROUP A (CIVIL & MECHANICAL)

I CIVIL ENGINEERING PRACTICE 9

Buildings:

(a) Study of plumbing and carpentry components of residential and industrial buildings. Safety aspects.

Plumbing Works:

(a) Study of pipeline joints, its location and functions: valves, taps, couplings, unions, reducers, elbows in household fittings.

(b) Study of pipe connections requirements for pumps and turbines.

(c) Preparation of plumbing line sketches for water supply and sewage works.

(d) Hands-on-exercise:

Basic pipe connections – Mixed pipe material connection – Pipe connections with different joining components.

(e) Demonstration of plumbing requirements of high-rise buildings.

Carpentry using Power Tools only:

(a) Study of the joints in roofs, doors, windows and furniture.

(b) Hands-on-exercise:

Wood work, joints by sawing, planing and cutting.

II MECHANICAL ENGINEERING PRACTICE 13

Welding:

(a) Preparation of arc welding of butt joints, lap joints and tee joints.

(b) Gas welding practice

Basic Machining:

(a) Simple Turning and Taper turning

(b) Drilling Practice

Sheet Metal Work:

(a) Forming & Bending:

(b) Model making – Trays, funnels, etc.

(c) Different type of joints.

Machine assembly practice:

(a) Study of centrifugal pump

(b) Study of air conditioner

Demonstration on:

(a) Smithy operations, upsetting, swaging, setting down and bending. Example – Exercise – Production of hexagonal headed bolt.

(b) Foundry operations like mould preparation for gear and step cone pulley.

(c) Fitting – Exercises – Preparation of square fitting and vee – fitting models.

GROUP B (ELECTRICAL & ELECTRONICS)

III ELECTRICAL ENGINEERING PRACTICE 10

1. Residential house wiring using switches, fuse, indicator, lamp and energy meter.
2. Fluorescent lamp wiring.
3. Stair case wiring
4. Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
5. Measurement of energy using single phase energy meter.
6. Measurement of resistance to earth of an electrical equipment.

IV ELECTRONICS ENGINEERING PRACTICE 13

1. Study of Electronic components and equipments – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CR.
2. Study of logic gates AND, OR, EOR and NOT.
3. Generation of Clock Signal.
4. Soldering practice – Components Devices and Circuits – Using general purpose PCB.
5. Measurement of ripple factor of HWR and FWR.

TOTAL: 45 PERIODS

OUTCOMES:

- ability to fabricate carpentry components and pipe connections including plumbing works.
- ability to use welding equipments to join the structures.
- ability to fabricate electrical and electronics circuits.

REFERENCES:

1. Jeyachandran K., Natarajan S. & Balasubramanian S., "A Primer on Engineering Practices Laboratory", Anuradha Publications, 2007.
2. Jeyapoovan T., Saravanapandian M. & Pranitha S., "Engineering Practices Lab Manual", Vikas Puplishing House Pvt.Ltd, 2006.
3. Bawa H.S., "Workshop Practice", Tata McGraw – Hill Publishing Company Limited, 2007.
4. Rajendra Prasad A. & Sarma P.M.M.S., "Workshop Practice", Sree Sai Publication, 2002.
5. Kannaiah P. & Narayana K.L., "Manual on Workshop Practice", Scitech Publications, 1999.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

CIVIL

1. Assorted components for plumbing consisting of metallic pipes, plastic pipes, flexible pipes, couplings, unions, elbows, plugs and other fittings.	15 Sets.
2. Carpentry vice (fitted to work bench)	15 Nos.
3. Standard woodworking tools	15 Sets.
4. Models of industrial trusses, door joints, furniture joints	5 each
5. Power Tools: (a) Rotary Hammer	2 Nos
(b) Demolition Hammer	2 Nos
(c) Circular Saw	2 Nos
(d) Planer	2 Nos
(e) Hand Drilling Machine	2 Nos
(f) Jigsaw	2 Nos

MECHANICAL

1. Arc welding transformer with cables and holders	5 Nos.
2. Welding booth with exhaust facility	5 Nos.
3. Welding accessories like welding shield, chipping hammer, wire brush, etc.	5 Sets.
4. Oxygen and acetylene gas cylinders, blow pipe and other welding outfit.	2 Nos.
5. Centre lathe	2 Nos.
6. Hearth furnace, anvil and smithy tools	2 Sets.
7. Moulding table, foundry tools	2 Sets.
8. Power Tool: Angle Grinder	2 Nos
9. Study-purpose items: centrifugal pump, air-conditioner	One each.

ELECTRICAL

1. Assorted electrical components for house wiring	15 Sets
2. Electrical measuring instruments	10 Sets
3. Study purpose items: Iron box, fan and regulator, emergency lamp	1 each
4. Megger (250V/500V)	1 No.
5. Power Tools: (a) Range Finder	2 Nos
(b) Digital Live-wire detector	2 Nos

ELECTRONICS

1. Soldering guns	10 Nos.
2. Assorted electronic components for making circuits	50 Nos.
3. Small PCBs	10 Nos.
4. Multimeters	10 Nos.
5. Study purpose items: Telephone, FM radio, low-voltage power supply	

GE6163 PHYSICS AND CHEMISTRY LABORATORY – I

L	T	P	C
0	0	2	1

PHYSICS LABORATORY – I

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

LIST OF EXPERIMENTS

(Any FIVE Experiments)

1. (a) Determination of Wavelength, and particle size using Laser
   (b) Determination of acceptance angle in an optical fiber.
2. Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3. Determination of wavelength of mercury spectrum – spectrometer grating
4. Determination of thermal conductivity of a bad conductor – Lee's Disc method.
5. Determination of Young's modulus by Non uniform bending method
6. Determination of specific resistance of a given coil of wire – Carey Foster's Bridge

OUTCOMES:

- The hands on exercises undergone by the students will help them to apply physics principles of optics and thermal physics to evaluate engineering properties of materials.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Diode laser, lycopodium powder, glass plate, optical fiber.
2. Ultrasonic interferometer
3. Spectrometer, mercury lamp, grating
4. Lee's Disc experimental set up
5. Traveling microscope, meter scale, knife edge, weights
6. Carey foster's bridge set up

(vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

CHEMISTRY LABORATORY- I

OBJECTIVES:

- To make the student to acquire practical skills in the determination of water quality parameters through volumetric and instrumental analysis.
- To acquaint the students with the determination of molecular weight of a polymer by vacometry.

LIST OF EXPERIMENTS

(Any FIVE Experiments)

1 Determination of DO content of water sample by Winkler's method.
2 Determination of chloride content of water sample by argentometric method.
3 Determination of strength of given hydrochloric acid using pH meter.
4 Determination of strength of acids in a mixture using conductivity meter.
5 Estimation of iron content of the water sample using spectrophotometer. (1,10- phenanthroline / thiocyanate method).
6 Determination of molecular weight of polyvinylalcohol using Ostwald viscometer.
7 Conductometric titration of strong acid vs strong base.

TOTAL: 30 PERIODS

OUTCOMES:

- The students will be outfitted with hands-on knowledge in the quantitative chemical analysis of water quality related parameters.

REFERENCES:

1. Daniel R. Palleros, "Experimental organic chemistry" John Wiley & Sons, Inc., New York 2001.
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore 1994.
3. Jeffery G.H., Bassett J., Mendham J.and Denny vogel's R.C, "Text book of quantitative analysis chemical analysis", ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.
4. Kolthoff I.M., Sandell E.B. et al. "Quantitative chemical analysis", Mcmillan, Madras 1980.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1.	Iodine flask	-	30 Nos
2.	pH meter	-	5 Nos
3.	Conductivity meter	-	5 Nos
4.	Spectrophotometer	-	5 Nos
5.	Ostwald Viscometer	-	10 Nos

Common Apparatus : Pipette, Burette, conical flask, percelain tile, dropper (each 30 Nos.)

HS6251 TECHNICAL ENGLISH II L T P C
3 1 0 4

OBJECTIVES:

- To make learners acquire listening and speaking skills in both formal and informal contexts.
- To help them develop their reading skills by familiarizing them with different types of reading strategies.
- To equip them with writing skills needed for academic as well as workplace contexts.
- To make them acquire language skills at their own pace by using e-materials and language lab components.

UNIT I 9+3

Listening - Listening to informal conversations and participating; Speaking - Opening a conversation (greetings, comments on topics like weather) - Turn taking - Closing a conversation (excuses, general wish, positive comment, thanks); Reading - Developing analytical skills, Deductive and inductive reasoning - Extensive reading; Writing - Effective use of SMS for sending short notes and messages - Using 'emoticons' as symbols in email messages; Grammar - Regular and irregular verbs - Active and passive voice; Vocabulary - Homonyms (e.g. 'can') - Homophones (e.g. 'some', 'sum'); E-materials - Interactive exercise on Grammar and vocabulary – blogging; Language Lab - Listening to different types of conversation and answering questions.

UNIT II 9+3

Listening - Listening to situation based dialogues; Speaking - Conversation practice in real life situations, asking for directions (using polite expressions), giving directions (using imperative sentences), Purchasing goods from a shop, Discussing various aspects of a film (they have already seen) or a book (they have already read); Reading - Reading a short story or an article from newspaper, Critical reading, Comprehension skills; Writing - Writing a review / summary of a story / article, Personal letter (Inviting your friend to a function, congratulating someone for his / her success, thanking one's friends / relatives); Grammar - modal verbs, Purpose expressions; Vocabulary - Phrasal verbs and their meanings, Using phrasal verbs in sentences; E-materials - Interactive exercises on Grammar and vocabulary, Extensive reading activity (reading stories / novels), Posting reviews in blogs - Language Lab - Dialogues (Fill up exercises), Recording students' dialogues.

UNIT III 9+3

Listening - Listening to the conversation - Understanding the structure of conversations; Speaking - Conversation skills with a sense of stress, intonation, pronunciation and meaning - Seeking information – expressing feelings (affection, anger, regret, etc.); Reading - Speed reading – reading passages with time limit - Skimming; Writing - Minutes of meeting – format and practice in the preparation of minutes - Writing summary after reading articles from journals - Format for journal articles – elements of technical articles (abstract, introduction, methodology, results, discussion, conclusion, appendices,

references) - Writing strategies; Grammar - Conditional clauses - Cause and effect expressions; Vocabulary - Words used as nouns and verbs without any change in the spelling (e.g. 'rock', 'train', 'ring'); E-materials - Interactive exercise on Grammar and vocabulary - Speed Reading practice exercises; Language Lab - Intonation practice using EFLU and RIE materials – Attending a meeting and writing minutes.

UNIT IV **9+3**

Listening - Listening to a telephone conversation, Viewing model interviews (face-to-face, telephonic and video conferencing); Speaking - Role play practice in telephone skills - listening and responding, -asking questions, -note taking – passing on messages, Role play and mock interview for grasping interview skills; Reading - Reading the job advertisements and the profile of the company concerned – scanning; Writing - Applying for a job – cover letter - résumé preparation – vision, mission and goals of the candidate; Grammar - Numerical expressions - Connectives (discourse markers); Vocabulary - Idioms and their meanings – using idioms in sentences; E-materials - Interactive exercises on Grammar and Vocabulary - Different forms of résumés- Filling up a résumé / cover letter; Language Lab - Telephonic interview – recording the responses - e-résumé writing.

UNIT V **9+3**

Listening - Viewing a model group discussion and reviewing the performance of each participant - Identifying the characteristics of a good listener; Speaking - Group discussion skills – initiating the discussion – exchanging suggestions and proposals – expressing dissent/agreement – assertiveness in expressing opinions – mind mapping technique; Reading - Note making skills – making notes from books, or any form of written materials - Intensive reading; Writing – Checklist - Types of reports – Feasibility / Project report – report format – recommendations / suggestions – interpretation of data (using charts for effective presentation); Grammar - Use of clauses; Vocabulary – Collocation; E-materials - Interactive grammar and vocabulary exercises - Sample GD - Pictures for discussion, Interactive grammar and vocabulary exercises; Language Lab - Different models of group discussion.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

Learners should be able to

- speak convincingly, express their opinions clearly, initiate a discussion, negotiate, argue using appropriate communicative strategies.
- write effectively and persuasively and produce different types of writing such as narration, description, exposition and argument as well as creative, critical, analytical and evaluative writing.
- read different genres of texts, infer implied meanings and critically analyse and evaluate them for ideas as well as for method of presentation.
- listen/view and comprehend different spoken excerpts critically and infer unspoken and implied meanings.

TEXTBOOKS:

1. Department of English, Anna University. Mindscapes: English for Technologists and Engineers. Orient Blackswan, Chennai. 2012
2. Dhanavel, S.P. English and Communication Skills for Students of Science and Engineering. Orient Blackswan, Chennai. 2011

REFERENCES:

1. Anderson, Paul V. Technical Communication: A Reader-Centered Approach. Cengage. New Delhi. 2008
2. Muralikrishna, & Sunita Mishra. Communication Skills for Engineers. Pearson, New Delhi. 2011
3. Riordan, Daniel. G. Technical Communication. Cengage Learning, New Delhi. 2005

4. Sharma, Sangeetha & Binod Mishra. Communication Skills for Engineers and Scientists. PHI Learning, New Delhi. 2009
5. Smith-Worthington, Darlene & Sue Jefferson. Technical Writing for Success. Cengage, Mason USA. 2007

EXTENSIVE Reading (Not for Examination)

1. Khera, Shiv. You can Win. Macmillan, Delhi. 1998.

Websites

1. http://www.englishclub.com
2. http://owl.english.purdue.edu

TEACHING METHODS:

- Lectures
- Activities conducted individually, in pairs and in groups like individual writing and presentations, group discussions, interviews, reporting, etc
- Long presentations using visual aids
- Listening and viewing activities with follow up activities like discussions, filling up worksheets, writing exercises (using language lab wherever necessary/possible) etc
- Projects like group reports, mock interviews etc using a combination of two or more of the language skills

EVALUATION PATTERN:

Internal assessment: 20%

3 tests of which two are pen and paper tests and the other is a combination of different modes of assessment like

- Project
- Assignment
- Report
- Creative writing, etc.

All the four skills are to be tested with equal weightage given to each.

- ✓ Speaking assessment: Individual presentations, Group discussions
- ✓ Reading assessment: Reading passages with comprehension questions graded following Bloom's taxonomy
- ✓ Writing assessment: Writing essays, CVs, reports etc. Writing should include grammar and vocabulary.
- ✓ Listening/Viewing assessment: Lectures, dialogues, film clippings with questions on verbal as well as audio/visual content graded following Bloom's taxonomy.

End Semester Examination: 80%

MA6251 MATHEMATICS – II L T P C
3 1 0 4

OBJECTIVES:

- To make the student acquire sound knowledge of techniques in solving ordinary differential equations that model engineering problems.
- To acquaint the student with the concepts of vector calculus needed for problems in all engineering disciplines.
- To develop an understanding of the standard techniques of complex variable theory so as to enable the student to apply them with confidence, in application areas such as heat conduction, elasticity, fluid dynamics and flow the of electric current.

- To make the student appreciate the purpose of using transforms to create a new domain in which it is easier to handle the problem that is being investigated.

UNIT I VECTOR CALCULUS 9+3

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 parallelopipeds.

UNIT II ORDINARY DIFFERENTIAL EQUATIONS 9+3

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 III LAPLACE TRANSFORM 9+3

Laplace transform – Sufficient condition for existence – Transform of elementary functions – Basic properties – Transforms of derivatives and integrals of functions - Derivatives and integrals of transforms - Transforms of unit step function and impulse functions – Transform of periodic functions. Inverse Laplace transform -Statement of Convolution theorem – Initial and final value theorems – Solution of linear ODE of second order with constant coefficients using Laplace transformation techniques.

UNIT IV ANALYTIC FUNCTIONS 9+3

Functions of a complex variable – Analytic functions: Necessary conditions – Cauchy-Riemann equations and sufficient conditions (excluding proofs) – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: $w = z+k$, kz, $1/z$, z^2, e^z and bilinear transformation.

UNIT V COMPLEX INTEGRATION 9+3

Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula – Taylor's and Laurent's series expansions – Singular points – Residues – Cauchy's residue theorem – Evaluation of real definite integrals as contour integrals around unit circle and semi-circle (excluding poles on the real axis).

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- The subject helps the students to develop the fundamentals and basic concepts in vector calculus, ODE, Laplace transform and complex functions. Students will be able to solve problems related to engineering applications by using these techniques.

TEXT BOOKS:

1. Bali N. P and Manish Goyal, "A Text book of Engineering Mathematics", Eighth Edition, Laxmi Publications Pvt Ltd.,2011.
2. Grewal. B.S, "Higher Engineering Mathematics", 41st Edition, Khanna Publications, Delhi, 2011.

REFERENCES:

1. Dass, H.K., and Er. Rajnish Verma," Higher Engineering Mathematics", S. Chand Private Ltd., 2011
2. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2012.
3. Peter V. O'Neil," Advanced Engineering Mathematics", 7th Edition, Cengage learning, 2012.
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 2008.

5. Sivarama Krishna Das P. and Rukmangadachari E., “Engineering Mathematics” Volume II, Second Edition, PEARSON Publishing, 2011.

PH6251 ENGINEERING PHYSICS – II L T P C
3 0 0 3

OBJECTIVES:

- To enrich the understanding of various types of materials and their applications in engineering and technology.

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 – compound semiconductors -direct and indirect band gap- derivation of carrier concentration in n-type and p-type semiconductor – variation of Fermi level with temperature and impurity concentration –– Hall effect –Determination of Hall coefficient – Applications.

UNIT III MAGNETIC AND SUPERCONDUCTING MATERIALS 9

Origin of magnetic moment – Bohr magneton – comparison of Dia, Para and Ferro magnetism – Domain theory – Hysteresis – soft and hard magnetic materials – antiferromagnetic materials – Ferrites and its applications

Superconductivity: properties – Type I and Type II superconductors – BCS theory of superconductivity(Qualitative) - High T_c 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 ADVANCED ENGINEERING MATERIALS 9

Metallic glasses: preparation, properties and applications. Shape memory alloys (SMA): Characteristics, properties of NiTi alloy, application, Nanomaterials– Preparation -pulsed laser deposition – chemical vapour deposition – Applications – NLO materials – Birefringence- optical Kerr effect – Classification of Biomaterials and its applications

TOTAL : 45 PERIODS

OUTCOMES:

- The students will have the knowledge on physics of materials and that knowledge will be used by them in different engineering and technology applications.

TEXT BOOKS:

1. Arumugam M., Materials Science. Anuradha publishers, 2010
2. Pillai S.O., Solid State Physics. New Age International(P) Ltd., publishers, 2009

REFERENCES:

1. Palanisamy P.K. Materials Science. SCITECH Publishers, 2011
2. Senthilkumar G. Engineering Physics II. VRB Publishers, 2011
3. Mani P. Engineering Physics II. Dhanam Publications, 2011

4. Marikani A. Engineering Physics. PHI Learning Pvt., India, 2009

CY6251 ENGINEERING CHEMISTRY - II

L	T	P	C
3	0	0	3

OBJECTIVES:

- To make the students conversant with boiler feed water requirements, related problems and water treatment techniques.
- Principles of electrochemical reactions, redox reactions in corrosion of materials and methods for corrosion prevention and protection of materials.
- Principles and generation of energy in batteries, nuclear reactors, solar cells, wind mills and fuel cells.
- Preparation, properties and applications of engineering materials.
- Types of fuels, calorific value calculations, manufacture of solid, liquid and gaseous fuels.

UNIT I WATER TECHNOLOGY 9

Introduction to boiler feed water-requirements-formation of deposits in steam boilers and heat exchangers- disadvantages (wastage of fuels, decrease in efficiency, boiler explosion) prevention of scale formation -softening of hard water -external treatment zeolite and demineralization - internal treatment- boiler compounds (phosphate, calgon, carbonate, colloidal) - caustic embrittlement -boiler corrosion-priming and foaming-desalination of brackish water –reverse osmosis.

UNIT II ELECTROCHEMISTRY AND CORROSION 9

Electrochemical cell - redox reaction, electrode potential- origin of electrode potential-oxidation potential- reduction potential, measurement and applications - electrochemical series and its significance - Nernst equation (derivation and problems). Corrosion- causes-factors- types-chemical, electrochemical corrosion (galvanic, differential aeration), corrosion control - material selection and design aspects - electrochemical protection – sacrificial anode method and impressed current cathodic method. Paints- constituents and function. Electroplating of Copper and electroless plating of nickel.

UNIT III ENERGY SOURCES 9

Introduction- nuclear energy- nuclear fission- controlled nuclear fission- nuclear fusion-differences between nuclear fission and fusion- nuclear chain reactions- nuclear reactor power generator- classification of nuclear reactor- light water reactor- breeder reactor-solar energy conversion- solar cells- wind energy. Batteries and fuel cells:Types of batteries- alkaline battery- lead storage battery- nickel-cadmium battery- lithium battery-fuel cell H_2 -O_2 fuel cell- applications.

UNIT IV ENGINEERING MATERIALS 9

Abrasives: definition, classification or types, grinding wheel, abrasive paper and cloth. Refractories: definition, characteristics, classification, properties – refractoriness and RUL, dimensional stability, thermal spalling, thermal expansion, porosity; Manufacture of alumina, magnesite and silicon carbide, Portland cement- manufacture and properties - setting and hardening of cement, special cement- waterproof and white cement–properties and uses. Glass - manufacture, types, properties and uses.

UNIT V FUELS AND COMBUSTION 9

Fuel: Introduction- classification of fuels- calorific value- higher and lower calorific values-coal- analysis of coal (proximate and ultimate)- carbonization- manufacture of metallurgical coke (Otto Hoffmann method) - petroleum- manufacture of synthetic petrol (Bergius process)- knocking- octane number - diesel oil- cetane number - natural gas- compressed natural gas(CNG)- liquefied petroleum gases(LPG)- producer gas- water gas. Power alcohol and bio diesel. Combustion of fuels: introduction- theoretical calculation of calorific

value- calculation of stoichiometry of fuel and air ratio- ignition temperature- explosive range - flue gas analysis (ORSAT Method).

TOTAL : 45 PERIODS

OUTCOMES:

- The knowledge gained on engineering materials, fuels, energy sources and water treatment techniques will facilitate better understanding of engineering processes and applications for further learning.

TEXT BOOKS:

1. Vairam S, Kalyani P and SubaRamesh.,"Engineering Chemistry"., Wiley India PvtLtd.,New Delhi., 2011
2. DaraS.S,UmareS.S."Engineering Chemistry", S. Chand & Company Ltd., New Delhi , 2010

REFERENCES:

1 Kannan P. and Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009

2. AshimaSrivastava and Janhavi N N., "Concepts of Engineering Chemistry", ACME Learning Private Limited., New Delhi., 2010.
3. RenuBapna and Renu Gupta., "Engineering Chemistry", Macmillan India Publisher Ltd., 2010.

4 Pahari A and Chauhan B., "Engineering Chemistry"., Firewall Media., New Delhi., 2010

GE6252 BASIC ELECTRICAL AND ELECTRONICS ENGINEERING L T P C
4 0 0 4

OBJECTIVES:

- To explain the basic theorems used in Electrical circuits and the different components and function of electrical machines.
- To explain the fundamentals of semiconductor and applications.
- To explain the principles of digital electronics
- To impart knowledge of communication.

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

OUTCOMES:

- ability to identify the electrical components explain the characteristics of electrical machines.
- ability to identify electronics components and use of them to design circuits.

TEXT BOOKS:

1. Mittle N., "Basic Electrical Engineering", Tata McGraw Hill Edition, New Delhi, 1990.
2. Sedha R.S., "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.

GE6253 ENGINEERING MECHANICS L T P C
3 1 0 4

OBJECTIVES:

- To develop capacity to predict the effect of force and motion in the course of carrying out the design functions of engineering.

UNIT I BASICS AND STATICS OF PARTICLES 12

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces –– Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

UNIT II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram – Types of supports –Action and reaction forces –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 – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids 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 laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction –wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

TOTAL : 60 PERIODS

OUTCOMES:

- ability to explain the differential principles applies to solve engineering problems dealing with force, displacement, velocity and acceleration.
- ability to analyse the forces in any structures.
- ability to solve rigid body subjected to dynamic forces.

TEXT BOOKS:

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

REFERENCES:

1. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition, Pearson Education 2010.
2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and Dynamics", 4th Edition, Pearson Education 2006.
3. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume 2", Third Edition, John Wiley & Sons,1993.
4. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics", 3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
5. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International (P) Limited Publishers, 1998.
6. Kumar, K.L., "Engineering Mechanics", 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi 2008.

GE6261 COMPUTER AIDED DRAFTING AND MODELING LABORATORY L T P C
0 1 2 2

OBJECTIVES:

- To develop skill to use software to create 2D and 3D models.

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.

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

TOTAL: 45 PERIODS

OUTCOMES:

- ability to use the software packers for drafting and modeling
- ability to create 2D and 3D models of Engineering Components

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

Sl.No	Description of Equipment	Quantity
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.

GE6262 PHYSICS AND CHEMISTRY LABORATORY – II L T P C
0 0 2 1

PHYSICS LABORATORY – II

OBJECTIVES:

- To introduce different experiments to test basic understanding of physics concepts applied in optics, thermal physics and properties of matter.

LIST OF EXPERIMENTS

(Any FIVE Experiments)

1. Determination of Young's modulus by uniform bending method
2. Determination of band gap of a semiconductor
3. Determination of Coefficient of viscosity of a liquid –Poiseuille's method
4. Determination of Dispersive power of a prism - Spectrometer
5. Determination of thickness of a thin wire – Air wedge method
6. Determination of Rigidity modulus – Torsion pendulum

OUTCOMES:

- The students will have the ability to test materials by using their knowledge of applied physics principles in optics and properties of matter.

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Traveling microscope, meter scale, Knife edge, weights
2. Band gap experimental set up
3. Burette, Capillary tube, rubber tube, stop clock, beaker and weighing balance
4. spectrometer, prism, sodium vapour lamp.
5. Air-wedge experimental set up.
6. Torsion pendulum set up.
   (vernier Caliper, Screw gauge, reading lens are required for most of the experiments)

CHEMISTRY LABORATORY - II

OBJECTIVES:

- To make the student acquire practical skills in the wet chemical and instrumental methods for quantitative estimation of hardness, alkalinity, metal ion content, corrosion in metals and cement analysis.

LIST OF EXPERIMENTS
(Any FIVE Experiments)

1 Determination of alkalinity in water sample
2 Determination of total, temporary & permanent hardness of water by EDTA method
3 Estimation of copper content of the given solution by EDTA method
4 Estimation of iron content of the given solution using potentiometer
5 Estimation of sodium present in water using flame photometer
6 Corrosion experiment – weight loss method
7 Conductometric precipitation titration using $BaCl_2$ and Na_2SO_4
8 Determination of CaO in Cement.

TOTAL : 30 PERIODS

OUTCOMES:

- The students will be conversant with hands-on knowledge in the quantitative chemical analysis of water quality related parameters, corrosion measurement and cement analysis.

REFERENCES:

1. Daniel R. Palleros, “Experimental organic chemistry” John Wiley & Sons, Inc., New York, 2001.
2. Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., “Vogel’s Textbook of practical organic chemistry, LBS Singapore ,1994.
3. Jeffery G.H, Bassett J., Mendham J. and Denny R.C., “Vogel’s Text book of quantitative analysis chemical analysis”, ELBS 5th Edn. Longman, Singapore publishers, Singapore, 1996.

3. Kolthoff I.M. and Sandell E.B. et al. Quantitative chemical analysis, McMillan, Madras 1980

- **Laboratory classes on alternate weeks for Physics and Chemistry.**

LIST OF EQUIPMENT FOR A BATCH OF 30 STUDENTS:

1. Potentiometer - 5 Nos
2. Flame photo meter - 5 Nos
3. Weighing Balance - 5 Nos
4. Conductivity meter - 5 Nos

Common Apparatus : Pipette, Burette, conical flask, percelain tile, dropper (30 Nos each)

GE6263	COMPUTER PROGRAMMING LABORATORY	L	T	P	C
		0	1	2	2

OBJECTIVES:

The Students should be made to

- Be exposed to Unix shell commands
- Be familiar with an editor on Unix
- Learn to program in Shell script
- Learn to write C programme for Unix platform

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

OUTCOMES:

At the end of the course the students should be able to:

- Use Shell commands
- Design of Implement Unix shell scripts
- Write and execute C programs on Unix

HARDWARE / SOFTWARE REQUIREMENTS FOR A BATCH OF 30 STUDENTS

Hardware

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

Software

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

MA6351 TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS L T P C
3 1 0 4

OBJECTIVES:

- To introduce Fourier series analysis which is central to many applications in engineering apart from its use in solving boundary value problems.
- To acquaint the student with Fourier transform techniques used in wide variety of situations.
- To introduce the effective mathematical tools for the solutions of partial differential equations that model several physical processes and to develop Z transform techniques for discrete time systems.

UNIT I PARTIAL DIFFERENTIAL EQUATIONS 9

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

UNIT II FOURIER SERIES 9

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 identity – Harmonic analysis.

UNIT III APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS 9

Classification of PDE – Method of separation of variables - Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two dimensional equation of heat conduction (excluding insulated edges).

UNIT IV FOURIER TRANSFORMS 9

Statement of Fourier integral theorem – Fourier transform pair – Fourier sine and cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval's identity.

UNIT V Z - TRANSFORMS AND DIFFERENCE EQUATIONS 9

Z- transforms - Elementary properties – Inverse Z - transform (using partial fraction and residues) – Convolution theorem - Formation of difference equations – Solution of difference equations using
Z - transform.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- The understanding of the mathematical principles on transforms and partial differential equations would provide them the ability to formulate and solve some of the physical problems of engineering.

TEXT BOOKS:

1. Veerarajan. T., "Transforms and Partial Differential Equations", Tata McGraw Hill Education Pvt. Ltd., New Delhi, Second reprint, 2012.
2. Grewal. B.S., "Higher Engineering Mathematics", 42nd Edition, Khanna Publishers, Delhi, 2012.

3. Narayanan.S., Manicavachagom Pillay.T.K and Ramanaiah.G "Advanced Mathematics for Engineering Students" Vol. II & III, S.Viswanathan Publishers Pvt Ltd. 1998.

REFERENCES:

1. Bali.N.P and Manish Goyal, "A Textbook of Engineering Mathematics", 7th Edition, Laxmi Publications Pvt Ltd , 2007.
2. Ramana.B.V., "Higher Engineering Mathematics", Tata Mc-GrawHill Publishing Company Limited, NewDelhi, 2008.
3. Glyn James, "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2007.
4. Erwin Kreyszig, "Advanced Engineering Mathematics", 8th Edition, Wiley India, 2007.
5. Ray Wylie. C and Barrett.L.C, "Advanced Engineering Mathematics" Tata Mc Graw Hill Education Pvt Ltd, Sixth Edition, New Delhi, 2012.
6. Datta.K.B., "Mathematical Methods of Science and Engineering", Cengage Learning India Pvt Ltd, Delhi, 2013.

GE6351 ENVIRONMENTAL SCIENCE AND ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To the study of nature and the facts about environment.

- To finding and implementing scientific, technological, economic and political solutions to environmental problems.
- To study the interrelationship between living organism and environment.
- To appreciate the importance of environment by assessing its impact on the human world; envision the surrounding environment, its functions and its value.
- To study the dynamic processes and understand the features of the earth's interior and surface.
- To study the integrated themes and biodiversity, natural resources, pollution control and waste management.

UNIT I ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY 12

Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity. Field study of common plants, insects, birds
Field study of simple ecosystems – pond, river, hill slopes, etc.

UNIT II ENVIRONMENTAL POLLUTION 10

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry-Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;-Mitigation procedures- Control of particulate and gaseous emission, Control of SO_2, NO_X, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial

and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution – pollution case studies – Field study of local polluted site – Urban / Rural / Industrial / Agricultural.

UNIT III NATURAL RESOURCES 10

Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; 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. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants. Field study of local area to document environmental assets – river / forest / grassland / hill / mountain.

UNIT IV SOCIAL ISSUES AND THE ENVIRONMENT 7

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act –The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labeling of environmentally friendly products (Ecomark). enforcement machinery involved in environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides.
Public awareness.

UNIT V HUMAN POPULATION AND THE ENVIRONMENT 6

Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote sensing-role of information technology in environment and human health – Case studies.

TOTAL : 45 PERIODS

OUTCOMES:

Environmental Pollution or problems cannot be solved by mere laws. Public participation is an important aspect which serves the environmental Protection. One will obtain knowledge on the following after completing the course.

- Public awareness of environmental is at infant stage.
- Ignorance and incomplete knowledge has lead to misconceptions
- Development and improvement in std. of living has lead to serious environmental disasters

TEXT BOOKS:

1. Gilbert M.Masters, 'Introduction to Environmental Engineering and Science', 2nd edition, Pearson Education (2004).

2. Benny Joseph, 'Environmental Science and Engineering', Tata McGraw-Hill, New Delhi, (2006).

REFERENCES:

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

PT6301 MATERIALS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To enable the students to understand

- Mechanical behavior of materials, types of fractures and testing
- Importance of phase diagram
- 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 - ductilebrittle 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, Polymeric and composite materials, metal matrix composites, 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**

Ceramics- Types- Bonding and their structure –Defects - calcinations, grain growth and solid liquid phase sintering; Ceramic coatings and their deposition; Properties of photonic, electro-optic, magnetic and superconducting ceramics ferrites; Applications of electronic ceramics in various devices including sensors for gases, temperature, pressure and voltage, and in optical communication, magnetic and oxide electronics, and electric power and energy storage devices.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students

- Will familiarize in mechanical behavior of materials
- Will develop phase diagram for compound material
- Will demonstrate about selection of coating tools

TEXT BOOKS :

1. M. Arumugham, Material Science, Anuradha Agencies, 1st Ed., 1987.
2. G. E. Dieter, Mechanical metallurgy, McGraw-Hill, 2000.
3. William D. Callister, Material Science and Engineering", Seventh Edition, Wiley Publication, 2006

REFERENCES:

1. R. C. Buchanan, Ceramic Materials for Electronics, Marcel Dekker, 1986
2. J. C. Anderson, K. D. Leaver, R. D.Rawlings, J. M. Alexander, Material Science, Donald S. Clark and Wilbur R Warney, Physical metallurgy, Affltd. East west press.
3. C. W. Richards, Engineering material Science, Prentice Hall Of India.
4. V.S. Raghavan, "Material Science".

PT6302 ORGANIC CHEMISTRY AND TECHNOLOGY L T P C
3 1 0 4

OBJECTIVE:

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 **9**

Structure reactivity and mechanism: Classification and IUPAC Nomenclature of organic compounds, Functional groups, classification and reactions, bonding in organic molecules –Hybridization - Methane, ethylene, acetylene, and butadiene. - Polarity of bonds- Hydrogen bonding- Dipole Moment - Electron displacement effect - Inductive - Electromeric - Conjugative - mesomeric and Resonance effects- Stereochemistry- General idea of optical and stereoisomerisms, geometrical isomerism-

UNIT II **9**

Types of bond breakage- homolysis and heterolysis, 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 rearrangements - General conditions and mechanism of each of the above.

UNIT III **9**

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 **9**

Synthesis and Manufacturing, properties and uses of - Formaldehyde - Epicholorohydrin - Ethylene oxide - Propylene oxide - Ethylene glycol, Propylene glycol – Phenols - Aniline- Bisphenol-A, Phthalic acid - Adipic acid - Maleic acid - Maleic anhydride - Phthalic anhydride-ξ-caprolactam, ξ-Caprolactone

UNIT V **9**

Synthesis, Properties and uses of Styrene – Hexamethylene diamine - Urea - Acrylic acid - Methacrylic acid - Acrylonitrile - Methyl methacrylate – Tolulene diisocyanate (TDI) Hexamethylene diisocyanate (HMDI)- Diphenyl methane diisocyanate (MDI)-Pyrrole, Furan- Thiophene- benzimidazoles, Oxazoles.

TOTAL (L:45 + T:15): 60 PERIODS

OUTCOMES:

Upon completion of this course, the students

- Will develop knowledge in functional group of chemicals
- Willunderstand the mechanism of organic reactions
- Will have knowledge of synthesis properties and uses of organic compound

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,18th 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

CE6402 **STRENGTH OF MATERIALS** **LT P C**
3 1 0 4

OBJECTIVES:

To enable the students

- To know the method of finding slope and deflection of beams and trusses using energy theorems and to know the concept of analysing indeterminate beam
- To estimate the load carrying capacity of columns, stresses due to unsymmetrical bending and various theories for failure of material.

UNIT I ENERGY PRINCIPLES **9**

Strain energy and strain energy density – strain energy due to axial load, shear, flexure and torsion – Castigliano’s theorems – Maxwell’s reciprocal theorems - Principle of virtual work – application of energy theorems for computing deflections in beams and trusses - Williot Mohr's Diagram.

UNIT II INDETERMINATE BEAMS 9

Concept of Analysis - Propped cantilever and fixed beams-fixed end moments and reactions – Theorem of three moments – analysis of continuous beams – shear force and bending moment diagrams.

UNIT III COLUMNS AND CYLINDER 9

Euler's theory of long columns – critical loads for prismatic columns with different end conditions; Rankine-Gordon formula for eccentrically loaded columns – Eccentrically loaded short columns – middle third rule – core section – Thick cylinders – Compound cylinders.

UNIT IV STATE OF STRESS IN THREE DIMENSIONS 9

Determination of principal stresses and principal planes – Volumetric strain –Theories of failure – Principal stress - Principal strain – shear stress – Strain energy and distortion energy theories – application in analysis of stress, load carrying capacity.

UNIT V ADVANCED TOPICS IN BENDING OF BEAMS 9

nsymmetrical bending of beams of symmetrical and unsymmetrical sections – Shear Centre - curved beams – Winkler Bach formula**.**

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- Students will have through knowledge in analysis of indeterminate beams and use of energy method for estimating the slope and deflections of beams and trusses.
- They will be in a position to assess the behaviour of columns, beams and failure of materials.

TEXT BOOKS:

1. Rajput R.K. "Strength of Materials (Mechanics of Solids)", S.Chand & company Ltd., New Delhi, 2010.
2. Egor P Popov, "Engineering Mechanics of Solids", 2nd edition, PHI Learning Pvt. Ltd., New Delhi, 2012

REFERENCES:

1. Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 2003
2. William A .Nash, "Theory and Problems of Strength of Materials", Schaum's Outline Series, Tata McGraw Hill Publishing company ,2007.
3. Punmia B.C."Theory of Structures" (SMTS) Vol 1&II, Laxmi Publishing Pvt Ltd, New Delhi 2004.
4. Rattan.S.S., "Strength of Materials", Tata McGraw Hill Education Pvt.Ltd., New Delhi, 2011.

PT6303 POLYMER CHEMISTRY L T P C
3 0 0 3

OBJECTIVE:

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

UNIT I 9

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 **9**

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 – Advanced Polymerization Techniques - Atom Transfer Radical Polymerization (ATRP), Group Transfer Polymerization (GTP), Reversible Addition Fragmentation Termination (RAFT).

UNIT III **9**

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 **9**

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

UNIT V **9**

Chemicalreactions ofpolymers –Hydrolysis – Acidolysis – Aminolysis-Hydrogenation– Additionandsubstitutionreactions–crosslinkingreactions. Polymer degradation– Mechanical degradation–Mechano-chemicaldegradation–OxidativedegradationHydrolyticdegradation– Photodegradation.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completion of this course, the students

- Will develop knowledge in polymerization techniques
- Will be aware about chemical reaction of polymers
- Will be able to determine the molecular weight of the polymer

TEXT BOOKS:

1. F.W. Billmeyer, “Textbook of Polymer Science”, Wiley international publishers, 2000
2. George Odian , “ Principles of polymerisation”, Seymor Robert
3. V.R. Gowariker, “Polymer Science” – New Age International (P) Ltd, Publishers

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

PL6311 POLYMER CHEMISTRY LABORATORY L T P C
0 0 3 2

OBJECTIVE:
To train the student to identify plastics and rubbers by different methods

LIST OF EXPERIMENTS
Identification of polymers by simple methods like density, melting point, burning characteristics,solubilityandconfirmatorytestbychemicalanalysis.

A. PLASTICS
1. Polyethylene
2. Polypropylene
3. Polystyrene
4. Polyvinyl Chloride
5. Polyamide
6. Polyethyleneterephthalate
7. Polybutyleneterephthalate
8. Polycarbonate
9. Polyacetal
10. Polyphenyleneoxide
11. Polyphenylenesulphide
12. PhenolFormaldehyde
13. Ureaformaldehyde
14. Melamineformaldehyde

B. **IDENTIFICATION OF RUBBERS BY SIMPLE METHODS**
1. NaturalRubber (NR)
2. PolybutyleneRubber (BR)
3. StyreneButadieneRubber (SBR)
4. IsopreneRubber (IR)
5. IsobutieneIsoprene Rubber (IIR)
6. ChloropreneRubber (CR)
7. Acrylonitrile–ButadieneRubber (NBR)
8. SiliconeRubber

TOTAL : 45 PERIODS

OUTCOMES:
Upon completion of this course, the student will be able to
- Identify different types of plastics by their characteristics
- Identify different types of rubbers by their characteristics

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

BunsenBurner	15Nos
ElectronicBalance	1No
ThermostaticWaterbath	2Nos
MeltingPointApparatus	1No
RetortStand	
PolymerSamplesandGlasswares	15Nos

REFERENCE:
1. Identificationofplasticsandrubbersbysimplemethods,CIPETpublications2002

PL6312 ORGANIC CHEMISTRY LABORATORY L T P C
0 0 3 2

OBJECTIVE:
To practice the students in preparation and identification of organic compounds

LIST OF EXPERIMENTS

PARTA : Identification of organic compounds of the following types:

1. Alcohols
2. Aldehydes
3. ketones
4. Carboxylicacids
5. Esters
6. Nitrocompounds
7. Amines
8. Amides
9. Carbohydrates
10. Halogencompounds
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

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Conicalflask		15No. Liebigcondenser	
15No Roundbottomflask		15No. Burette	
15No. Pipette		15No. Iodineflask	
15No. Testtubes	01	Gross Testtubeholder	15No. Tongs
15No. Bunsenburner		15No. Chemicals	

OUTCOMES:
After the completion of this practical course, the student would be able to

- Identify organic compounds by different methods
- Prepare organic compounds by different methods
- Carry out quantitative analysis of phenol, acetone, urea, formaldehyde, methyl methacrylate and acrylonitrile

REFERENCE:

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

MA6468 PROBABILITY AND STATISTICS L T P C
3 1 0 4

OBJECTIVES:

- This course aims at providing the required skill to apply the statistical tools in engineering problems.

UNIT I RANDOM VARIABLES 9

Discrete and continuous random variables – Moments – Moment generating functions – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions.

UNIT II TWO - DIMENSIONAL RANDOM VARIABLES 9

Joint distributions – Marginal and conditional distributions – Covariance – Correlation and Linear regression – Transformation of random variables – Central limit theorem (for independent and identically distributed random variables).

UNIT III TESTING OF HYPOTHESIS 9

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on Normal distribution for single mean and difference of means -Tests based on t, Chi-square and F distributions for mean, variance and proportion - Contingency table (test for independent) - Goodness of fit.

UNIT IV DESIGN OF EXPERIMENTS 9

One way and Two way classifications - Completely randomized design – Randomized block design – Latin square design - 2^2 factorial design.

UNIT V STATISTICAL QUALITY CONTROL 9

Control charts for measurements (X and R charts) – Control charts for attributes (p, c and np charts) – Tolerance limits - Acceptance sampling.

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- The students will have a fundamental knowledge of the concepts of probability. Have knowledge of standard distributions which can describe real life phenomenon. Have the notion of sampling distributions and statistical techniques used in engineering and management problems.

TEXT BOOKS:

1. Milton. J. S. and Arnold. J.C., "Introduction to Probability and Statistics", Tata McGraw Hill, 4th Edition, 2007.
2. Johnson. R.A. and Gupta. C.B., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 7th Edition, 2007.
3. Papoulis. A and Unnikrishnapillai. S., "Probability, Random Variables and Stochastic Processes " Mc Graw Hill Education India , 4th Edition, New Delhi , 2010.

REFERENCES:

1. Devore. J.L., "Probability and Statistics for Engineering and the Sciences", Cengage Learning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L. and Ye. K., "Probability and Statistics for Engineers and Scientists", Pearson Education, Asia , 8th Edition, 2007.
3. Ross, S.M., "Introduction to Probability and Statistics for Engineers and Scientists", 3rd Edition, Elsevier, 2004.
4. Spiegel. M.R., Schiller. J. and Srinivasan. R.A., "Schaum's Outline of Theory and Problems of Probability and Statistics", Tata McGraw Hill Edition, 2004.

PT6401 MOULD MANUFACTURING ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

To impart knowledge on mould making techniques such as metal cutting, metal erosion, metal deposition, metal displacement and mould polishing

UNIT I **9**

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 **9**

Copy milling, Pentograph, Profile grinding, Electrical discharge machining - Types of EDM, design consideration & functions and technological planning. Applications of wire cut EDM in mold making. CNC Controlled Machines (Lathe, milling)

UNIT III **9**

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 **9**

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 **9**

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, Hardness testing, Comparators, Optical profiles projectors, Tool makers microscope, Optical flats - types and uses.

TOTAL : 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- will demonstrate mold making process
- will have the knowledge in surface finishing of mold
- will acquire skills in inspection of mold

TEXT BOOKS:

1. Klus Stokhert (Edt.), Mold making handbook for Plastic Engineers, HanserPublishers, 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. C-B & Liv C.N.K. Computer aided design & manufacture, East West Press, 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.

PT6402 POLYMER STRUCTURE AND PROPERTY RELATIONSHIP L T P C
3 0 0 3

OBJECTIVES:

To enable the students 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 and properties of polymers- Linear, branched, crosslinked, and network polymers-Homochain and hetero atomic chain polymers- Copolymers and its types- 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, crystallization & cold crystallization temperatures - Prediction of T_C, Tg 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 - Factors affecting the electrical conductivity of polymers.

Optical properties -Effect of polymer structure on optical properties -clarity, transparency, haze, transmittance, absorbance, 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

OUTCOMES:

Upon completing this course, the students

- Will understand the influence of polymer structure in its properties
- Will understand the importance of glass transition temperature in polymer
- Will able to determine solvents for polymer using solubility parameter

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.

PT6403 PRINCIPLES OF CHEMICAL ENGINEERING L T P C
3 0 0 3

OBJECTIVE:

To enable the students to understand about the fluid flow, heat transfer and mass transfer in engineering applications.

UNIT I FUNDAMENTALS OF CHEMICAL ENGINEERING AND FLUID FLOW 9

Introduction, units, concept of atomic weight, equivalent weight and moles, composition of Solids, liquids and solutions, gas constant, ideal gas law, Fluid Flow: Newtonian and Non-Newtonian fluid- flow characteristics- Bernoulli's theorem-Hagen Poisuille equation, measurement of fluid flow.

UNIT II MECHANICAL OPERATIONS 9

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.

UNIT III HEAT TRANSFER 9

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. Co current, Counter current, shell & tube heat exchangers.

UNIT IV MASS TRANSFER 9

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

UNIT V UNIT OPERATIONS 9

Absorption - Principle and equipment (packed towers and plate columns). Distillation - Vapour liquid equilibria, flash distillation, and Binary distillation. Industrial equipments for distillation Adsorption - Principle and equipment for adsorption. Extraction - Principle and equipment for adsorption. (Basic principles and equipment description only. Mathematical consideration not required for absorption adsorption, extraction)

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course, students

- Will attain knowledge in fluid behavior and solid properties
- Will understand conduction of heat and mass
- Will familiarize in equipments for distillation.

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.

PT6404 PHYSICAL CHEMISTRY OF POLYMERS L T P C

3 0 0 3

OBJECTIVES:

To make the students

- To learn about different conformational and configurational states of polymers and sizes of the polymer chains using different models
- To understand the basics of thermodynamics and applications of these concepts in thermoelasticty of rubbers
- To study about various thermal transitions of polymers
- To know about the orientation in polymers and various processes to induce orientation
- To understand the dissolution of polymers based on thermodynamics

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

OUTCOMES:

After the completion of this course, the students would know about

- Different configurational isomers of polymers
- Various transitions of polymers and factors affecting the transition of polymers.
- Concept of chain orientation and the effect of orientation on the properties of polymers.
- Concept of dissolution of polymers.

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.

PL6401 PLASTICS MATERIALS AND APPLICATIONS – I L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To learn about the general methods of preparation of individual class of plastic materials
- To study about the general properties, processing behaviour and applications of different class of plastic materials
- To understand about the structure- property relation of different class of plastic materials

UNIT I HISTORY 9

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 9

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 9

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

UNIT IV HIGH PERFORMANCE PLASTICS 9

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 9

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

OUTCOME:

Students learn about various methods of preparation of different plastic materials. They also understand about the properties of polymers based on the structure. They learn about various processing techniques suitable for particular end use applications. They can also select the individual plastic materials based on end use applications.

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.

PT6411 CHEMICAL ENGINEERING LABORATORY L T P C
0 0 3 2

OBJECTIVE:
To practice the students on various techniques for reducing and separating of particles, flow properties of fluids.

LIST OF 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
19. Particle size and Surface area of filler particles.

(Any nine Experiments)

TOTAL : 45 PERIODS

OUTCOMES:
Upon completing this course, the students will
- Be able to apply the different technique for size reduction
- Attain skill in function of fluid pressure apparatus.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

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.
BET surface analyser	1 No
Venturi meter apparatus	1 No.
Orifice/mouth piece apparatus	1 No.
Stop watch	2 No.
Meter scale	2 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.

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.

PT6412 MOULD MANUFACTURING ENGINEERING LABORATORY L T P C
0 0 3 2

OBJECTIVE:

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

LIST OF EXPERIMENTS

1. Exercise on Shaping machine - making stepped block
2. Exercise on Shaping machine - making beveled block
3. Exercise on Horizontal Milling-Gear cutting
4. Exercise on Vertical Milling
5. Exercise on lathe - external thread
6. Exercise on lather- taper turning
7. Exercise on Surface Grinding.
8. Exercise on Slotting Machine.
9. Grinding of Cutting tools.
10. Study of different types of Cutting tools.
11. Measurements using Micrometer, vernier, Height gauge and Slip gauge.
12. Measurement of angle using Sine Bar.
13. Checking of straightness using auto collimeter.
14. Application of Dial gauge.

(Any 8 experiments from the above)

TOTAL : 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will understand the mould parts manufacturing technique
- Will attain knowledge in machining process
- Will know about the polishing methods

DEMOMSTRATION EXPERIMENT :

To make a simple mold for hand molding machine

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

- Shaping machine 2 No.
- Vertical milling machine 1 No.
- Horizontal milling machine 1 No
- Lathe 10 No.
- Plain surface grinding machine 1 No.
- Bench grinder 2 No.
- Vernier caliper 2 No.
- Vernier height gauge 2 No.
- Vernier Depth Gauge 1 No
- Micrometer 2 No
- Sine bar 2 No.

MA6459 NUMERICAL METHODS L T P C
3 1 0 4

OBJECTIVES:

- This course aims at providing the necessary basic concepts of a few numerical methods and give procedures for solving numerically different kinds of problems occurring in engineering and technology

UNIT I SOLUTION OF EQUATIONS AND EIGENVALUE PROBLEMS 10+3

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

UNIT II INTERPOLATION AND APPROXIMATION 8+3

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

UNIT III NUMERICAL DIFFERENTIATION AND INTEGRATION 9+3

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

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

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

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

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

TOTAL (L:45+T:15): 60 PERIODS

OUTCOMES:

- The students will have a clear perception of the power of numerical techniques, ideas and would be able to demonstrate the applications of these techniques to problems drawn from industry, management and other engineering fields.

TEXT BOOKS:

1. Grewal. B.S., and Grewal. J.S., " Numerical methods in Engineering andScience", Khanna Publishers, New Delhi, 9th Edition, 2007.
2. Gerald. C. F., and Wheatley. P. O., " Applied Numerical Analysis", Pearson Education, Asia, New Delhi, 6th Edition, 2006.

REFERENCES:

1. Chapra. S.C., and Canale.R.P., "Numerical Methods for Engineers, Tata McGraw-Hill, New Delhi, 5th Edition, 2007.
2. Brian Bradie. "A friendly introduction to Numerical analysis", Pearson Education, Asia, New Delhi, 2007.
3. Sankara Rao. K., "Numerical methods for Scientists and Engineers", PrenticeHall of India Private Ltd., New Delhi, 3rd Edition, 2007.

PL6501 POLYMER RHEOLOGY L T P C
3 0 0 3

OBJECTIVE:

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

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

OUTCOMES:

Upon completing this course, the students

- Will understand the influence of rheology in polymer properties.
- Will acquire knowledge in handling rheological instruments
- Will attain the knowledge in flow behaviour of polymers.

TEXT BOOKS:

1. J.A.Brydson, Flow properties of polymer melts, life books, London, 1978.
2. R.J. Crawford, Plastics Engineering, Butterworth - Heinemann, Oxford, 1998

REFERENCES:

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

PL6502 POLYMERIZATION ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To understand various polymerization techniques and catalysts used to produce addition polymers.
- To understand the copolymerization technique to produce important co-polymers
- To learn the manufacturing of thermosetting molding powders from phenol formaldehyde and melamine

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.

UNIT II **9**

Catalysts-their utility in polymers and stereo-specific polymerizations - Zieglar-Natta, Metallocene and other catalystss.

9

UNIT III

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

OUTCOME:

Students will have clear understanding about the various polymerization techniques and catalyst used for the manufacturing of various polymers. They will also learn about properties and applications of commercial plastic materials.

TEXTBOOKS:

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.

REFERENCES:

1. Polymer Science by Gowriker-Viswanathan-Sreedhar.
2. Odian; George, Principles of Polymerization, McGraw-Hill Book Co., New York,(1970).
3. Polymerization Process Modeling, N A Dotson, R Galvan, R L Laurence and M Tirrell, VCH Pub., Ind., 1996.
4. Reaction Engineering of Step Growth Polymerization, S K Gupta and Anil Kumar, Plenum Press, 1987.

PL6503 CAD/CAM/CAE FOR PLASTICS ENGINEERING L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To understand the basics of design aspects for the manufacturing of mould.
- To develop the knowledge of computer aided manufacturing.
- To learn about the various CNC machines used for the manufacturing of moulds.

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

OUTCOME:
Upon completion of this course, the students will acquire the knowledge of computer aided design and manufacturing for moulds for plastics processing. They also learn about various CNC machining processes used in mould manufacturing.

TEXTBOOKS:

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
5. Inc., Englewood Cliffs - New Jersey).

REFERENCES:

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

PL6504 PLASTICS MATERIALS & APPLICATIONS – II L T P C
3 0 0 3

OBJECTIVES:
To enable the students
- To learn about the general methods of preparation, properties and application of different specialty plastics.
- To understand the concept of reinforcement and know the properties of different reinforcements.
- To study the structure, properties and application of fibre reinforced thermoplastic and thermoset composites.

- To understand the concept of compatibility and study the structure and properties of important commercial blends.
- To study the effect of different mineral fillers on the properties of engineering thermoplastics.
- To know the structure, property and applications of bio and electrically active polymers.

UNIT I **9**

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 **9**

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 **9**

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 **9**

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

UNIT V **12**

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

TOTAL : 45 PERIODS

OUTCOME:

Students would have clear understanding about the structure and properties of different speciality plastics. They also learn the importance of reinforcement in composites. They also understand about the role of compatibiliser on the properties of different polymer blends.They also know about the structure and properties of different mineral filled thermoplastic materials.

TEXTBOOKS:

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.

REFERENCES:

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

PL6505 PLASTICS PROCESSING TECHNOLOGY – I L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To understand the various processing techniques of plastic materials.
- To learn the fundamentals and compression molding and transfer molding of thermoset plastics.
- To learn the basic processing of thermoplastics by injection molding, extrusion and blow moulding.

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

OUTCOME:

On completing this course, the students would acquire the knowledge of processing of plastic materials by injection moulding, extrusion, and blow moulding. and also the other processing techniques like compression molding and transfer moulding of thermoset plastics.

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).

GE6563 COMMUNICATION SKILLS – LABORATORY BASED L T P C
0 0 4 2

OBJECTIVES:

- To provide opportunities to learners to practice their communicative skills to make them become proficient users of English.
- To enable learners to fine-tune their linguistic skills (LSRW) with the help of technology to communicate globally.
- To enhance the performance of learners at placement interviews and group discussions and other recruitment procedures.

CONTENTS:

UNIT I LISTENING/VIEWING 10

Listening and note-taking – Listening to telephonic conversations – Ted talks – Inspiring Speeches – Watching documentaries on personalities, places, socio-cultural events, TV news programmes and discussions to answer different kinds questions, viz., identifying key idea and comprehension questions… so on.

UNIT II SPEAKING 12

Conversation practice – Interview – Group Discussion – Introducing oneself and others – Role play – Debate – Presentation – Panel discussion – Neutral accent.

UNIT III READING 10

Different genres of text (literature, media, technical) for comprehension – Reading strategies like note-making – reading graphs, charts and graphic organizer – Sequencing sentences – reading online sources like e-books, e-journals and e-newspapers.

UNIT IV WRITING 12

Blogs – Tweets – Online resume/ – e-mails – SMS and Online texting – Report writing – Describing charts and tables – Writing for media on current events.

UNIT V VOCABULARY 8

Idioms and Phrases – Proverbs – Collocations – Chunks of language.

UNIT VI GRAMMAR 8

Sentence structures – Subject-Verb agreement – Pronoun-Antecedent agreement – Tense forms – Active and passive voices – Direct and Indirect speeches – Cohesive devices.

TOTAL : 60 PERIODS

TEACHING METHODS:

1. To be totally learner-centric with minimum teacher intervention as the course revolves around practice.
2. Suitable audio/video samples from Podcast/YouTube to be used for illustrative purposes.
3. Portfolio approach for writing to be followed. Learners are to be encouraged to blog, tweet, text and email employing appropriate language.
4. GD/Interview/Role Play/Debate could be conducted off the laboratory (in a regular classroom) but learners are to be exposed to telephonic interview and video conferencing.
5. Learners are to be assigned to read/write/listen/view materials outside the classroom as well for graining proficiency and better participation in the class.

Lab Infrastructure:

Sl. No.	Description of Equipment (Minimum configuration)	Qty Required
1	**Server**	1 No.
	• PIV System	
	• 1 GB RAM / 40 GB HDD	
	• OS: Win 2000 server	
	• Audio card with headphones	
	• JRE 1.3	
2	**Client Systems**	60 Nos.
	• PIII System	
	• 256 or 512 MB RAM / 40 GB HDD	
	• OS: Win 2000	
	• Audio card with headphones	
	• JRE 1.3	
3	Handicam	1 No.
4	Television 46"	1 No.
5	Collar mike	1 No.
6	Cordless mike	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	1 No.

Evaluation:

Internal: 20 marks

Record maintenance: Students should write a report on a regular basis on the activities conducted, focusing on the details such as the description of the activity, ideas emerged, learning outcomes and so on. At the end of the semester records can be evaluated out of 20 marks.

External: 80 marks

Online Test	- 35 marks
Interview	- 15 marks
Presentation	- 15 marks
Group Discussion	- 15 marks

Note on Internal and External Evaluation:

1. Interview – mock interview can be conducted on one-on-one basis.
2. Speaking **–** example for role play:
   a. Marketing engineer convincing a customer to buy his product.
   b. Telephonic conversation- fixing an official appointment / placing an order / enquiring and so on.
3. Presentation – should be extempore on simple topics
4. Discussion – topics of different kinds; general topics, case studies and abstract concept

OUTCOMES:

At the end of the course, learners should be able to

- Take international examination such as IELTS and TOEFL
- Make presentations and Participate in Group Discussions.
- Successfully answer questions in interviews**.**

REFERENCES:

1. Barker, A. **Improve Your Communication Skills.** New Delhi: Kogan Page India Pvt. Ltd., 2006.
2. Craven, Miles. **Listening Extra – A resource book of multi-level skills activities**.Cambridge University Press, 2004.
3. Gammidge, Mick. **Speaking Extra - A resource book of multi-level skills activities.** Cambridge University Press, 2004.
4. Hartley, Peter. **Group Communication**. London: Routledge, 2004.
5. John Seely. **The Oxford Guide to Writing and Speaking**. New Delhi: Oxford University Press, 2004.
6. Naterop, Jean & Rod Revell. **Telephoning in English**. Cambridge University Press, 1987.
7. Ramesh, Gopalswamy and Mahadevan Ramesh. **The ACE of Soft Skills**. New Delhi: Pearson, 2010.

PL6511 PLASTICS PROCESSING LABORATORY – 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 differenthand 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

PL6512 POLYMER ENGINEERING LABORATORY L T P C
0 0 4 2

OBJECTIVE:
To practice the students on different polymerization techniques

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

OUTCOME:
Upon completion of this practical course, the student would be able to carry out polymerization and study the kinetics of reactions.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

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.

PL6601 FUNDAMENTALS OF PLASTICS MOULD AND DIE DESIGN **L T P C**
3 0 0 3

OBJECTIVES:

To enable the students

- To learn the fundamentals of mould design and different types of moulds.
- To learn the basic product design aspects related to the products made by injection molding, extrusion and blow moulding.

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

OUTCOME:

Upon completion of this course, the students will understand the basics of Plastics mould design and also product design. They also acquire knowledge about various moulds for different processing techniques.

TEXTBOOKS:

1. Plastic Design & Processing - By Sharma, S.C.
2. Injection Mould Design Fundamentals (Vol. I& II) - By Glanvill & Denton
3. Plastics Moulds & Dies - By Sors, & Others.

REFERENCES:

1. Injection Mould -By VDI.
2. Injection Mould Design for Thermoplastic - By Pye, R.G.W.
3. Injection Mould & Molding - By Dym.
4. Injection Moulds – 130 Proven Design - By Gastrow, H.
5. Plastics Product Design Engineering Hand Book - By Dubois, H.
6. Plastics Product Design & Process Engineering - By Belofsky, Harold.

PL6606 RUBBER TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

- To provide the students with basic knowledge on the natural rubber and various synthetic rubbers and their processing.
- To enable the students to understand the need of various additives and compounding of rubbers and vulcanization.
- To enable the students to learn the basic processing of rubber products like hose conveyor belts etc.

UNIT I NATURAL RUBBER 9

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

UNIT II COMPOUNDING DESIGN AND VULCANIZATION 9

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

UNIT III SYNTHETIC ELASTOMERS 9

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

UNIT IV THERMOPLASTIC ELASTOMERS 9

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

UNIT V RUBBER PRODUCT MANUFACTURING 9

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

TOTAL : 45 PERIODS

OUTCOME:

Upon completion of this course, the students will acquire the knowledge of natural rubber and other synthetic elastomers. They learn the basics of rubber compounding and vulcanization and rubber products manufacturing.

TEXTBOOKS:

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

REFERENCES:

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

PL6602 PLASTICS TESTING TECHNIQUES – I L T P C
3 0 0 3

OBJECTIVE:

- To develop the knowledge of National & International standards for testing methods.
- To create the knowledge about the different testing techniques and its basic concepts for evaluating the chemical, mechanical, electrical, optical, thermal, and permanence properties of plastic materials.
- To enable the students to identify and compare the properties of different plastics materials.
- To enable the students to learn about the property of the plastic material for several applications.

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

OUTCOME:

Upon completion of this course,

- Students will learn how the plastics materials are tested for its chemical, mechanical, electrical, optical, thermal, and permanence properties.
- Students will be able to identify the plastic materials for some specified applications based on its property.

TEXTBOOKS:

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

REFERENCES:

1. Brown; Paul F (Ed), Hand Book of Plastics Test Methods, Longman Scientific and Technical, Harlow (1988).
2. Shah, Vishnu, Hand Book of Plastics Testing Technology, John Wiley and Sons, SPE Monograph (1984).
3. Blythe; A. R., Electrical Properties of Polymers, Cambridge University Press, Cambridge (1979).

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

PL6603 PROCESS CONTROL & INSTRUMENTATION L T P C
3 0 0 3

OBJECTIVES:

- To enable the students in understanding instrumentation and control systems used in various processing machines.
- To understand the construction, operation, and application of temperature and flow measurement instruments.

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

OUTCOME:

Students would learn about various control systems and construction and operation of temperature and flow measurement instruments.

TEXTBOOKS:

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.

REFERENCES:

1. Oggunaika B.A. and Ray W.H., "Process Dynamics, Modeling and control". Oxford University Press, U.K. 1994.
2. Alciatore D.G. and Histand M.B., "Introduction to Mechatronics", Tata McGraw Hill.
3. Bolton W. "Mechatronics", Pearson Education Singapore.

PL6604 ADDITIVES AND COMPOUNDING L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To know various draw backs of polymer materials and suitable remedies.
- To understand the mechanism of degradation of polymers and stabilizing additives
- To know the various compounding methodologies for plastics materials and learn the maintenance of compounding machinery..

UNIT I **9**

Fillers-Antioxidants-Thermal Stabilisers,. Ultraviolet stabilizer. Colourants-Fire retardants-Coupling agents-blowing-agents-

UNIT II **9**

Plasticisers, Toughening-agents - Antistatic agents-Anti blocking agents-Slip and antislip agents-processing aids - Lubricants- 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

OUTCOME:

Students will have clear understanding of various types of additives for plastics and their merits and demerits. They learn about various compounding methods used in the manufacturing of compounded thermoplastics and thermosets.

TEXTBOOKS:

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.

REFERENCES:

1. Hand Book of Plastics Test Methods by Brown R.P.
2. Mascia; L.,The Role of Additives in Plastics, Edward Arnold Publishers Ltd., U. K. (1974).
3. Murphy; John, Additives for Plastics Handbook, 2nd Edition, Elsevier Advanced Technology, Oxford.

PL6605 PLASTICS PROCESSING TECHNOLOGY – II L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To understand the processing techniques like thermoforming, calendaring, and rotational moulding.
- To learn the manufacturing of cellular plastics.
- To learn the basic of machining and joining of plastics by various adhesion and welding techniques.

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

TOTAL : 45 PERIODS

OUTCOME:

Upon completion of this course, the students will acquire the knowledge of specific processing techniques such as thermoforming, calendaring, and rotational moulding. They also learn the machining and joining of plastic materials.

TEXTBOOKS:

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.

REFERENCES:

1. Plastics Materials & Processing - By Schwartz & Goodman.
2. Injection Molding - By Athalye, A.S.
3. Injection Molding Technology - By V.D.I.
4. Innovation in Polymer Processing - By Stevenson.
5. Extrusion The definitive Processing Guide and Hand Book - By Giles, H.H & Others.
6. Compression Molding - By Iyesew, A.I.
7. Polymer Extrusion - By Rauwedaal, Chris.
8. Thermoforming - By James & Throne.
9. Basic Principle of rotational molding - By Crawford, R.J & Throne, J.L.
10. Basic Principle of Rotational Molding - By Bruins.
11. Basic Principle of Thermoforming - By Brycle, D.M
12. Plastics Injection Molding - By Brycle, D.M.
13. Injection molding of Plastics component - By Bown John.
14. Plastics Mold Design Vol.1 Compression & Transfer Moulds - By Bebb.
15. Plastics forming - By Beadle.
16. Plastics Forming - By Figher.
17. Calendering of Plastics - By Elden & Swan.
18. Welding of Plastics - By New Man.

PL6611 PLASTICS PROCESSING LABORATORY – II L T P C
0 0 4 2

OBJECTIVE:
To practice the students in different types of moulding machines.

S. N.	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 molding & 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
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

OUTCOME:

Upon completing this practical course, the student will have hands on experience on different types of moulding machines

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PL6612 PLASTICS TESTING LABORATORY – I L T P C
0 0 4 2

OBJECTIVE:
To train the students on testing of plastic materials

LIST OF EXPERIMENTS

Sl. No.	Experiment
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,
7)	Testing of Electrical and Optical properties of Plastics
8)	Introduction to product testing

TOTAL: 60 PERIODS

OUTCOMES:
Upon completion of this course, the students would be able to
- Determine important properties of plastic materials
- Prepare specimen by injection moulding and contour cutting

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Sl. No	Name of the Equipment	Quantity Required
1	Melt Flow Index Tester	1 No.
2	Universal testing machine	1 Nos.
3	Tear strength tester	1 No.
4	Impact strength tester	1Nos.
5	Dart Impact tester for Films and laminates	1 No.
6	Shore A – Hardness tester	1 No.
7	Shore D – Hardness tester	1 No.
8	Rockwell Hardness tester	1 No.
9	Barcol Hardness tester	1 No.
10	Q-UV weatherometer	1 No.
Specimen Preparation		

Sl. No	Name of the Equipment	Quantity Required
1	Melt Flow Index Tester	1 No.
11	Injection moulding machine	1 No.
12	Compression moulding machine	1 Nos.
13	Two roll mill	1 No.
14	Contour cutter	1 No.
Electrical and Optical Properties		
15	Volume and Surface resistivity	1 No.
16	Dielectric strength	1 Nos.
17	Arc Resistance	1 No.
18	Haze meter	1 No.

PL6701 POLYMER COMPOSITE TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To understand the properties and manufacturing of various polymer matrix materials used for Plastic composites.
- To know the manufacturing, different grades and properties of various reinforcements used in Plastic composites.
- To learn about the functions and requirements of different types of additives needed in the manufacture of plastics composites.
- To learn various processing techniques , testing and applications of fibre reinforced plastics

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**

Thermosetting and thermoplastic matrix materials for the composites – unsaturated polyester resins, epoxy resins, vinyester resins – curing of these resins and their selection for a particular application

UNIT III **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 IV **9**

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

UNIT V **9**

Prepregs - 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

OUTCOME:

Students would have clear understanding of plastics composites – various components like matrix, reinforcement, special additives etc. They also learn about various processing techniques used for the manufacturing of plastics composites, testing of composites and various application areas.

TEXTBOOKS:

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 Engineers, Woodhead Publishing Ltd., Cambridge (1994), Reprint (2007).

REFERENCES:

1. Macosko; Christopher W., RIM: Fundamentals of Reaction Injection Moulding, Society of Plastics Engineer, Hanser Publisher, Munich (1989).
2. Miller; Edward, Introduction to Plastics and Composites, Marcel Dekker, Inc., New York (1996).

PL6702 PLASTICS TESTING TECHNIQUES - II **L T P C**
3 0 0 3

OBJECTIVE:

- To develop knowledge of National & International standards for testing methods.
- To create the knowledge about the conditioning of samples and sample preparation techniques for testing various properties of plastics materials.
- To enable the students to learn about the evaluation of thermal, electrical, optical and mechanical properties of plastics materials.
- To create knowledge about testing of plastics products as per the standards.

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

OUTCOME:

Upon completion of this course

- Students will learn how the plastics materials are tested for its chemical, mechanical, electrical, optical, thermal, and permanence properties.
- Students will be able to know how the quality of the plastics products can be controlled.

TEXTBOOKS:

1. Simple Methods for Identification of Plastics By Brawn, R.B.Analysis of Plastics By Crompton, J.
2. Plastic Engineering Hand Book & D-5 By Society of Plastics Industry Inc Identification & Analysis of PlasticsBy Haslam & Others..
3. 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).

REFERENCES:

1. Brown; Roger P (Ed.), Hand Book of Polymer Testing, Marcel Dekker, Inc, New York (1999).
2. Brown; Paul F (Ed), Hand Book of Plastics Test Methods, Longman Scientific and Technical, Harlow (1988).

3. Shah, Vishnu, Hand Book of Plastics Testing Technology, John Wiley and Sons, SPE Monograph (1984).
4. Mitcheli Jr.; John, Applied Polymer Analysis and Characterization-Recent Development in Techniques, Instrumentation, Problem Solving, Hanser Publishers, Munich.
5. Plastics Testing Technology Hand book By Shah, Vishu.
6. Hand Books of Plastics Test Methods By Brown, R.P.
7. Testing and Evaluation of Plastics By Mathur, A.A & Bhardwaj, I.S.
8. Hand Book of Plastics Test Method By Jamead, G.C.I & Riley, M.M.
9. Hand Book of Plastics Technology 2 vol. By Allen, W.S & Baker P.N.

PL6703 INDUSTRIAL MANAGEMENT & COSTING L T P C
3 0 0 3

OBJECTIVES:
To enable the students
- To learn the principles of organization management, entrepreneurship, and total quality management.
- To understand the costing of an organization.

UNIT I PRINCIPLES OF MANAGEMENT ORGANISATION 9
Planning, organization, staffing, coordination, directing, controlling, Communicating, Organization as a process and structure: Types of organization.

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
- 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

OUTCOME:

Upon completion of this course, the student

- Will develop the management skills
- Will familiarize in total quality manageme
- Will understand the various elements costing of an organization

TEXTBOOKS:

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.

REFERENCES:

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

PL6704 PLASTICS PRODUCT DESIGN L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To understand the concepts of product design and composite product design.
- To learn the design for threaded moulds and insert moulded products.

UNIT I 10

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 **8**

Moulded threads—thread pieces—threaded holes
Inserts-Materials-Selection of metal for inserts-minimum wall thickness of material round 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

OUTCOME:
Students will acquire the knowledge and principles of basic product design.

TEXTBOOKS:

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
3. Publishers, Munich Vienna New York, 1994.

REFERENCES:

1. N G Mc Crum, Principles of Polymer Engineering, Oxford Science Publications, New York, 1997.
2. Belofsky, H., “Plastics Product Design and Processing Engineering, Hanser Publishers, Munich Vienna New York, 1994.
3. Plastics Product Design Engineering Hand Book- By Dubois, H.
4. Plastics Product Design & Process Engineering -By Belofsky, Harold.

PL6711 PLASTICS TESTING LABORATORY – II L T P C
0 0 4 2

OBJECTIVE:
To train the students in testing of plastics for properties

LIST OF EXPERIMENTS

Sl. No.	Experiment
1)	Compounding, Blending using Two Roll Mill and Specimen
2)	Determinations of Carbon Black Content and Dispersion of Olefinic
3)	Determination of environmental stress cracking resistance for
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

OUTCOMES:
At the end of this course, the students would be in the position to test the plastics for their functional properties used for different applications.

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

Name of the Equipment	Quantity Required
Ribbon Blender	1No.
Compounding Extruder	1No.
Injection moulding machine	1 No.
Compression moulding machine	1Nos.
Two roll mill	1 No.
Contour cutter	1 No.
Carbon black content tester	1 No.
Environmental stress cracking resistance tester	1 No.
Mechanical and Product Testing	

Name of the Equipment	Quantity Required
Ribbon Blender	1No.
Compounding Extruder	1No.
Universal testing machine	1Nos.
Tear strength tester	1 No.
Impact strength tester	1 Nos.
Abrasion resistance tester	1 No.
Burst strength tester	1 No.
Humidity chamber	1 No.
Gas permeability tester	1 No
Hydrostatic bursting pressure tester	1 No
Reversion tester	1 No
Falling Dart Impact Tester for films and Pipes	1No.

PL6712 DESIGN AND MOULD FLOW ANALYSIS PRACTICE USING CAD/CAM/CAE

L T P C
0 0 4 2

OBJECTIVE:
To practice the students in computer aided design software for mould design

LIST OF EXPERIMENTS

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 PERIODS

OUTCOMES:

At the end of this course, the students can design the moulds using CAD software

LIST OF EQUIPMENT FOR BATCH OF 30 STUDENTS

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.

PL6001 PLASTICS WASTE MANAGEMENT AND RECYCLING TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To know various sources of plastics waste generation and the segregation methods for recycling the plastics and recycling codes of commodity and engineering plastics.
- To learn about primary recycling techniques with examples/case studies.
- To understand the recycling of various commodity and engineering plastics.

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 aspects.
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

OUTCOME:

On completing this course, the students would understand the impact of plastic waste on environment and learn the technologies available for recycling and reusing of both commercial and engineering plastics. They also become familiarize with various policies and legislations related to environmental issues of plastics waste.

TEXT BOOKS:

1. “Plastic Waste Management" Nabil Mustafa, Marcel Dekker, New York, 1995.
2. John Schiles, Polymer Recycling.

REFERENCE:

1. Recycling & Plastics Waste Management, Edited by Dr.J.S.Anand, CIPET, 1997.

PT6003 PLASTICS PACKAGING TECHNOLOGY L T P C
3 0 0 3

OBJECTIVE:
To enable the students to understand the concepts of materials used in packaging, machinery in packaging and testing of packaging material.

UNIT I **9**
Introduction to plastics packaging: functions of packaging, advantages of plastic packaging, distribution hazards, special requirements of food and medical packaging, packaging legislation and regulation. Packaging as a system: Elements, approach, package, design, relation criteria for packaging materials, packaging equipment checklist, case histories Major packaging plastics Introduction - PE, PP, PS, PVC, polyesters, PVA, EVA, PA, PC, ionomers & fluoro polymers.

UNIT II **9**
Conversion process - Compression & transfer for moulding, Injection moulding, Blow moulding, Extrusion, roto moulding, thermoforming, Lamination, metallizing, decoration process, Shrink wrapping, Pallet & stretch wrapping, sealing methods, Plasma barrier coatings. Energy requirement for conversion

UNIT III **9**
Extrusion, film and flexible packaging - extrusion, cast film & sheet, Blown film, Multi layer film & sheet coatings, laminations & coextrusions, stretch and shrink wrap, pouching, sealing, evaluation of seals in flexible packages, advantages of flexible packaging - flexible packaging products. Specialized packaging for food products.

UNIT IV **9**
Thermoformed, moulded and rigid packages, Thermoforming packages: Position & thermoforming & wrap forming, variations in thermoforming and solid phase pressure forming, scrabbles, twin sheet & melt - to- mold thermoforming, skin packaging, thermoforming moulds, thermoforming fill- real, Aseptic thermoforming, advantages & disadvantages of moulding foams, other cushioning materials & distribution packaging - Polystyrene & other foams systems cushioning, Design of molded cushioning systems, plastic pallets, drums & other shipping containers.

UNIT V **9**
Testing of plastic packages, Barrier, Migration & compatibility, Printing, labeling & pigmenting, Sterilization systems and health care products. Packaging hazards and their controls. Environmental considerations.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completing this course, the students
- Will demonstrate the plastic packaging process.
- Will familiarize in testing of plastic packaging
- Will attain the knowledge of thermoforming packaging

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

REFERENCES:

1. Walter Soroka, 'Fundamentals of Packing Technology' Institute of Plastics Packaging, 1999.
2. Neil Farmer (Ed.) Trends in Packaging of Food, Beverages and Other Fast-Moving Consumer Goods, Wood Head Publishing India Pvt Ltd. 2013.

PT6071 FIBRE TECHNOLOGY L T P C
3 0 0 3

OBJECTIVES:

To enable the students to learn the

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

UNIT I **9**

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

UNIT II **9**

Polymer production for acrylic fibres - polypropylene - production of other fibres - PVC fibres - PVA fibres - Aramid fibres - Melt spinning - Polymer feed - melt spinning equipment - high speed spinning - spin draw processes - crystallization method - melt spinning of PET & PP stable fibres - wet and dry spinning comparison. Spin finishes - functions of spin finish - methods of application of spin finish - spin finish for polyester staple fibres - spin finish for texturing process - effect of spin finish on dyeing.

UNIT III **9**

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

UNIT IV **9**

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

UNIT V **9**

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

TOTAL : 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will have knowledge of polymer used in fiber formation.
- Will demonstrate the processing techniques for fiber formation.
- Will attain the knowledge of testing of fiber.

TEXT BOOK:

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

REFERENCES:

1. Fourne, Franz, “Synthetic Fibres, Machines and Equipment, Manufacture, Properties”, Hanser Publishes, 1999.
2. Corbman Bernard P., “Textiles: fibre to fabric”, Sixth Edition, McGraw Hill, 1983.

PL6003 BIODEGREDABLE POLYMERS L T P C
3 0 0 3

OBJECTIVE:

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

UNIT I CHEMISTRY AND BIOCHEMISTRY OF POLYMER DEGRADATION 9

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

UNIT II PARTICULATE STARCH BASED PRODUCTS 9

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

UNIT III BIOPOLYESTERS 9

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

UNIT IV RECYCLING TECHNOLOGY FOR BIODEGRADABLE PLASTICS 9

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

UNIT V TEST METHODS & STANDARDS FOR BIODEGRADABLE PLASTICS 9

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

TOTAL : 45 PERIODS

OUTCOME:

Upon completion of this course, the students

- Will familiarize about polymer degradation.
- Will develop the knowledge in mechanism of degradation
- Will acquire the skill in assessing bio-degradability of polymers

TEXT BOOKS:

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

REFERENCES:

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

PL6004 SPECIALITY POLYMERS L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To know about the various structural features of a polymers that make them high temperature resistant and flame resistant.
- To understand the basics of conducting polymers, their synthesis, doping and applications.
- To learn the synthesis and applications of ionic polymers and ionomers and their applications
- To know about various specialty polymers that are used in telecommunications, biomedical, construction, and rocket propellants.

UNIT I 9

High temperature and fire resistant polymers improving low performance polymers for hightemperature 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 resins 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 V **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

OUTCOME:

Students shall have learnt about various aspects related to high temperature resistant and flame resistant polymers. Students must be able to select various polymers for specific applications like aerospace, telecommunications, biomedical etc.

TEXTBOOKS:

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

REFERENCES:

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

PL6005 **POLYURETHANE TECHNOLOGY** **L T P C**
3 0 0 3

OBJECTIVE:

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

UNIT I **9**

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

UNIT II **9**

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

UNIT III **9**

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

UNIT IV **9**

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

UNIT V **9**

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

TOTAL : 45 PERIODS

OUTCOMES:

Upon completing this course, the students

- Will understand the importance of poly urethane in engineering application
- Will familarize about manufacturing techniques for poly urethane
- Will attain the knowledge of qualitative and quantitative analysis of poly urethane

TEXT BOOKS:

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

REFERENCES:

1. David Landel and Steve Lee , Poly Urethanes, Jhon Wiley 2002.
2. James Henry Saunders and Kurtz Charles Frisch, Poly Urethanes: Chemistry and Technology, R. E. Krieger, 1987.

PL6006 **POLYMER NANOCOMPOSITES** **L T P C**
3 0 0 3

OBJECTIVES:

To enable the students

- To understand the basics and chemistry of nano size materials and their synthesis, characterization and applications.
- To know the manufacturing and processing of clay/polymer nanocomposites.
- To learn about the flow behavior of nanofiller/polymer systems and their processing and applications.

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 of polymer nanocomposites.

TOTAL : 45 PERIODS

OUTCOME:

Students would demonstrate a clear understanding of nanocomposites – clay/polymer nanocomposites, carbon nanotube polymer composites, and metal/polymer nanocomposites. They will be able to correlate the processing and economics of polymer nanocomposites compared to conventional polymer composites.

TEXT BOOKS:

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).

REFERENCE:

1. 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).

PT6007 ADHESIVES AND SURFACE COATINGS **L T P C**
3 0 0 3

OBJECTIVES:

To enable the students to understand the following:

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

UNIT I **9**

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

UNIT II **9**

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

UNIT III **9**

Joint design, stress, types of joints, selection of joint detail, joint criteria, surface preparation of adherends-metals, plastics and rubbers. Adhesive bonding processmethods 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

OUTCOMES:

Upon completing this course, the students

- Will attain the knowledge in mechanism of adhesion
- Will familiarize about the compounding of paints
- Will demonstrate the adhesive types and application

TEXT BOOKS:

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

REFERENCES:

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

PL6008 **BIOMEDICALS PLASTICS** **L T P C**
3 0 0 3

OBJECTIVES:
To enable the students
- To understand various natural and synthetic polymers used for biomedical applications and their compatibility with biological system.
- To learn about the plastics that are used as implants in cardiovascular, ophthalmology, and other artificial organs.
- To be familiarized with the polymers used in dental applications.

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

OUTCOME:
Students would understand about various plastics that are used for biomedical applications such as cardiovascular, dental, ophthalmology, and other artificial organs. Students also understand the compatibility of biomedical polymers with biological systems..

TEXTBOOKS:
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.

REFERENCES:

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

GE6084 HUMAN RIGHTS L T P C
3 0 0 3

OBJECTIVES :

- To sensitize the Engineering students to various aspects of Human Rights.

UNIT I **9**

Human Rights – Meaning, origin and Development. Notion and classification of Rights – Natural, Moral and Legal Rights. Civil and Political Rights, Economic, Social and Cultural Rights; collective / Solidarity Rights.

UNIT II **9**

Evolution of the concept of Human Rights Magana carta – Geneva convention of 1864. Universal Declaration of Human Rights, 1948. Theories of Human Rights.

UNIT III **9**

Theories and perspectives of UN Laws – UN Agencies to monitor and compliance.

UNIT IV **9**

Human Rights in India – Constitutional Provisions / Guarantees.

UNIT V **9**

Human Rights of Disadvantaged People – Women, Children, Displaced persons and Disabled persons, including Aged and HIV Infected People. Implementation of Human Rights – National and State Human Rights Commission – Judiciary – Role of NGO's, Media, Educational Institutions, Social Movements.

TOTAL : 45 PERIODS

OUTCOME :

- Engineering students will acquire the basic knowledge of human rights.

REFERENCES:

1. Kapoor S.K., “Human Rights under International law and Indian Laws”, Central Law Agency, Allahabad, 2014.
2. Chandra U., “Human Rights”, Allahabad Law Agency, Allahabad, 2014.
3. Upendra Baxi, The Future of Human Rights, Oxford University Press, New Delhi.

PL6009 STATISTICAL QUALITY CONTROL TECHNIQUES L T P C
3 0 0 3

OBJECTIVES:

To enable the students

- To learn the basics of quality control techniques and related terminologies and definitions.
- To learn and apply various statistical quality control techniques.
- To understand the need of quality control and testing in improving the product quality.
- To know the basics of a quality management system like ISO 9000.

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

OUTCOME:
Students will be able to understand the basics of quality control techniques. Students must be able to apply various statistical quality control techniques for maintaining the quality of products in a manufacturing system. They will be familiarized with quality system like IS 9000.

TEXTBOOKS:
1. Banks, Jerry : Principles of Quality Control, John Wiley & Sons.
2. Agarwal B.L. : Basic Statistics, New Age International (P) Ltd., New Delhi.

REFERENCE:
1. Grant E.L. & Leavenworth R.S. : Statistical Quality Control : McGraw Hill Book Company, New Delhi.

GE6757 TOTAL QUALITY MANAGEMENT L T P C
3 0 0 3

OBJECTIVE :
To facilitate the understanding of Quality Management principles and processes.

UNIT I INTRODUCTION 9
Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Costs of quality.

UNIT II TQM PRINCIPLES 9
Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating.

UNIT III TQM TOOLS AND 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 AND TECHNIQUES II 9
Control Charts - Process Capability - Concepts of Six Sigma - Quality Function Development (QFD) - Taguchi quality loss function - TPM - Concepts, improvement needs - Performance measures.

UNIT V QUALITY SYSTEMS 9
Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors..

TOTAL : 45 PERIODS

OUTCOME :

The student would be able to apply the tools and techniques of quality management to manufacturing and services processes.

TEXTBOOK:

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", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
3. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.

GE6075 PROFESSIONAL ETHICS IN ENGINEERING LT P C
3 0 0 3

OBJECTIVE:

- To enable the students to create an awareness on Engineering Ethics and Human Values, to instill Moral and Social Values and Loyalty and to appreciate the rights of others.

UNIT I HUMAN VALUES 10

Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management.

UNIT II ENGINEERING ETHICS 9

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS 9

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination

UNIT V GLOBAL ISSUES 8

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership –Code of Conduct – Corporate Social

Responsibility

TOTAL : 45 PERIODS

OUTCOME :

Upon completion of the course, the student should be able to apply ethics in society, discuss the ethical issues related to engineering and realize the responsibilities and rights in the society

TEXTBOOKS:

1. Mike W. Martin and Roland Schinzinger, “Ethics in Engineering”, Tata McGraw Hill, New Delhi, 2003.
2. Govindarajan M, Natarajan S, Senthil Kumar V. S, “Engineering Ethics”, Prentice Hall of India, New Delhi, 2004.

REFERENCES:

1. Charles B. Fleddermann, “Engineering Ethics”, Pearson Prentice Hall, New Jersey, 2004.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning, 2009
3. John R Boatright, “Ethics and the Conduct of Business”, Pearson Education, New Delhi, 2003
4. Edmund G Seebauer and Robert L Barry, “Fundametals of Ethics for Scientists and Engineers”, Oxford University Press, Oxford, 2001
5. Laura P. Hartman and Joe Desjardins, “Business Ethics: Decision Making for Personal Integrity and Social Responsibility” Mc Graw Hill education, India Pvt. Ltd.,New Delhi 2013.\
6. World Community Service Centre, ‘ Value Education’, Vethathiri publications, Erode, 2011

Web sources:

1. www.onlineethics.org
2. www.nspe.org
3. www.globalethics.org
4. www.ethics.org

GE6083 DISASTER MANAGEMENT L T P C

3 0 0 3

OBJECTIVES:

- To provide students an exposure to disasters, their significance and types.
- To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction
- To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
- To enhance awareness of institutional processes in the country and
- To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live, with due sensitivity

UNIT I INTRODUCTION TO DISASTERS 9

Definition: Disaster, Hazard, Vulnerability, Resilience, Risks – Disasters: Types of disasters – Earthquake, Landslide, Flood, Drought, Fire etc - Classification, Causes, Impacts including social, economic, political, environmental, health, psychosocial, etc.- Differential impacts- in terms of caste, class, gender, age, location, disability - Global

trends in disasters: urban disasters, pandemics, complex emergencies, Climate change-Dos and Don'ts during various types of Disasters.

UNIT II APPROACHES TO DISASTER RISK REDUCTION (DRR) 9

Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of-community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processess and Framework at State and Central Level- State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies.

UNIT III INTER-RELATIONSHIP BETWEEN DISASTERS AND DEVELOPMENT 9

Factors affecting Vulnerabilities, differential impacts, impact of Development projects such as dams, embankments, changes in Land-use etc.- Climate Change Adaptation- IPCC Scenario and Scenarios in the context of India - Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT IV DISASTER RISK MANAGEMENT IN INDIA 9

Hazard and Vulnerability profile of India, Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management, Institutional arrangements (Mitigation, Response and Preparedness, Disaster Management Act and Policy - Other related policies, plans, programmes and legislation – Role of GIS and Information Technology Components in Preparedness, Risk Assessment, Response and Recovery Phases of Disaster – Disaster Damage Assessment.

UNIT V DISASTER MANAGEMENT: APPLICATIONS AND CASE STUDIES AND FIELD WORKS 9

Landslide Hazard Zonation: Case Studies, Earthquake Vulnerability Assessment of Buildings and Infrastructure: Case Studies, Drought Assessment: Case Studies, Coastal Flooding: Storm Surge Assessment, Floods: Fluvial and Pluvial Flooding: Case Studies; Forest Fire: Case Studies, Man Made disasters: Case Studies, Space Based Inputs for Disaster Mitigation and Management and field works related to disaster management.

TOTAL: 45 PERIODS

OUTCOMES:

The students will be able to

- Differentiate the types of disasters, causes and their impact on environment and society
- Assess vulnerability and various methods of risk reduction measures as well as mitigation.
- Draw the hazard and vulnerability profile of India, Scenarious in the Indian context,
- Disaster damage assessment and management.

TEXTBOOKS:

1. Singhal J.P. "Disaster Management", Laxmi Publications, 2010. ISBN-10: 9380386427 ISBN-13: 978-9380386423
2. Tushar Bhattacharya, "Disaster Science and Management", McGraw Hill India Education Pvt. Ltd., 2012. **ISBN-10:** 1259007367, **ISBN-13:** 978-1259007361]
3. Gupta Anil K, Sreeja S. Nair. Environmental Knowledge for Disaster Risk Management, NIDM, New Delhi, 2011
4. Kapur Anu Vulnerable India: A Geographical Study of Disasters, IIAS and Sage Publishers, New Delhi, 2010.

REFERENCES

1. Govt. of India: Disaster Management Act , Government of India, New Delhi, 2005
2. Government of India, National Disaster Management Policy,2009.