ANNA UNIVERSITY, CHENNAI
AFFILIATED INSTITUTIONS
R - 2009
M.TECH. PLASTIC TECHNOLOGY
I SEMESTER (FULL TIME) CURRICULUM AND SYLLABI

SEMESTER I

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEORY</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>PT9211</td>
<td>Plastic Materials</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PT9212</td>
<td>Plastics Processing Technology</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PT9213</td>
<td>Plastics Mould &amp; Product Design</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PT9214</td>
<td>Plastics Mould Manufacturing Technology</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>5.</td>
<td>PT9215</td>
<td>Additives and Compounding</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>6.</td>
<td>PT9216</td>
<td>Mathematics for Plastics Technology</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td><strong>PRACTICAL</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>PT9217</td>
<td>Plastics Processing Laboratory – I</td>
<td>0</td>
<td>0</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>8.</td>
<td>PT9218</td>
<td>Plastics Product/Tool Design Laboratory</td>
<td>0</td>
<td>0</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>9.</td>
<td>PT9219</td>
<td>Seminar I</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td>19</td>
<td>0</td>
<td>20</td>
<td>26</td>
</tr>
</tbody>
</table>

ELECTIVE I

<table>
<thead>
<tr>
<th>SL. NO</th>
<th>COURSE CODE</th>
<th>COURSE TITLE</th>
<th>L</th>
<th>T</th>
<th>P</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>PT9251</td>
<td>Plastics Characterization Techniques</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>PT9252</td>
<td>Biodegradable Plastics</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PT9253</td>
<td>Advanced Plastics Processing Technology</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>4.</td>
<td>PT9254</td>
<td>Polymeric Nanocomposites</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
</tbody>
</table>
UNIT I  POLYMER CHEMISTRY 9

UNIT II  COMMODITY PLASTICS 9
Sources and Manufacture of raw materials - Methods of manufacture of Polymer, General Properties and applications of Polyethylene - Polypropylene and their copolymers - Vinyl Polymers and Co-polymer - Polystyrene and Copolymers - Acrylic and copolymers - Cellulose Polymers.

UNIT III  ENGINEERING PLASTICS 9
Sources and Manufacture of raw materials, Methods of Manufacture of Polymer, General Properties and applications of Acrylonitrile Butadiene Styrene - Polymides (PA-6, PA-66, PA-6,10, PA-11 & 12) - Polycarbonates - Polycetal & Copolymers - Thermoplastic Polyesters (PET & PBT) - Polyphenylene oxide - Polysulfones - Fluro polymers (PVF, PVDF, PTFE, PCTFE) - Thermoplastic Polyurethane.

UNIT IV  SPECIALITY PLASTICS 9
Sources and Manufacture of raw materials, Methods of manufacture of Polymer, General properties and applications of Polyphenylene Sulphide - Polyphenylene ether - Polyetherether ketone - Polyimide and related polymers - Liquid Crystal Polymers - Conductive Polymers – Plastic alloys and blends.

UNIT V  THERMOSETTING PLASTICS AND BIO-DEGRADABLE PLASTICS 9
Sources and Manufacture of raw materials, Methods of manufacture of resin - Additives - Curing and cross linking agents - General properties and applications of Phenol Formaldehyde - Urea Formaldehyde - Melamine Formaldehyde - Unsaturated Polyesters - Epoxy resins - Polyurethane and Silicones.


TOTAL : 45 PERIODS

REFERENCES
UNIT I  INTRODUCTION & INJECTION MOULDING  9
Basic principles – Classification of processing methods – Effect of polymer properties on processing behaviour.
Injection Moulding – Definition of terms – Specification – Types of machines used – Part & their functions – Cycle time – Process variables & its effect on Moulding quality – Cavity pressure profile – Factor influencing moulding shrinkage, annealing – Frozen-in Stresses – Types of clamping systems and their merits & demerits – Start up and shut down procedures – Processing parameters and special precaution to be taken while processing of Engineering plastics such as Nylon, Acetal, PC, etc., - Common moulding defects, causes and remedies.

UNIT II  COMPRESSION MOULDING  9

UNIT III  TRANSFER MOULDING & THERMOSET INJECTION MOULDING  9

UNIT IV  EXTRUSION  9

UNIT V  BLOW MOULDING  9

TOTAL : 45 PERIODS
REFERENCES

PT 9213  PLASTICS MOULD & PRODUCT DESIGN  L T P C  3 0 0 3
UNIT I  INJECTION MOULD DESIGN 9


Parting line/Parting surface: Types of parting surface - plain – stepped – irregular – local stepped and profile parting surface – complex edge form.


UNIT II  TYPES OF MOULDS 9


Blow Mould Design & Extrusion Die Design
UNIT III  COMPRESSION & TRANSFER MOULD DESIGN

Types of compression mould - open flash - semi-positive type - positive - displacement moulds - types of loading chambers - bulk factor - flash thickness - pot design - depth of loading chamber calculation - projected area - compression pressure - clamping force - deciding no. of impression by technological method - heating system - types of heaters - heat losses - heat requirement & heater capacity - advantages and disadvantages of compression mould.

Types of transfer moulds - integral pot transfer mould – Top & Bottom plunger design - auxiliary ram transfer mould - transfer pot design - projected area - transfer pressure - clamping force - pressure pad design - design of sprue runner and gate - calculations - advantages and disadvantages of transfer mould.

UNIT IV  PLASTICS 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 – steps in product design - emphasize on designing with engineering plastics - Taper or draft - Fits & Tolerances – Designing with plastics for load bearing applications like gears, bearing, etc.


UNIT V  TYPES OF INSERTS


Quality and economy – tooling aspects on product design – process variables vs product design – product design appraisal - Product design limitations – shrinkage vs tolerance – end use requirements with case studies – product design tips - prototype development – rapid prototyping techniques – stereo lithography.

TOTAL: 45 PERIODS

REFERENCES
UNIT I    MATERIAL FOR MOULDS
Selection of steels – Properties of steels – common steels used for moulds – strength of materials, calculation of wall thickness for cavity – Insert size – Life of mould
Non-ferrous metals for mould construction: Application – Zinc base alloys – Aluminium alloys – Beryllium copper
Non-metallic materials for mould construction: Advantages and its applications – epoxies - polyester – silicon

UNIT II    SURFACE TREATMENT OF MOULD MATERIALS

UNIT III    MOULD MAKING TECHNIQUES

UNIT IV    INSPECTION AND QUALITY CONTROL OF MOULDS
Introduction to Tool Room measuring instruments – Vernier – Micrometer – Height Gauge – Slip Gauge – Dial Gauge – Measuring tapers and angles – CMM.

UNIT V    MOULD ESTIMATION, REPAIR AND PROTECTION
Procedure for estimating mould cost – General outline – Cost calculation – Basic moulds – Cavity – Basic functional components – Special functions etc.

TOTAL: 60 PERIODS

REFERENCES
UNIT I  INTRODUCTION TO ADDITIVES 9
Introduction - Technological Requirements - Classification - Chemistry and Mechanism - Selection Criteria - General effect on Properties - Evaluation and functions of additives.

UNIT II ADDITIVES 9

UNIT III COMPOUNDING TECHNIQUES 9
Selection of Polymers and Compounding ingredients - General objectives - possibilities and limitations of mixing and compounding - Methods of incorporation of additives into polymer materials.

UNIT IV COMPOUNDING EQUIPMENTS 9

UNIT V END USE MARKET FOR PLASTICS 9
Principles of Material selection including consideration of conventional materials competitive with plastics - Case studies on material suitability (e.g., Plastic Gears, Feeding Bottle, Bowels for micro wave ovens). Survey and uses of plastics with reasons for their importance in major industries like, Agriculture, Packaging, Building, Transport, Electrical, Electronics and Telecommunications, Medical and Furniture.

TOTAL : 45 PERIODS

REFERENCES
UNIT I

UNIT II

UNIT III
Vector and tensor analysis, Matrices and Determinants, Laplace and Fourier transforms. Introduction to numeric use of the above techniques in plastics engineering and calculations.

UNIT IV
Probability: Random experiment, classical and statistical definition of probability, Distribution Functions: - Binomial, Normal, Poisson, Uniform, Mean, Variance, Moment dispersion, Kertosis, Median, Mode, Least square method of curve fitting, Regression Analysis, correlation co-efficient.

UNIT V

TOTAL : 45 PERIODS

REFERENCES

PT9217
PLASTICS PROCESSING LABORATORY - I

1. Injection Moulding (Hand Operated)
2. Injection Moulding (Semi-Automatic)
3. Injection Moulding (Automatic)
4. Extrusion Processes
5. Compression Moulding (Hand Operated)
6. Compression Moulding (Semi Automatic)
7. Blow Moulding (Hand Operated)
8. Scrap Grinding

TOTAL : 90 PERIODS
LABORATORY REQUIREMENTS

1. Injection moulding machine (conventional) - 2 Nos.
2. Plastic tube extrusion machine - 1 No.
5. Blow moulding machine (conventional) - 1 No.

REFERENCES:

PT9218  PLASTICS PRODUCT/TOOL DESIGN LABORATORY  L T P C
              0 0 12 4

1. Part Drawing from product
2. Design of Mould elements
3. Two plate Mould Design (Injection) – Single impression
4. Two plate Mould Design – Multi impression
5. Three plate Mould Design (Injection) – Multi impression
6. Split Mould Design (Injection)
7. Compression Mould Design
8. Transfer Mould Design
9. Mould Design for Industrial Components
10. Blow Mould Design
11. Extrusion Die Design

TOTAL: 180 PERIODS

LABORATORY REQUIREMENTS

1. Drafting machine - 30 Nos.
2. Computer system with Auto cad software - 15 Nos.

REFERENCES
UNIT I MOLECULAR WEIGHT DETERMINATION
Molecular weight averages - Molecular weight determination techniques like End-group analysis, Colliquative Properties - Ebulliometry, Osmometry and Vapour phase Osmometry, Light scattering techniques, Solution viscometry, and Gel Permeation Chromatography.

UNIT II SPECTROSCOPIC CHARACTERIZATION

UNIT III MICROSCOPIC AND CHROMATOGRAPHIC CHARACTERIZATION

UNIT IV THERMAL CHARACTERIZATION
The basis of Thermal Analysis - Differential Thermal Analysis (DTA) and Differential Scanning Calorimetry (DSC) - Thermo-mechanical Analysis (TMA) - Thermo gravimetric Analysis (TGA) - Dynamic Mechanical Thermal Analysis (DMA) and Dielectrical Thermal Analysis.

UNIT V RHEOLOGICAL CHARACTERIZATION

REFERENCES
UNIT II  
Starch filled plastic – thermoplastic starch – starch based materials in the market – other additives for biodegradation.

UNIT III  

UNIT IV  

UNIT V  

TOTAL: 45 PERIODS

REFERENCES

PT9253  ADVANCED PLASTICS PROCESSING TECHNOLOGY  L T P C  3 0 0 3

UNIT I  SPECIALIZED INJECTION MOULDING PROCESS - I  9

UNIT II  SPECIALISED INJECTION MOULDING PROCESS – II  9
Multi-layer Moulding, Counter flow moulding, Liquid Injection Moulding processes. Structural foam moulding - Low pressure and high pressure processes - Merits & demerits.

UNIT III  ADVANCED BLOW MOULDING - I  9

UNIT IV  ADVANCED BLOW MOULDING – II  9
UNIT V      ADVANCED EXTRUSION PROCESSES
Introduction - Profile Extrusion - Material - Process - Process optimisation - Cooling
Profile applications. Process, down stream equipments - dies and application.

Multi-layer films, co-extruded sheets, Pipes, Corrugated pipes.

REFERENCES

TOTAL : 45 PERIODS