## 6.1 POLYMER TESTING, CHARACTERISATION & QUALITY CONTROL

| L | T | P |
|---|---|---|
| 3 | - | 3 |

**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 assessing its potential application by evaluating various associated properties.

**DETAILED CONTENTS**

1. Testing - Overview of various testing methods and standards such as ASTM, BIS, DIN and ISO, Test specimens preparation : milling, punching, template, cutting from sheets or films product (06 hrs)

2. Identification of plastics (04 hrs)

   Visual test, burning test, element detection and end group analysis.

3. Physical properties (04 hrs)

   Specific gravity, Water absorption, Moisture content analysis

4. Mechanical Properties (06 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, Dynamic Mechanical analysis (DMA)
   - Hardness, shore and rockwell hardness, Abrasion resistance.

5. Thermal properties (06 hrs)

   Melting point, Vicat softening point, heat distortion temperature

6. Electrical properties (06 hrs)
   Dielectric strength, Arc resistance, Insulation resistance, Volume and surface resistivity

7. Optical properties (04 hrs)
   Light transmittance, Haze, Gloss, refractive index

8. Flow properties (04 hrs)

Melt flow index, capillary rheometer, cone and plate viscometer

9. Quality Control (04 hrs)

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

10. Introduction to material characterization techniques e.g. NMR, DSC, TGA, XRD (04 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.

**INSTRUCTIONAL STRATEGY**

Different articles or products should be given to the student for testing and quality control.

**RECOMMENDED BOOKS**

1. Handbook of Polymer testing by Roger P. Brown; Blackwell Publishing Ltd Oxford, UK, 1999
2. Plastics - Materials and Processing by Abrentstrong, Prentice Hall of India publication, New Delhi, 2000
3. Plastics Testing by Vishu Shah, Wiley Publisher, New York, 1984
4. Identification of Plastics by CIPET, published by Kluwer Academic publishers, 2002
5. Identification of Plastics, by M/S AS Athalye, London lliffe Books Ltd., New Delhi 2010

## SUGGESTED DISTRIBUTION OF MARKS

| Topic No. | Time Allotted (Hrs) | Marks Allotted (%) |
|---|---|---|
| 1 | 6 | 12 |
| 2 | 4 | 9 |
| 3 | 4 | 9 |
| 4 | 6 | 12 |
| 5 | 6 | 12 |
| 6 | 6 | 12 |
| 7 | 4 | 9 |
| 8 | 4 | 9 |
| 9 | 4 | 8 |
| 10 | 4 | 8 |
| **Total** | **48** | **100** |

## 6.2 DESIGN OF DIES AND MOULDS – II

| L | T | P |
|---|---|---|
| 3 | - | 4 |

**RATIONALE**

A diploma holder 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**

1. Dies (22 hrs)

- General features of extrusion dies
- Die materials
- Design features dies - Polymer melt flow, die geometry, material of construction, ease of maintenance and cleaning. Die land, die swell
- Heating system and temperature control
- Types of dies
- Dies for rod, flexible tube, wire coating

2. Compression Mould and Transfer Moulds (14 hrs)

- Types of compression moulds - positive, semi-positive, flash and landed positive type
- Calculation of clamp pressure, ram pressure, platen size, no. of impressions. Selection of compression moulding machine
- Principles of transfer moulding, pot capacity, design of sprue, runner and gates

3. Blow Moulds (12 hrs)

- Materials for Blow moulds
- Extrusion blow moulds - cavity and pinch off
- Injection blow moulds - neck design, mandrel design, parison thickness control
- Mould cooling

**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. 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
2. Published by Tata McGraw Hill Co., New Delhi.
3. 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.
4. Injection Moulding Handbook by Dominick V Rosato and Donald V Rosato, Published by Tata McGraw Hill Co., New Delhi.
5. Plastic Engineering Handbook by Joel Frados; Van Nostrand Reinhold Company Publication,
6. Published by Tata McGraw Hill Co., New Delhi.
7. Plastic Engineering by RJ Crawford; Maxwell Macmillan International edition Publication,
8. Published by Tata McGraw Hill Co., New Delhi.


## SUGGESTED DISTRIBUTION OF MARKS

| Topic No. | Time Allotted (Hrs) | Marks Allotted (%) |
|---|---|---|
| 1 | 22 | 50 |
| 2 | 14 | 30 |
| 3 | 12 | 20 |
| **Total** | **48** | **100** |

## 6.3 PLASTIC PRODUCT DESIGN

| L | T | P |
|---|---|---|
| 4 | - | - |

**RATIONALE**

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

**DETAILED CONTENTS**

1. Preliminary design considerations (06 hrs)

   Design steps for plastic product, mechanical requirements.

2. Materials Selection (12 hrs)

   - Various materials and selection of material for particular application. Cost economics
   - Various processing limitations with Plastic product design, effects of environmental exposure

3. Product Design Features (14 hrs)

   - Surface finish
   - Texturing
   - Shape
   - Positioning of holes
   - Ribs
   - Fillets and rounds
   - Wall thickness

4. Design Activities (08 hrs)

   - Stages of product development
   - Feasibility study and product life cycle

5. Method of joining and machining such as welding, riveting, cementing and adhesion, cutting, sampling, drilling (18 hrs)

   - Assembly methods
   - Inside sharp corners
   - Weld lines
   - Draft angles
   - Gate side and location
   - Moulded inserts
   - Internal plastics threads

- Undercuts
- Tolerance
- Functional surfaces and Letters and alphabets

6. Case study of statically and dynamically loaded plastic product like Gears, Spring etc (06 hrs)

**INSTRUCTIONAL STRATEGY**

Diploma students should do practical to design injection moulds types two plate and three plate moulds for automatic and semi-automatic machines**.**

**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 Publishing
5. Plastics : Materials and Processing by A Brent Strong, Prentice Hall of India, New Delhi
6. Plastic Product Design Handbook by Edward Miller, Marcel Dekker Publications
7. Plastics Technology : Theory, Design and Manufacture by William J.Patton


**SUGGESTED DISTRIBUTION OF MARKS**

| Topic No. | Time Allotted (Hrs) | Marks Allotted (%) |
|---|---|---|
| 1 | 6 | 10 |
| 2 | 12 | 18 |
| 3 | 14 | 20 |
| 4 | 8 | 12 |
| 5 | 18 | 30 |
| 6 | 6 | 10 |
| **Total** | **64** | **100** |

## 6.4 PROCESS INSTRUMENTATION AND CONTROL

| L | T | P |
|---|---|---|
| 4 | - | 3 |

**RATIONALE**

This subject gives the knowledge of various instruments used to measure various process parameters. This course will impart knowledge on working principle, construction, repair and use of these instruments.

**DETAILED CONTENTS**

1. Measurement Systems or Elements of Measurement Instruments (8 hrs)

   Measurement and its aim, primary and secondary element, manipulating and functioning elements, static characteristics, calibration, Accuracy, Precision, repeatability, drift, sensitivity, resolution, Dead Zone, Static Error.

2. Temperature Measurement (10 hrs)

   Temperature scales, methods of temperature Measurement: Expansion thermometers, filled system thermometer, electric temperature instruments, pyrometers.

3. Pressure Measurement (10 hrs)

   Units of pressure, methods of pressure measurement, manometers, elastic pressure transducers, force balance pressure gaugers, electrical pressure transducer, measurement of vacuum.

4. Level Measurement (10 hrs)

   Methods of Liquid level measurement, Direct Methods: Sight Glass, Float, Displacer, Indirect Methods: Pressure Gauge, Air Trap, Diaphragm box, Air Purge, Radioactive, Ultrasonic, Capacitive Solid level Measurement, Solid level Measurement.

5. Analyzers and Recorders (10 hrs)

   pH meter, viscosity measurement, various types of analyzers. Oxygen analyzer, Infrared Analyzer, Orsat Analyzer. Circular charts and strip chart recorders.

6. Introduction to Process Control (10 hrs)

   Definition and example of process control system. Block diagram representation of process control system, component of a process control system, Transfer function of a control system, types of process control system – open loop control system, closed loop control system, feed forward and feed backward control system, cascade control system (in brief). System Input-Step, Ramp, Sinusoidal, Pulse.

7. Control Valve (6 hrs)

Valve Characteristics, Valve Types, Valve Actuator and Valve Positioning.

## LIST OF PRACTICALS

1. To calibrate pressure gauge with the help of dead weight pressure gauge
2. To calibrate bimetallic thermometer, resistance thermometer, thermocouple, energy meter and watt meter.
3. To measure pressure with the help of different types of manometers.
4. To determine the characteristics of a flapper nozzle system.
5. To study on-off controller for temperature control.
6. To study constructional details of strip chart recorder.
7. To study measurement of relative humidity and to compare the value with psychometric chart.
8. To study constructional details of circular chart recorder.
9. To plot the curve between flow rate and percent opening of control valve with the help of DCS (Distributed Control System)

## INSTRUCTIONAL STRATEGY

The subject gives the knowledge of various process, instruments and controls to measure process parameters. So the theoretical knowledge of this subject should be properly imparted to the students with the help of practical examples. Each topic should be supplemented with examples.

## RECOMMENDED BOOKS

1. Industrial Instrumentation by Donald P. Eckman, Wiley eastern publications.
2. Process System Analysis and Control by Cughnour, McGraw Hill publications.
3. Industrial Instrumentation by SK Singh, Tata McGraw Hill Publicaions.
4. Principles of Industrial Instrumentation by D. Patro Nalis, Tata McGraw Hill Publications

## SUGGESTED DISTRIBUTION OF MARKS

| Topic No. | Time Allotted (Hrs) | Marks Allotted (%) |
|---|---|---|
| 1 | 8 | 15 |
| 2 | 10 | 15 |
| 3 | 10 | 15 |
| 4 | 10 | 15 |
| 5 | 10 | 15 |
| 6 | 10 | 15 |
| 7 | 6 | 10 |
| **Total** | **64** | **100** |

## 6.5 EMPLOYABILITY SKILLS – II

| L | T | P |
|---|---|---|
| - | - | 2 |

**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 to prepare students for employability in job market and survive in cut throat competition among professionals.

**DETAILED CONTENTS**

1. Oral Practice

| | | |
|---|---|---|
| i) | Mock interview | (05 hrs) |
| ii) | Preparing for meeting | (05 hrs) |
| iii) | Group discussion | (05 hrs) |
| iv) | Seminar presentation | (05 hrs) |
| v) | Making a presentation | (12 hrs) |

a) Elements of good presentation
b) Structure and tools of presentation
c) Paper reading
d) Power point presentation

## 6.6 ENTREPRENEURSHIP DEVELOPMENT AND MANAGEMENT

| L | T | P |
|---|---|---|
| 3 | - | - |

**RATIONALE**

In the present day scenario, it has become imperative to impart entrepreneurship and management concepts to students so that a significant percentage of them can be directed towards setting up and managing their own small enterprises. This subject focuses on imparting the necessary competencies and skills of enterprise set up and its management.

**DETAILED CONTENTS**

**SECTION – A ENTREPRENEURSHIP**

1. Introduction (14 hrs)

- Concept /Meaning and its need
- Qualities and functions of entrepreneur and barriers in entrepreneurship
- Sole proprietorship and partnership forms of business organisations
- Schemes of assistance by entrepreneurial support agencies at National, State, District level: NSIC, NRDC, DC:MSME, SIDBI, NABARD, Commercial Banks, SFC's TCO, KVIB, DIC, Technology Business Incubator (TBI) and Science and Technology Entrepreneur Parks (STEP).

2. Market Survey and Opportunity Identification (10 hrs)

- Scanning of business environment
- Salient features of National and State industrial policies and resultant business opportunities
- Types and conduct of market survey
- Assessment of demand and supply in potential areas of growth
- Identifying business opportunity
- Considerations in product selection

3. Project report Preparation (08 hrs)

- Preliminary project report
- Detailed project report including technical, economic and market feasibility
- Common errors in project report preparations
- Exercises on preparation of project report

**SECTION –B MANAGEMENT**

4. Introduction to Management (04 hrs)

- Definitions and importance of management
- Functions of management: Importance and Process of planning, organising, staffing, directing and controlling
- Principles of management (Henri Fayol, F.W. Taylor)
- Concept and structure of an organisation
- Types of industrial organisations

a) Line organisation
b) Line and staff organisation
c) Functional Organisation

5. Leadership and Motivation (03 hrs)

a) Leadership

- Definition and Need
- Qualities and functions of a leader
- Manager Vs leader
- Types of leadership

b) Motivation

- Definitions and characteristics
- Factors affecting motivation
- Theories of motivation (Maslow, Herzberg, McGregor)

6. Management Scope in Different Areas (06 hrs)

a) Human Resource Management

- Introduction and objective
- Introduction to Man power planning, recruitment and selection
- Introduction to performance appraisal methods

b) Material and Store Management

- Introduction functions, and objectives
- ABC Analysis and EOQ

c) Marketing and sales

- Introduction, importance, and its functions
- Physical distribution

- Introduction to promotion mix
- Sales promotion

d) Financial Management

- Introductions, importance and its functions
- Elementary knowledge of income tax, sales tax, excise duty, custom duty and VAT

7. Miscellaneous Topics (03 hrs)

a) Customer Relation Management (CRM)

- Definition and need
- Types of CRM

b) Total Quality Management (TQM)

- Statistical process control
- Total employees Involvement
- Just in time (JIT)

c) Intellectual Property Right (IPR)

- Introductions, definition and its importance
- Infringement related to patents, copy right, trade mark

**Note:** In addition, different activities like conduct of entrepreneurship awareness camp extension lecturers by outside experts, interactions sessions with entrepreneurs and industrial visits may also be organised.

**INSTRUCTIONAL STRATEGY**

Some of the topics may be taught using question/answer, assignment or seminar method. The teacher will discuss stories and case studies with students, which in turn will develop appropriate managerial and entrepreneurial qualities in the students. In addition, expert lecturers may also be arranged from outside experts and students may be taken to nearby industrial organisations on visit. Approach extracted reading and handouts may be provided.

**RECOMMENDED BOOKS**

1. A Handbook of Entrepreneurship, Edited by BS Rathore and Dr JS Saini; Aapga Publications, Panchkula (Haryana)
2. Entrepreneurship Development published by Tata McGraw Hill Publishing Company Ltd., New Delhi

3. Entrepreneurship Development in India by CB Gupta and P Srinivasan; Sultan Chand and Sons, New Delhi
4. Entrepreneurship Development - Small Business Enterprises by Poornima M Charantimath; Pearson Education, New Delhi
5. Entrepreneurship : New Venture Creation by David H Holt; Prentice Hall of India Pvt. Ltd., New Delhi
6. Handbook of Small Scale Industry by PM Bhandari
7. Principles and Practice of Management by L M Prasad; Sultan Chand & Sons, New Delhi

## SUGGESTED DISTRIBUTION OF MARKS

| Topic No. | Time Allotted (Hrs) | Marks Allotted (%) |
|---|---|---|
| 1 | 14 | 28 |
| 2 | 10 | 20 |
| 3 | 08 | 16 |
| 4 | 04 | 10 |
| 5 | 03 | 06 |
| 6 | 06 | 14 |
| 7 | 03 | 06 |
| **Total** | **48** | **100** |

## 6.7 PROJECT WORK

**L T P**
**- - 6**

Project work aims at developing skills in the students whereby they apply the totality of knowledge and skills gained through the course in the solution of particular problem or undertaking a project. The students have various aptitudes and strengths. Project work, therefore, should match the strengths of students. For this purpose, students should be asked to identify the type of project work, they would like to execute. It is also essential that the faculty of the respective department may have a brainstorming session to identify suitable project assignments. The project assignment can be individual assignment or a group assignment. There should not be more than 3 students if the project work is given for a group. The students should identify or given project assignment at least two to three months in advance. The project work identified in collaboration with industry may be preferred.

Each teacher is expected to guide the project work of 5-6 students.

- Projects related to designing new dies, moulds, jigs and fixtures
- Projects related to increasing productivity
- Projects related to quality assurance
- Projects related to estimation and economics of production
- Projects connected with repair and maintenance of plant and equipment
- Projects related to identification of raw material thereby reducing the wastage
- Projects related to suggesting substitutes of the polymer being used
- Any other related problems of interest of host industry

A suggestive criteria for assessing student performance by the external (personnel from industry) and internal (teacher) examiner is given in table below:

| | Performance criteria | % marks | Rating Scale | | | | |
|---|---|---|---|---|---|---|---|
| | | | excellent | Very good | good | fair | poor |
| 1. | Selection of project assignment | 10 | 10 | 8 | 6 | 4 | 2 |
| 2. | Planning and execution of considerations | 10 | 10 | 8 | 6 | 4 | 2 |
| 3. | Quality of performance | 20 | 20 | 16 | 12 | 8 | 4 |
| 4. | Providing solution of the problems or production of final product | 20 | 20 | 16 | 12 | 8 | 4 |
| 5. | Sense of responsibility | 10 | 10 | 8 | 6 | 4 | 2 |
| 6. | Self expression/ communication skills | 5 | 5 | 4 | 3 | 2 | 1 |
| 7. | Interpersonal skills/human relations | 5 | 5 | 4 | 3 | 2 | 1 |
| 8. | Report writing skills | 10 | 10 | 8 | 6 | 4 | 2 |
| 9. | Viva voce | 10 | 10 | 8 | 6 | 4 | 2 |
| | Total Marks | 100 | 100 | 80 | 60 | 40 | 20 |
| | | | | | | | |

The overall grading of the practical training shall be made as per following table

| | **Range of maximum marks** | **Overall grade** |
|---|---|---|
| i) | More than 80 | Excellent |
| ii) | 79 <> 65 | Very good |
| iii) | 64 <> 50 | Good |
| iv) | 49 <> 40 | Fair |
| v) | Less than 40 | Poor |

In order to qualify for the diploma, students must get "Overall Good grade" failing which the students may be given one more chance of undergoing 8 -10 weeks of project oriented professional training in the same industry and re-evaluated before being disqualified and declared "not eligible to receive diploma ". It is also important to note that the students must get more than six "goods" or above "good" grade in different performance criteria items in order to get "Overall Good" grade.

Important Notes

1. This criteria must be followed by the internal and external examiner and they should see the daily, weekly and monthly reports while awarding marks as per the above criteria.

2. The criteria for evaluation of the students have been worked out for 100 maximum marks. The internal and external examiners will evaluate students separately and give marks as per the study and evaluation scheme of examination.

3. The external examiner, preferably, a person from industry/organization, who has been associated with the project-oriented professional training of the students, should evaluate the students performance as per the above criteria.

4. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific nearby industries are approached for instituting such awards.

The teachers are free to evolve another criteria of assessment, depending upon the type of project work.

It is proposed that the institute may organize an annual exhibition of the project work done by the students and invite leading Industrial organisations in such an exhibition. It is also proposed that two students or two projects which are rated best be given merit certificate at the time of annual day of the institute. It would be better if specific industries are approached for instituting such awards.