

## 5.1 PLASTIC PROCESSING TECHNIQUES - II

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4 - 4

### 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 (06 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 with details of operating conditions 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. (04 hrs)
3. Nip rolls, bubble casing, winding equipment, cutting devices, stretching and orientation. (04 hrs)
4. Extruder performance and their curves. (04 hrs)
5. Blown film extrusion, extrusion of pipes, wires and cables, sheets and filaments (08 hrs)
6. Coextrusion of films and sheets (06 hrs)

#### b) BLOW MOULDING

7. Basic principles of blow moulding, Types of blow moulding :- Extrusion blow moulding, Injection blow moulding. Blow molding of irregular shapes (08 hrs)
8. Raw Materials for blow moulding (02 hrs)
9. Production of parison, a). by extrusion b). by injection. Parison wall thickness control, Parison blowing systems, effect of process variables on product design and properties. Parison programming, mould venting. (08 hrs)
10. Newer concepts including extrusion- stretch blow moulding, injection stretch (08 hrs)

blow moulding, multi layer moulding etc.

11. 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 (06 hrs)

### LIST OF PRACTICALS

1. To produce rigid PVC pipe of 3 different diameters on extruder
2. To study the specification and working 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 and working of automatic Blow Moulding Machine
5. Production of components on semi automatic blow machine by setting the process parameters

### INSTRUCTIONAL STRATEGY

Industry visits should be organized.

### RECOMMENDED BOOKS

1. Plastic Engineering Handbook by Joel Frados
2. Processing of Plastics by AS Athalye
3. Plastic Processing Data Handbook by Rosato and Rosato

### SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	10
2	04	06
3	04	06
4	04	06
5	08	12
6	06	10
7	08	12
8	02	04
9	08	12
10	08	12
11	06	10
<b>Total</b>	<b>64</b>	<b>100</b>

## 5.2 DESIGN OF DIES AND MOULDS – I

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### RATIONALE

A diploma holder in polymer technology is engaged in manufacturing polymer components for which design of moulds and dies is essential. This subject will impart them requisite knowledge and skill in design of moulds and dies.

### DETAILED CONTENTS

1. Mould design: Concept considerations and materials used for dies and moulds and their characteristics (06 hrs)
2. Impressions - Core and cavity, Types of cavity and core, their advantages and disadvantages. Bolster plate and its types, guide pillar, guide bush, register ring and their types. Mould clamping - direct, indirect (08 hrs)
3. Parting surface - Types of parting surface, selection of parting surface, Relief of parting surfaces, venting (06 hrs)
4. Feed system (08 hrs)
  - Runners - Sprue, runners and its types, balancing of runners, size of runners
  - Gates - Types of gates, size of gates
5. Ejection system - Ejector grid, ejector plate assembly, ejection techniques, ejection from fixed half, sprue pullers (06 hrs)
6. Cooling system - Cooling integer type mould plates and its types, Cooling insert bolster assembly and its types, Cooling other mold parts, Water connection and its types (06 hrs)
7. Splits - Introduction, sliding splits and types, Angled lift splits and types (05 hrs)
8. Side cores and side Cavities: Introduction, types of side core and side cavities (05 hrs)
9. Molding Internal Undercuts: Introduction, Form pin, Split core, Side core, Stripping internal undercut (06 hrs)

10. Mould for threaded component: Introduction (06 hrs)
- Moulds for internally threaded components and its types
  - Moulds for externally threaded components and its types
11. Types of Mold - Two plate mould, Three plate mould, Hot runner mould (02 hrs)

### LIST OF PRACTICALS

- 1) Procedure for Designing an Injection Mold: Primary positioning of inserts, the ejector system, the ejector grid, complete the top half of drawing, complete the plan view, complete the cross-section, complete the drawing.
- 2) To design and draw various mould parts.
- 3) To design and draw a single impression two plate injection mould by taking suitable at least four component.
- 4) To design and draw a multiple impression two plate injection mould by taking suitable at least two component.
- 5) To design and draw a multiple impression three plate injection mould by taking suitable at least two component.
- 6) To design and draw a multiple impression split mould by taking suitable at least two component.
- 7) To design and draw a multiple impression runnerless mould by taking suitable component.

**Note:** Maximum 10 sheets will be prepared by the students on computer using AutoCAD software or latest design software.

### INSTRUCTIONAL STRATEGY

Students should practically make injection moulds for household, medical equipment and auto parts.

**RECOMMENDED BOOKS**

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

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	06	9
2	08	13
3	06	9
4	08	13
5	06	9
6	06	9
7	05	8
8	05	8
9	06	9
10	06	9
11	02	4
<b>Total</b>	<b>64</b>	<b>100</b>

### 5.3 MAINTENANCE OF PLASTIC PROCESSING MACHINERY

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#### RATIONALE

Most of the diploma holders get employment in plastic processing industry, where they operate processing machinery and manage production. The purpose of this subject is to equip the students with the knowledge of repair and maintenance of such machines and equipments.

#### DETAILED CONTENTS

1. Maintenance, objective of maintenance, importance of maintenance, preventive maintenance, breakdown maintenance, predictive maintenance, schedule maintenance, maintenance planning (06 hrs)
2. Factors to be considered by installation/erection and commissioning of plastic processing machinery. Vibrations and foundation. General method of alignment/levelling (06 hrs)
3. Repair and maintenance of following electrical equipments (18 hrs)
  - Electrical induction motors (slipping motors and squirrel cage motors), variable speed motors, their characteristics and speed control
  - Starters, circuit breakers (air circuit breakers, oil circuit breakers and miniature circuit breakers)
  - Brief introduction to limit switches timers, relays, temperature controllers, and thermocouples, heaters (ordinary and ceramic type)
  - Study of safety rules and regulations
4. Repair and maintenance of following components used in plastics processing machinery (18 hrs)
  - Barrel, screw, thrust unit, primary gearboxes, calender roll, mill roll
  - Pumps – gear pump, piston pump, radial/axial pump and screw pump
  - Valves, valve sequences, valve counted balance, break valve, pressure reducing valve, throttle valve, different control valves, solenoid valves
  - Hydraulic motors, hydraulic actuators, filters, compressors, oil seeds, O-rings
  - Lubrication system-central lubrication system
  - Transmission system i.e. gears, V-belts, chains

## LIST OF PRACTICALS

1. To check the line alignment/levelling of various machinery like PVC pipe plant, injection molding machine and blow molding machine
2. Repair and maintenance of hydraulic system in machines such as injection molding, blow molding machines
3. Study of repair and maintenance of hydraulic motors
4. Study of lubrication system, central lubrication system, o-rings, oil seals
5. To carry out break down maintenance of electrical equipments like induction motors, variable speed motors, circuit breakers used in plastics processing machinery
6. Repair and maintenance of heater
7. To carry out the preventive maintenance of machines like injection molding machine, blow molding machine, PVC pipe plant, CNC injection molding machine
8. Repair and maintenance of various pumps and valves

## INSTRUCTIONAL STRATEGY

Students should be asked to do small repair activities in the laboratories and workshops.

## RECOMMENDED BOOKS

1. Fundamentals of Electrical and Electronics Technology by B.L. Thereja
2. Electrical Wiring Estimation and Costing by JB Gupta.
3. Electrical Engineering by KD Sharma
4. Electronics Devices and Circuits by J. Millman and CC Halkias.
5. Basic Electrical Engineering by Kastkin A and Perikatin, M.
6. Hydraulic manual by Vickers
7. Mechanical design By R.S. Khurmi
8. Production Technology By HMT
9. Guide to machine tools By IMTMA
10. Preventive maintenance by APTE
11. Workshop Technology Vol.I and IV By Hajra Chowdhury
12. Machinery hand book by ITB

## SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	15
2	06	15
3	18	35
4	18	35
<b>Total</b>	<b>48</b>	<b>100</b>

## 5.4 COMPOUNDING AND FORMULATION OF PLASTICS

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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, defoamers, smoke, suppressants
3. Formulation and role of various ingredients in the compounding for both thermoplastics and thermoset materials. (08 hrs)
4. Compounding equipments - Ribbon blender, High speed mixer, Banbury, Two roll mill, Mixer extruder (construction and working of these equipments), Ultra turax mixers, High sheer mixers, Intensive dry mixer, Compounder, Twin screw extruders, construction and working of Kneaders, Dispersors (24 hrs)
5. Compounding of PVC for rigid, semi-rigid and flexible applications. (04 hrs)



## LIST OF PRACTICALS

Demonstrations/operations of the following practicals (Approx. five experiments)

1. Extraction of inorganic additives from PVC i.e. fillers, pigments etc. by dissolving PVC compound in solvents such as THF, EDC and Cyclohexanone and removing PVC and soluble organic materials
2. Making a PVC compound having following ingredients (100 parts)  
Stabilizer (2 – 3 parts), Lubricant (0.5 – 1.0 parts); plasticizers (20 – 50 parts); Pigment (0.5 – 1 part) and Filler (10 –40 parts) on a two roll mill and compression moulding of a sheet
3. Cutting dunbell shaped test pieces for tensile strength from compression moulded sheet as prepared in (2) and finding tensile strength and elongation with or without plasticizer. Calculation of percent increase in elongation
4. Analysis of the effects of fillers on mechanical properties of PVC compound
5. Compounding of polyethylene with various additives, fillers, stabilizers, blowing agent and rubber
6. Mechanical property measurement of compounded polyethylene and evaluation of the effect of compounding variables.
7. To synthesize the UF resin with suitable additives
8. To synthesize the nylon 6,6 with suitable additives

## INSTRUCTIONAL STRATEGY

Compounding and additives should be shown in the industry.

## 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

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted (Hrs)</b>	<b>Marks Allotted (%)</b>
1	10	15
2	18	30
3	08	10
4	24	40
5	04	05
<b>Total</b>	<b>64</b>	<b>100</b>

## 5.5 EMPLOYABILITY SKILLS – I

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### RATIONALE

The present day world requires professionals who are not only well qualified and competent but also possess good communication skills. Our diploma students not only need to possess subject related knowledge but also soft skills to get good jobs or to rise steadily at their work place. The objective of this subject is to prepare students for employability in job market and survive in cut throat competition among professionals.

### DETAILED CONTENTS

- |    |  |          |
|----|--|----------|
| 1. | Writing skills                                   | (08 hrs) |
|    | i) Official and business correspondence          |          |
|    | ii) Job application - covering letter and resume |          |
|    | iii) Report writing - key features and kinds     |          |
| 2. | Oral Communication Skills                        | (20 hrs) |
|    | i) Giving advice                                 |          |
|    | ii) Making comparisons                           |          |
|    | iii) Agreeing and disagreeing                    |          |
|    | iv) Taking turns in conversation                 |          |
|    | v) Fixing and cancelling appointments            |          |
| 3. | Generic Skills                                   | (04 hrs) |
|    | i) Stress management                             |          |
|    | ii) Time management                              |          |
|    | iii) Negotiations and conflict resolution        |          |
|    | iv) Team work and leadership qualities           |          |

## 5.6 ENVIRONMENTAL EDUCATION

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### RATIONALE

Education about environment protection is a must for all the citizens. In addition, a diploma holder must have knowledge of different types of pollution caused by industries and construction activities so that he may help in balancing the eco system and controlling pollution by adopting pollution control measures. He should also be aware of environmental laws related to the control of pollution.

### DETAILED CONTENTS

1. Definition, Scope and Importance of Environmental Education (02 hrs)
2. Basics of ecology, biodiversity, eco system and sustainable development (03 hrs)
3. Sources of pollution - natural and manmade, causes, effects and control measures of pollution (air, water, noise, soil, radioactive and nuclear) and their units of measurement (12 hrs)
4. Solid waste management – Causes, effects and control measures of urban and industrial waste (06 hrs)
5. Mining and deforestation – Causes, effects and control measures (04 hrs)
6. Environmental Legislation - Water (prevention and control of pollution) Act 1974, Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board, Environmental Impact Assessment (EIA) (10 hrs)
7. Role of Non-conventional Energy Resources (Solar Energy, Wind Energy, Bio Energy, Hydro Energy) (04 hrs)
8. Current Issues in Environmental Pollution – Global Warming, Green House Effect, Depletion of Ozone Layer, Recycling of Material, Environmental Ethics, Rain Water Harvesting, Maintenance of Groundwater, Acid Rain, Carbon Credits (07 hrs)

### INSTRUCTIONAL STRATEGY

The contents will be covered through lecture cum discussion sessions. In addition, in order to have more appreciation of need for protection of environment, it is suggested that different activities pertaining to Environmental Education like video films, seminars, environmental awareness camps and expert lectures may also be organized.

**RECOMMENDED BOOKS**

1. Environmental Engineering and Management by Suresh K Dhameja; SK Kataria and Sons, New Delhi.
2. Environmental Science by Dr. Suresh K Dhameja; SK Kataria and Sons, New Delhi.
3. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
4. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
5. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
7. Environmental Studies by Erach Bharucha; UGC University Press.

**SUGGESTED DISTRIBUTION OF MARKS**

<b>Topic No.</b>	<b>Time Allotted for Lectures (Periods)</b>	<b>Marks Allotted (%)</b>
1	02	04
2	03	06
3	12	24
4	06	12
5	04	10
6	10	20
7	04	10
8	07	14
<b>Total</b>	<b>48</b>	<b>100</b>