

## 5.1 PLASTIC PROCESSING TECHNIQUES - II

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### RATIONALE

The purpose of this subject is to equip the students with the knowledge of processes utilized in extrusion and blow moulding. This subject develops the competence of the students in major industrially practiced processing techniques.

### DETAILED CONTENTS

- a) EXTRUSION**
1. Introduction (6 hrs)  
Introduction to extrusion process, different types of extruders:- single screw and twin screw extruder, vented barrel extruder, general principles of operation, die swell, function of various parts i.e. barrel, screw, screenpack, die, breaker plate, adaptor.
  2. Types of screws in use for processing different plastics, Feed, Compression and Metering zone, Die zone, L/D ratio and its significance. (3 hrs)
  3. Nip rolls, bubble casing, winding equipment, cutting devices, stretching and orientation. (3 hrs)
  4. Extruder performance and their curves. (4 hrs)
  5. Blown film extrusion, extrusion of pipes, wires and cables, sheets and filaments (8 hrs)
  6. Coextrusion of films and sheets (6 hrs)
- b) BLOW MOULDING**
7. Basic principles of blow moulding, Types of blow moulding :- Extrusion blow moulding, injection blow moulding. Blow molding irregular containers (8 hrs)
  8. Materials for blow moulding (2 hrs)
  9. Production of parison, a). by extrusion b). by injection. Parison wall thickness control, Parison blowing systems, air requirement for blowing, effect of process variables on product design and properties. Parison programming, mould venting. (8 hrs)

10. Newer concepts including extrusion- stretch blow moulding, injection stretch blow moulding, multi layer moulding etc. (8 hrs)
11. Printing techniques – flexographic printing, gravure printing, pad printing, screen printing, hot stamping (4 hrs)
12. Conversion of plastic films into laminate e.g. metal plastic laminates, paper-plastic laminates, plastic-plastic laminates. Advantages of multi-layer packaging, disadvantages of multi layer packaging (4 hrs)

### **LIST OF PRACTICALS**

1. To produce rigid PVC pipe of 3 different diameters on extruder
2. To study the specification of extruder available in the lab
3. Production of component on hand operated blow molding machine, using at least 3 moulds
4. To study the specification of automatic Blow Moulding Machine
5. Production of components on semi automatic blow machine by setting the process parameters
6. To do gravure printing
7. To do printing with pad printing machines

### **RECOMMENDED BOOKS**

1. Plastic Engineering Handbook by Joel Frados
2. Processing of Plastics by AS Athalye

## 5.2 INDUSTRIAL MANAGEMENT

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### RATIONALE

The knowledge of this subject is required of all diploma holders who wish to choose industry/field as this career. This course is designed to develop understanding of various functions of management, role of workers and engineers and providing knowledge about safety and labour, industrial laws and management in different areas.

### DETAILED CONTENTS

1. Principles of Management (2 hrs)
  - Management, different functions of management: Planning, organizing, coordination and control.
  - Structure of an industrial organization.
  - Functions of different departments. Relationship between individual departments.
  
2. Human and Industrial Relations (4 hrs)
  - Human relations and performance in organization.
  - Understand self and others for effective behaviour.
  - Behaviour modification techniques.
  - Industrial relations and disputes.
  - Relations with subordinates, peers and superiors.
  - Characteristics of group behaviour and trade unionism.
  - Mob psychology
  - Grievance, handling of grievances.
  - Agitations, strikes, lockouts, picketing and gherao
  - Labour welfare.
  - Workers' participation in management.
  
3. Professional Ethics (4 hrs)
  - Concept of ethics.
  - Concept of professionalism.
  - Need for professional ethics.
  - Code of professional ethics.
  - Typical problems of professional engineers.
  - Professional bodies and their role.

4. Motivation (4 hrs)
  - Factors determining motivation
  - Characteristics of motivation.
  - Methods for improving motivation.
  - Incentives, pay, promotion, rewards.
  - Job satisfaction and job enrichment.
  
5. Leadership (4 hrs)
  - Need for leadership.
  - Functions of a leader.
  - Factors for accomplishing effective leadership.
  - Manager as a leader.
  
6. Human Resource Development (4 hrs)
  - Introduction.
  - Staff development and career development.
  - Training strategies and methods
  
7. Wage Payment (4 hrs)
  - Introduction
  - Classification of wage payment scheme.
  
8. Labour, Industrial and Tax Laws (6 hrs)
  - Importance and necessity of industrial legislation.
  - Types of labour laws and disputes.
  - Brief description of the following Acts: The Factory Act 1948; Payment of Wages Act 1936; Workmen Compensation Act 1923; Industrial Dispute Act 1947; Employee' State Insurance Act, 1948; Provident Fund Act.
  - Various types of Taxes-Production Tax, Local Tax, Sales Tax, Excise Duty, Income Tax.
  - Labour Welfare schemes.
  
9. Accidents and Safety (4 hrs)
  - Classification of accidents; according to nature of injuries i.e. fatal, temporary; according to event and according to place.
  - Causes of accidents-psychological, physiological and other industrial hazards.
  - Effects of accidents.
  - Accidents-prone workers.
  - Action to be taken in case of accident with machines, electric shock, road accident, fires and erection and construction accidents.

- Safety consciousness & publicity.
- Safety procedures.
- Safety measures-Do's and don'ts & good housekeeping (5S).
- Safety measures during executions of Electrical Engineering works.

10. Environmental Management (4 hrs)

Basics of environmental pollution, various management techniques for control of environmental pollution, various control acts for air, water, solid waste and noise.

11. Materials Management (4 hrs)

Material in industry, inventory control model, ABC Analysis, Safety stock, Re-order, level, Economic ordering quantity, Stores equipment, Stores records, purchasing procedures, purchase records, Bin card, Cardex, Material handling, Manual lifting, Hoist, Cranes, conveyors, trucks, fork trucks.

12. Financial Management (3 hrs)

Important, ledger, Journal, Profit and Loss Account, Balance Sheet, Interpretation of Statements, Ratio Analysis, Project financing, Project appraisal, return on investments.

13. Marketing and Sales (3 hrs)

Sellers and Buyers markets, Marketing, Sales, Market conditions, monopoly, oligraphy, perfect competition, Cost Elements of Cost, Contribution, Break even analysis, Budgets, Pricing Policies.

### RECOMMENDED BOOKS

1. Industrial Engineering and Management by TR Banga.
2. Industrial Engineering and Management by OP Khanna, Dhanpat Rai Publications, Delhi.
3. Industrial Management by VK Sharma, OP Harkut.
4. Sharma BR, Environmental and Pollution Awareness: Satya Prakashan, New Delhi.
5. Thakur Kailash, Environment Protection Law & Policy in India: Deep & Deep publication, New Delhi.
6. Handbook of Small Scale Industry by P.M. Bhandari.
7. Marketing Management by Philip Kotler, Prentice Hall of India, New Delhi
8. Principles of Management by Philip Kotler, TEE Publication.
9. Industrial Organisation and Management by Tara Chand, Nem Chand and Brothers, Roorkee

### 5.3 COMPUTER AIDED MOULD DESIGN

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In this practical subject, the students are required to learn the basics of software such as Mechanical Desktop, Mould Creator, Mould Flow etc. and further to design at least 2 moulds for given components using these software.

## 5.4 DESIGN OF DIES AND MOULDS - II

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### RATIONALE

A diploma holder in Plastic Technology is engaged in manufacturing plastic components for which design of moulds and dies is essential. This subject will impart them requisite knowledge and skills in design of moulds and dies.

### DETAILED CONTENTS

#### Dies

1. General features of extrusion dies (3 hrs)
2. Die materials (3 hrs)
3. Design features dies – Polymer melt flow, die geometry, material of construction, ease of maintenance and cleaning. Die land, die swell (8 hrs)
4. Heating system and temperature control (2 hrs)
5. Types of dies (2 hrs)
6. Dies for rod, flexible tube, wire coating (10 hrs)

#### Compression Mold and Transfer Molds

7. Types of compression molds – positive, semi-positive, flash and landed positive type (8 hrs)
8. Calculation of clamp pressure, ram pressure, platen size, no. of impressions. Selection of compression molding machine (5 hrs)
9. Principles of transfer molding, pot capacity, design of sprue, runner and gates (7 hrs)

#### Blow Molds

10. Materials for flow molds (2 hrs)
11. Extrusion blow molds – cavity and pinch off (6 hrs)
12. Injection blow molds – neck design, mandrel design, Parison thickness control (5 hrs)
13. Mold cooling (3 hrs)

## **LIST OF PRACTICALS**

1. Design and drawing of a single impression compression mould
2. Design and drawing of a multi-impression compression mould
3. Design and drawing of a transfer mould
4. Design and drawing of a blow mould
5. Design and drawing of a die for pipe/tubing

Note: Minimum 10 sheets will be prepared by the students.

## **RECOMMENDED BOOKS**

1. Injection Mould Design by R.C.W Pye; Longman Scientific and Technical Publication
2. Plastic Mould Engineering Hand Book by J. Harry Don Bose and Mayne I prible, Van Nostrand Reinhold Company Publication
3. Injection Moulding Handbook by Dominick V Rosato and Donald V Rosato
4. Plastic Engineering Handbook by Joel Frados; Van Nostrand Reinhold Company Publication
5. Plastic Engineering by RJ Crawford; Maxwell Macmillan International editions Publication



## 5.5 PLASTIC TESTING AND QUALITY CONTROL

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### RATIONALE

It is necessary to test the raw materials and the products during various stages of their manufacture to control the quality. This subject provides the essential knowledge and skills to the students for doing this function.

### DETAILED CONTENTS

#### Testing

1. Overview of various testing methods and organisations such as ASTM, BIS, DIN and ISO (2 hrs)
2. Test specimens preparation : milling, punching, template, cutting from sheets or films product (4 hrs)
3. Identification of plastic (4 hrs)
  - Visual, burning, heating
  - Element, detection, analysis; chemistry, groups analysis
4. Physical properties (4 hrs)
 

Specific gravity, Water absorption, Moisture content analysis
5. Mechanical Properties (6 hrs)
  - Short term Mechanical properties - Tensile strength, impact strength (izod & charpy),\_flexural strength, fatigue resistance, compression strength, tear test
  - Long term Mechanical properties - creep and stress relaxation.
  - Hardness, shore and rockwell hardness, Abrasion resistance.
6. Thermal properties (6 hrs)
 

Melting point, Vicat softening point, heat distortion temperature
7. Electrical properties (6 hrs)
 

Dielectric strength, Arc resistance, Insulation resistance, Volume and surface resistivity

8. Optical properties (4 hrs)  
Light transmittance, Haze, Gloss, refractive index
9. Flow properties (4 hrs)  
Melt flow index, capillary rheometer, cone and plate viscometer

### **Quality Control**

10. Basic concept of statistical quality control, Visual inspection, Testing of a finished product, Analysis of test data to control finished product in relation to service requirement, Special tests on individual products to improve the quality (8 hrs)

### **LIST OF PRACTICALS**

1. To carry out volume and surface resistivity test on given samples of plastic
2. To determine the tensile strength, flexural strength of plastics specimen.
3. To determine impact strength of different plastics specimen.
4. To determine hardness (shore and rockwell) of different specimen of plastics.
5. To carry out dart impact test on given plastics films/laminates.
6. To determine the Melt Flow Index of given samples of plastics.
7. To carry out (i) heat detection test on given samples of plastics.  
(ii) vicat softening point test on given samples of plastics
8. To measure gloss of plastic specimen.
9. To carry out environmental stress cracking resistance test on given samples of plastics.

### **RECOMMENDED BOOKS**

1. Testing of Plastics by Roger Brown
2. Plastics – Materials and Processing by A brentstrong
3. Plastics Testing by Vishu Shah
4. Identification of Plastics by CIPET
5. Identification of Plastics by AS Athalye

## 5.6 COMPOUNDING OF POLYMERS

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### RATIONALE

Properties of all plastics get significantly modified by judicious addition of certain additives and appropriate compounding techniques. This subject aims at giving a detailed exposure on this topic. This subject combined with the subject on Engineering and Specialty Polymers makes the students capable of preparing and formulating the right materials for processing.

### DETAILED CONTENTS

1. Principles of compounding for modifying and enhancing processing and application properties and service life of plastics (10 hrs)
2. Definition and classification of additives (18 hrs)  
Description of following additives and their functions
  - Properties Modifiers - Plasticisers, Fillers, Impact modifiers, extenders
  - Processing aids - Heat stabilizers, Lubricants, solvents and diluents
  - Surface property modifiers -antistatic agents, antislip agent, antiblock/slip additives.
  - Colourants : Pigments and dyes.
  - Antiageing additives: - antioxidants, anti-ozonants, UV stablisers, fungicides, antitermites, bactericide additives.
  - Miscellaneous additives: - blowing agent, flame retardants and mould release agents.
3. Formulation and role of various ingredients in the compound for both thermoplastics and thermoset materials. (8 hrs)
4. Compounding equipments - Ribbon blender, High speed mixer, Banbury, Two roll mill, Mixer extruder (construction and working of these equipments). (12 hrs)
5. Mixing of solids and paste (with reference to thermosets' compounding) Mixers, Kneaders, dispersors (construction and working). (12 hrs)
6. Compounding of PVC for rigid, semi-rigid and flexible applications. (4 hrs)

**RECOMMENDED BOOKS**

1. Modern Plastics Encyclopedia, Vol. 59, No. 10A, McGraw Hill, New York,
2. The Role of Additives in Plastics by L. Mascia, John Wiley and Sons, New York
3. Anti-Oxidants by RR Paolino, in Modern Plastics Encyclopedia (MPE), 1982
4. Polymer Mixing Technology by George Mathews, Elsevier, New York
5. Encyclopedia of PVC, Vol. 1, Marcel Dekker, New York, "Plasticizers" by LG Krauskopf
6. PVC Technology by Titow, Elsevier, UK
7. PVC Technology by AS Athalye, Popular Plastics and Packaging

## 5.7 POLYMER PRODUCT DESIGN

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### RATIONALE

Diploma holders in plastic technology are expected to prepare the design of simple plastic products leading to development and its manufacturing. In doing this, they have to decide about material, process, machinery and testing procedures to manufacture quality products. This subject will impart requisite skills for polymer product design.

### DETAILED CONTENTS

1. Technical requirements : Preliminary design considerations (4 hrs)
2. Materials Selection (10 hrs)
  - Various materials and selection of material for particular application. Short term and long term properties. Cost economics, selection
  - Various processing limitations with polymer product design, environmental exposure
3. Product Design Features (10 hrs)
  - Surface finish
  - Texturing
  - Shape
  - Positioning of holes
  - Ribs
  - Fillets and rounds
  - Wall thickness
4. Design Activities (6 hrs)
  - Stages of product development
  - Feasibility study and product life cycle
5. Simple Design Problems (8 hrs)
  - Design of plastic structural parts of static load
  - Design of dynamically loaded plastic part
  - Design of plastic parts for specific applications, electrical, optical

6. Method of joining and machining such as welding, riveting, cementing (10hrs) and adhesion, cutting, sampling, drilling
  - Assembly methods
  - Inside sharp comers
  - Weld lines
  - Draft angles
  - Gate side and location
  - Moulded inserts
  - Internal plastics threads
  - Undercuts
  - Tolerance
  - Functional surfaces and jettering

### **RECOMMENDED BOOKS**

1. Plastic product Design, Vol. 1 by RD Beck, Van Nostrand Reinhdol Co. Publication
2. Plastic product Design, Vol. 1I by RD Beck, Van Nostrand Reinhdol Co. Publication
3. Plastic Engineering Handhook by Brydson
4. Plastics Engineering Handbook by J. Frados, International Thomas Publishing1994
5. Plastics : Materials and Processings by A Brent Strong, Prentice Hall
6. Plastic Product Design Handbook by Edward Miller, Marcel Dekker Publications
7. Plastics Technology : Theory, Design and Manufacture by William J.Patton