

5.1 POLYMER PROCESSING TECHNIQUES – II

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RATIONALE

After fabrication of the product, post processing operations are necessary to make the product commercially presentable. Finishing and other decorating and printing operations are instrumental in enhancing the aesthetics and visual appeal of the product. The emphasis is given especially on printing, lamination, coating techniques, compression and transfer moulding and rotational moulding.

DETAILED CONTENTS

1. Compression Moulding (10 hrs)
 General principles and working of compression moulding machine. Types of compression moulding machine - hand operated, automatic, single and multi daylight machines, bulk factor, preheating of moulds, cycle time, process variables and their control. Effect of process variables on product properties, compression moulding of Semiconductor and DMC compounds
2. Transfer Moulding (10 hrs)
 Principles of transfer moulding. Types of transfer moulding machines, moulding cycle theoretical calculation of line pressure, injection ram pressure, clamping pressure, pot capacity, compression of transfer moulding and compression moulding
3. Introduction to Pultrusion, hand layup technique (06 hrs)
4. Thermoforming (10 hrs)
 Basic principles, method of forming - straight forming, free forming, plug assist forming, drape forming, matched mould forming, slip forming, snap back forming, reverse draw forming, limitations and advantages of forming, materials for thermoforming, types of heating systems
5. Casting (06 hrs)
 Introduction, casting of PMMA, unsaturated polyesters and phenolic resins
6. Spinning Process (06 hrs)
 Melt, Wet and Dry Processes
7. Calendering (06 hrs)
 Introduction to calendering, types of calenders, advantages, limitations of calendaring and major applications

8. Rotational moulding of large containers (06 hrs)
9. Foam moulding (04 hrs)

Definition of moulding, processes, blowing agents, applications

LIST OF PRACTICALS

- 1) To produce small components on hand operated compression moulding machine
- 2) To produce components on automatic/semi automatic compression moulding machine
- 3) To produce articles on vacuum forming machine
- 4) To do casting of polyester resin
- 5) To do casting of PMMA
- 6) Exercises on high frequency PVC welding machine
- 7) Preparation of FRP sheet by hand lay up technique

INSTRUCTIONAL STRATEGY

Industrial visit should be organized.

RECOMMENDED BOOKS

- 1) Basic Engineering Handbook by Michael L Berins, Published by Prentice Hall of India, New Delhi
- 2) Plastic Processing Data Handbook by Rosato and Rosato, Published by M/S Van Nostrand Reinhold Company, New Delhi
- 3) Plastic Data Handbook by S.B. Packaging; Tata McGraw Hill

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	10	15
2	10	15
3	06	9
4	10	15
5	06	10
6	06	10
7	06	10
8	06	10
9	04	6
Total	64	100

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

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
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
Total	64	100

5.3 CHEMICAL REACTION ENGINEERING

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RATIONALE

It is a core subject of Chemical Engineering and is essential for understanding the kinetics of various reactions, types of reaction vessels and the performance of reactive systems used in industry.

DETAILED CONTENTS

1. Introduction to Chemical Kinetics (12 hrs)

Homogenous Reaction, Heterogeneous Reaction, Catalytic and Non-catalytic reaction, Elementary and Non – elementary, Simple and Multiple reaction, Reversible and Irreversible reaction, Endothermic and Exothermic reaction – definition and example. Chemical Equilibria, Le-chatlier principle and factors affecting chemical Equilibria like temperature, concentration, pressure, catalyst.

2. Kinetics of Homogenous Reaction (14 hrs)

Concept of rate of reaction, rate equation, rate constant, order of reaction, molecularity of reaction, factors affecting rate of reaction. Theories of reaction rate constant; Arrhenius Law and problems based on it from thermodynamics, from collision theory, from transmission state theory. Activation energy – concept.

3. Interpretation of Batch Reactor Data (20 hrs)

Constant Volume Batch Reactor, Relation of concentration and conversion for constant volume batch reactor, analysis of total pressure data obtained in constant volume batch reactor. Methods used to analyse the kinetic data/rate data or to determine order of reaction: Integral method of analysis of rate data – procedure. Integral method of analysis for irreversible unimolecular, first order reaction, bimolecular second order reaction, n^{th} order reaction, zero order reaction and simple problems. Half life concept for the overall order of irreversible reaction. Differential method of analysis of rate data or order of reaction – only procedure. Variable Volume Batch Reactor – concept only.

4. Reactors (12 hrs)

Basic type of reactors - batch reactor, CSTR, plug flow reactor, semi-batch reactor. Fixed bed reactor Vs Fluidised bed reactor. Performance equation for ideal batch reactor, MFR, PFR for constant volume – no derivation only final expression and their graphical representation of first order irreversible reaction. Concept of space time, space velocity, and holding time.

5. Catalysis (06 hrs)

Definition, types and classification, preparation of catalyst, ingredients (promoters, inhibitors, accelerators). Catalyst poisoning, regenerator.

INSTRUCTIONAL STRATEGY

Emphasis should be laid on problem-solving using some simple numericals.

RECOMMENDED BOOKS

1. Chemical Reaction Engineering by Levenspeil, John Wiley Publication
2. Chemical Engineering Kinetics by Smith, McGraw Hill Publication
3. Elements of Chemical Reaction Engineering by Fogler, Prentice Hall of India
4. Reaction Kinetics for Chemical Engineering by Wales, McGraw Hill Publication
5. Chemical Reaction Theory – An Introduction by Denbigh and Turner, Cambridge University Press Publication
6. Chemical Reaction Engineering by K.A. Gavhane, Nirali Publication

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted Hrs
1	12	15
2	14	25
3	20	30
4	12	20
5	06	10
Total	64	100

5.4 POLYMER COMPOUNDING AND FORMULATION

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RATIONALE

Properties of all polymer 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 polymer (06 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. (08 hrs)
4. Compounding equipments - Ribbon blender, High speed mixer, Banbury mixer, 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 types – (i) Batch mixer, (ii) Semi batch with sand mill and (iii) High performance mixer for paste. Kneaders, dispersors (construction and working) (12 hrs)
6. Compounding of at least four polymers for rigid, semi-rigid and flexible applications. (08 hrs)

LIST OF PRACTICALS

Demonstration/operation of the following practicals:

1. Property modification of Polymer granules by adding natural material like cellulose.
2. Mixing of virgin polymers with recycled polymers (both by melt method and solvent method)
3. Compounding of PVC with heat stabilizer, UV stabilizer etc.
4. Compounding of PS, PE and ABS with master batches of at least two different colour.
5. Study of Kneader and Mixers.
6. Study of two roll mill and mixing extruder.

INSTRUCTIONAL STRATEGY

More emphasis should be given to practical work and visit to local industry should be organised to show the students various types of equipment used for polymer compounding and formulation.

RECOMMENDED BOOKS

1. Modern Plastics Encyclopedia, Vol. 59, No. 10A, 1982-83; McGraw Hill, New York,
2. The Role of Additives in Plastics by L. Mascia; John Wiley and Sons, New York, 1975
3. Anti-Oxidants by RR Paolino, in Modern Plastics Encyclopedia (MPE), 1982

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	10
2	18	30
3	08	12
4	12	18
5	12	18
6	08	12
Total	64	100

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

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| 1. | Writing skills | (08 hrs) |
| | <ul style="list-style-type: none"> 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) |
| | <ul style="list-style-type: none"> 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) |
| | <ul style="list-style-type: none"> 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

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