POST DIPLOMA
IN
PLASTICS MOULD DESIGN WITH CAD/CAM
(PD-PMD WITH CAD/CAM)

SYLLABUS & CURRICULUM

2014
REvised: AUGUST 2016
Implemented from Academic Year: 2016-17

Academic Cell
Central Institute of Plastics Engineering &
Technology
Department of Chemicals & Petrochemicals, Ministry of Chemicals & Fertilizers,
Govt. of India
Head Office, Guindy, Chennai – 600 032.

Tel. No.: 91-44-22254780
Email: hocipetolc@gmail.com
Fax: 91-44-22254787
Web: www.cipet.gov.in
# POST DIPLOMA IN PLASTICS MOULD DESIGN WITH CAD/CAM (PD-PMD WITH CAD/CAM)

## SYLLABUS

### SEMESTER - I

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBJECT</th>
<th>CH</th>
<th>TH</th>
<th>EH</th>
<th>INT</th>
<th>EXT</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD 101</td>
<td>Plastics Materials</td>
<td>36½</td>
<td>4</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>PD 102</td>
<td>Plastics Product Design</td>
<td>51</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>PD 103</td>
<td>Plastics Mould Design – I</td>
<td>51</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>PD 104</td>
<td>Plastics Processing Technology</td>
<td>36½</td>
<td>4</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Total (18 weeks – 10½ hours per week)</td>
<td>174</td>
<td>15</td>
<td>12</td>
<td>160</td>
<td>240</td>
<td>400</td>
</tr>
</tbody>
</table>

**PRACTICAL**

| PDL 105 | Plastics Testing & QC Lab        | 27  | 4  | 50  | 50  | 100   |
| PDL 106 | Plastics Processing Lab          | 27  | 4  | 50  | 50  | 100   |
| PDL 107 | Design Lab – I                   | 270 | 8  | 200 | 200 | 400   |
| Library |                                  |     |    |     |     |       |
| Total (18 weeks – 19½ hours per week) | 351 | 16 | 300 | 300 | 600   |

### SEMESTER - II

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBJECT</th>
<th>CH</th>
<th>TH</th>
<th>EH</th>
<th>INT</th>
<th>EXT</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>PD 201</td>
<td>Plastics Mould Design – II</td>
<td>51</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>PD 202</td>
<td>Mould Manufacturing Technology</td>
<td>24</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>PD 203</td>
<td>Reverse Engineering And Rapid Prototyping</td>
<td>24</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td>PD 204</td>
<td>Process Planning &amp; Cost Estimation</td>
<td>24</td>
<td>3</td>
<td>3</td>
<td>40</td>
<td>60</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>Total (18 weeks – 7½ hours per week)</td>
<td>123</td>
<td>12</td>
<td>12</td>
<td>160</td>
<td>240</td>
<td>400</td>
</tr>
</tbody>
</table>

**PRACTICAL**

| PDL 205 | Manufacturing Practice              | 108 | 8  | 100 | 100 | 200   |
| PDL 206 | Design Lab - II                     | 270 | 8  | 200 | 200 | 400   |
| Library  |                                      | 27  | -  | -   | -   |       |
| Total (18 weeks – 22½ hours per week) | 405 | 16 | 300 | 300 | 600   |

**CH- Contact Hours**  **TH-Tutorial Hours**  **EH- Examination Hours**
### POST DIPLOMA IN PLASTICS MOULD DESIGN WITH CAD/CAM

*(PD-PMD WITH CAD/CAM)*

**SYLLABUS**

**SEMESTER - III**

<table>
<thead>
<tr>
<th>CODE</th>
<th>SUBJECT</th>
<th>HOURS</th>
<th>MARKS</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>PDL 301</td>
<td>Project Work</td>
<td><strong>378</strong></td>
<td>200</td>
<td>200</td>
<td>400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PDL 302</td>
<td>In plant training in industry **</td>
<td><strong>54</strong></td>
<td></td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PDL 303</td>
<td>Seminar – 20 weeks 4 hrs a week</td>
<td><strong>54</strong></td>
<td></td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Library – 20 weeks 4 hrs a week</td>
<td><strong>54</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td><strong>540</strong></td>
<td></td>
<td></td>
<td></td>
<td>600</td>
<td></td>
</tr>
</tbody>
</table>

**0CH- Contact Hours**    **TH-Tutorial Hours**    **EH- Examination Hours**

**Note:**

- Industrial Training should be of two weeks duration during the semester.
- Training Report from the Industry needs to be submitted.
PD-PMD With CAD/CAM
SEMMESTER – I (2014 Syllabus)

PD 101 - PLASTICS MATERIALS (40½ Hours)

UNIT I Polymers (6 Hours)
Introduction to polymers, Natural polymers – Polymerization – types of polymerization techniques. Types of plastics – thermoplastic & Thermoset – Amorphous & crystalline polymer. Introduction to thermal, mechanical, electrical, chemical & optical properties.

UNIT II Commodity Plastics (7½ Hours)

UNIT III Engineering Plastics (7½ Hours)
General Properties and application of Acrylonitrile Butadiene Styrene - Polyamides(PA-6, PA-6,6 & PA-11) - Polycarbonates - Polycetel & Copolymers - Thermoplastic Polyesters (PET & PBT)-Polyphenylene oxide – Polysulfones - Fluoro polymers (PVF, PVDF, PTFE, PCTFE) - Thermoplastic Polyurethane. Manufacturers & availability of various grades.

UNIT IV Specialty Plastics (12 Hours)


UNIT V Thermosetting Plastics (7½ Hours)

Text / Reference Books
2. Plastics Materials, Brydson, J.A
4. Text book of Polymer Science, Fred W Billmeyer
5. Polymer Science V.R. Gowariker

Note: Minimum of one assignment is mandatory from each unit.
PD-PMD With CAD/CAM
SEMESTER – I (2014 Syllabus)

PD 102 - PLASTICS PRODUCT DESIGN (54 Hours)

UNIT I Product Design Requirement (12 Hours)


Product design criteria – Structural, Environmental, Assembly, Aesthetics & Decoration. Product design check list, Good design practices, Safety in product design.

UNIT II Product Design Features (21 Hours)


UNIT III Design of Structural Elements (10½ Hours)

Designing with plastics for load bearing applications like gears, bearing, spring. Assembly – Mechanical fasteners

UNIT IV Composite Product Design (10½ Hours)

Design constraints – factor of safety for uncertainties in design – design failure criteria – optimization in design.

Text / Reference Books
1. Plastics Product Design, Beck
2. Plastic part design hand book, Rosato
3. The complete part design hand book (Injection Mould of Thermo Plastics), E. Alfredocampo

Note: Minimum of one assignment is mandatory from each unit.
PD 103 - PLASTICS MOULD DESIGN – I  (54 Hours)

UNIT I  Mould Design Fundamentals  (16½ Hours)
Introduction: Basic construction of mould – Types of moulds – Mould parts – mould plates, sprue bush, locating ring, core and cavity, Guide pillar & guide bush, Bolsters, Types of Bolsters, Mould clamping methods, Mould lifting arrangements
Parting Surface: Parting line/Parting surface: Flat parting surface – Non flat parting surface – stepped parting surface, irregular parting surface, angled surface, local stepped and profile parting surface, complex edge forms – Mould Venting.

UNIT II  (12 Hours)
Ejection System:
Mould Temperature Control System:

UNIT III  Types of Injection Moulds  (13½ Hours)

UNIT IV  Selection of Machines  (6 Hours)

UNIT V  Standard Mould Parts  (6 Hours)
Standard Mould Base- Advantages and limitations, manufacturers etc., Standard ejector pins, guide pins, bushes, mould date indicators, mould springs, cooling baffles, nipples, parting locks etc

Text / Reference Books
1. Injection Mould Design – Pye R.G.W
2. Injection Moulds 130 Proven Design Gastrow
Note: Minimum of one assignment is mandatory from each unit.
PD 104 - PLASTICS PROCESSING TECHNOLOGY  

UNIT I Injection Molding  
Types of injection moulding machines - machine specifications - projected area - plasticizing capacity - shot weight - type of locking systems - mould clamping - hydraulics - basic principles - hydraulics - hydraulic control - oil requirements - routine maintenance - safety rules.  
Mould setting – effect variables on mouldings - shrinkage - quality control aspects - faults - causes and remedies.

UNIT II  
Blow Moulding:  
Introduction to blow moulding - types of blow moulding operations - extrusion blow moulding - injection blow moulding - stretch blow moulding - basic principles - parison control - wall thickness in relation to parison - types of extruders for blow moulding - blow mould construction - setting and operation - mould cooling - clamping force - cycle time - moulding faults - causes and remedies - quality control - operator safety.

Extrusion:  
Introduction - extruder parts - extrusion screw - design features - design variables - extruder output - extrusion process parameters - their effects on product - extruder faults - causes and remedies. Extrusion of film, pipe, sheet, profile and coating - dies for different extrusion process - sizing units - hauloff units - process control systems - process variables - quality control and safety.

UNIT III  
Compression &Transfer Moulding:  
Compression moulding - fundamental principles - bulk factor - flow properties - processing temperatures - mould temperature control - moulding pressure - press tonnage - limitations - curing time - influence of processing parameters on the quality of the moulding - moulding conditions - raw material quantity (charge size) - by volume/weight - pelleting - preheating the pellets - simple test for rate of cure - defects - causes and remedies of the common moulding faults - operator safety and routine quality control.

UNIT IV  
Thermoforming:  
Introduction - thermoforming methods - thermoforming dies - thermoforming equipment description - temperature control - cycle time - defects, causes and remedies - quality control and safety

Roto-Moulding:  
Introduction to rotomoulding – principle of bi-axial rotation – equipment description – temperature control systems – cycle time – defects, causes and remedies.
Post Moulding Operations:
Printing and decoration of moulded items - films - pipes - sheets, etc. - hot stamping - pad printing - screen printing – rotogravure printing - heating ceiling - ultrasonic welding - adhesive bonding - fastening with metal inserts - limitations of post moulding operations - their advantages

UNIT V

Advanced Processing Techniques:
Reaction injection moulding - principles - machine description - process control - cycle time - defects, causes and remedies - quality control and safety. Twin screw injection moulding machine, Twin barrel Injection moulding machine. 
Structural foam moulding - principles - process description - process control - defects and remedies - quality control.
Resin transfer moulding - principles - process description - process control - defects and remedies - quality control.

Text / Reference Books
2. Plastics Materials, Brydson, J.A
4. Plastics Processing, Beadle

Note: Minimum of one assignment is mandatory from each unit.
## PD-PMD With CAD/CAM

**SEMESTER – I**

### PDL 105- PLASTICS TESTING & QC LAB

(27 hours)

**Practical Exercises**

<table>
<thead>
<tr>
<th>Exercise</th>
<th>Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Chemical Lab</td>
<td>2</td>
</tr>
<tr>
<td>2. Specimen Preparation Lab</td>
<td>2</td>
</tr>
<tr>
<td>3. Thermal Lab</td>
<td>6</td>
</tr>
<tr>
<td>4. Mechanical Lab</td>
<td>6</td>
</tr>
<tr>
<td>5. Electrical &amp; Optical Lab</td>
<td>2</td>
</tr>
<tr>
<td>6. Product Testing Lab</td>
<td>3</td>
</tr>
<tr>
<td>7. Rheological Lab</td>
<td>3</td>
</tr>
<tr>
<td>8. Characterization Lab</td>
<td>3</td>
</tr>
</tbody>
</table>
PDL 106 - PLASTICS PROCESSING LAB (27 hours)

Practical Exercises

1. Injection moulding machines: 10 Hours
   a) Hand operated
   b) Semi-automatic & automatic
   c) Microprocessor controlled automatic injection moulding process

2. Blow moulding machines: 2 Hours
   Hand operated, semi & automatic machines

3. Compression & Transfer moulding machines: 2 Hours
   Hand operated, semi & automatic

4. Extrusion: 9 Hours
   a) Pipe & profile extrusion
   b) Blown film extrusion
   c) Multilayer blown film extrusion

5. Rotomoulding machines 1 Hour

6. Thermoforming machines 1 Hour

7. Fibre reinforced plastics processing 2 Hours
PD-PMD With CAD/CAM

SEMESTER – I

PDL 107 - DESIGN LAB - I

(To be conducted in CAD/CAM Lab)

1. Introduction and Practice on 2D drafting on CAD software 27 Hours
2. Introduction and practice on 3D Modeling using Creo/UG/CATIA software 50 Hours
3. Design of standard Mould Base 14 Hours
4. Design of Hand Injection mold for single impression 8 Hours
5. Design of Single impression two plate Injection Mould 21 Hours
6. Design of Multi impression two plate Injection Mould 27 Hours
7. Study & detail for the Exercise No. 5/6 21 Hours
8. Design of Three Plate Injection Mould (multi impression) 27 Hours
9. Design of Split Injection Mould - without delayed action 27 Hours
10. Design of Split Injection Mould - with delayed action 27 Hours
11. Design of Injection Mould for internal undercut components 21 Hours

Note: Design Practicals Sl.No.:3 to 10 shall be carried out by utilizing CAD software.
PD 201 PLASTICS MOULD DESIGN – II (54 Hours)

UNIT I Advance Injection Mould Design (22 Hours)


UNIT II Compression & Transfer Mould Design (14 Hours)

Compression Mould Design:
Types of compression moulds, open flash, semi-positive, positive, displacement moulds, types of loading chambers, bulk factor, flash thickness, projected area, compression pressure, clamping force, no. of impression by technological method, heating system, types of heaters, heat loss, heat requirement & heater capacity.

Transfer Mould Design:
Types of transfer moulds, integral pot transfer mould, auxiliary ram, transfer pot design, projected area, transfer pressure, clamping force, pressure pad design, design of sprue runner and gate, advantages and disadvantages of transfer mould - design related calculations.

UNIT III Blow Mould Design (6 Hours)

Types of blow moulds - extrusion - injection stretch blow moulds - blow ratio - parison design - pinch off design - parting line - clamping force - mould venting, mould cooling - mould alignment. Design for industrial applications.

UNIT IV Extrusion Die Design (6 Hours)

Principles of extrusion - die geometry - die swell - die land design - sizing die design - construction of extrusion dies - blown film - pipe - profile - flat film - sheet - wire coating and co-extrusion dies.

UNIT V Rotational Mould Design (6 Hours)

Introduction – Mould material – Mould design: Mould frame, Moulded in inserts, Moulded handles, Movable cores. – Mould venting – Mould cooling.

Text / Reference Books
1. Plastics Product Design Beck, R
2. Injection Mould Design – Pye R.G.W
3. Injection Moulds 130 Proven Design Gastrow

Note: Minimum of one assignment is mandatory from each unit.
PD 202 - MOULD MANUFACTURING TECHNOLOGY  
(27 hours)

Unit I  
Material for Mould Making  
(7½ Hours)


Unit II  
Machinery for Mould Manufacture  
(7½ Hours)

Tool room machinery - their recognition, appreciations and limitations - machining operations and accuracy.  

Unit III  
CNC Machines  
(6 Hours)

Different types of CNC machine tools - Lathe, Milling, VMC, EDM, Wire EDM - CAD integrated with CAM.  
Introduction to tool room inspection-measuring instruments-co-ordinate measuring machine - taper and angle measurement techniques.

Unit IV  
(3 Hours)

Polishing Technology in Mould Making: Definition of surface roughness, basis of polishing technology - Effect of mould materials on polishability, Types of polishing tools, Methods of polishing - Basic information on ultra sonic polishing – Principles of Electro deposition in damaged moulding surfaces/Protective Coating.  
Surface Texturing of Moulds – Process description, types of moulds, types of patterns and mould shapes, metals that can be etched, mould preparation, limitations of chemical texturing.

Unit V  
(3 Hours)

Mould assembly-check list for mould assembly-fitting and assembly of various mould elements- core insert, cavity insert, sprue bush-ejection system assembly-blue matching and die spotting-venting - final inspection-fitting of locating ring and carrier bar- mould trial.

Text / Reference Books

1. Mould Making Hand Book, Stoeckert  
2. Plastics Moulds and Dies, Sors  
3. Injection Moulds, V.D.I  
5. Computer Numerical Control Machines (CNC), Radhakrishnan, P  
6. Fundamentals of Numerical Control Lock Wood F.B  
7. CNC Setting & Operation Work Book Renshaw, Tom

Note: Minimum of one assignment is mandatory from each unit.
PD 203 REVERSE ENGINEERING AND RAPID PROTOTYPING (27 hours)

Unit I  Reverse Engineering (6 Hours)

Geometric Modeling: Types of Geometric models and Solid Models
Reverse Engineering: Meaning, Definition & application, Computer aided reverse engineering,
Measuring devices -contact type, non contact type-CAD model construction from point cloud-
preprocessing, point clouds to surface model creation, Geometric data acquisition,3D
reconstruction, Applications and Case Studies

Unit II  Rapid Prototyping (3 Hours)

Introduction : Need - Development of RP systems – RP process chain - Impact of Rapid
Prototyping and Tooling on Product Development – Benefits- Applications.

Unit III  Liquid and Solid Based Rapid Prototyping systems (6 Hours)

Stereo lithography Apparatus, Fused deposition Modelling, Laminated object manufacturing,
three dimensional printing: Working Principles, details of processes, products, materials,
advantages, limitations and applications

Unit IV  Powder Based Rapid Prototyping Systems (6 Hours)

Selective Laser Sintering, Direct Metal Laser Sintering, Three Dimensional Printing, Laser
Engineered Net Shaping, Selective Laser Melting, Electron Beam Melting: Processes,
materials, products, advantages, applications and limitations

Unit V  Rapid Tooling (6 Hours)

Classification: Soft tooling, Production tooling, Bridge tooling; direct and indirect – Fabrication
processes, Vacuum casting - Applications.

Text / Reference Books

1. Tool Design – Cyril Donaldson,
2. Production Technology by P.C.Sharma, S.Chand & Company,
3. Production Technology by Dr.R.K.Jain,
4. Jig and Fixture Design by Edward G.Hoffman, Thomson Delmer Learning,
6. Rapid prototyping: Principles and applications, second edition, Chua C.K.,
7. Rapid Tooling: Technologies and Industrial Applications, Peter
9. Rapid Prototyping and Engineering applications : A tool box for

Note: Minimum of one assignment is mandatory from each unit.
PD 204 – PROCESS PLANNING & COST ESTIMATION (27 HOURS)

Unit I  Introduction (1½ Hours)


Unit II  Process planning activities for Mould manufacture (4½ Hours)

Introduction to Mould Manufacturing system, Details of mould manufacturing process - operation sequence, machine selection. Documents in process planning (process layout, process sheets and route sheets with example) – process plans for machining typical components.

Unit III  Estimating and Costing for mould manufacturing (7½ Hours)


Unit IV  Elements of Costing (6 Hours)


Unit V  Cost Estimation (7½ Hours)


Text / Reference Books

1. Industrial Engineering Management – Khanna O. P.
4. Russell R.S. and Taylor, B.W."Operations Management", PHI,
5. Chitale.A.V. and R.C.Gupta, “Product Design and Manufacturing”, PHI,

Note: Minimum of one assignment is mandatory from each unit.
PDL 205 - MANUFACTURING PRACTICE (108 Hours)

Practical Exercises on Mould Parts

1. Milling & Boring 12 Hours
2. Turning, thread cutting 10 Hours
3. Drilling, reaming & tapping 10 Hours
4. Grinding- wheel dressing, setting, balancing & grinding 10 Hours
5. EDM 10 Hours
6. Wire-EDM - programming & machining 10 Hours
7. CNC milling - programming & machining 12 Hours
8. CNC lathe - programming & machining 12 Hours
9. CNC EDM - programming & machining 12 Hours
10. Inspection & CMM 10 Hours
PD-PMD With CAD/CAM
SEMESTER – II 2014 SYLLABUS

PDL 206 - DESIGN LAB - II
(270 Hours)

(To be conducted in CAD/CAM lab)

1. Introduction and practice on 3D modeling using UG NX /CREO/CATIA (50 Hours)
2. Demonstration and practice on Mould Flow software (50 Hours)
3. Compression mould design -open flash (21 Hours)
4. Compression mould design - positive, semi-positive, (21 Hours)
5. Transfer mould design (21 Hours)
6. Extrusion Die Design (21 Hours)
7. Design of Blow mould (21 Hours)
8. Mould design for internal threaded components (automatic unscrewing) (22 Hours)
9. Hot Runner Mould (22 Hours)
10. Rotomould and thermoform mould design (21 Hours)

Note : Design Practicals Sl.No. : 3 to 11 shall be carried out by utilizing CAD software.
PDL 301 - PROJECT WORK

(378 Hours)

Project work shall be carried out by the Students in a group comprising of 4 to 5 members. The type of project shall be selected by the course in-charge in consultation with the local industries.

The scope of the project work is given below:

1. Development of Product Design and Mould Design Drawings using any CAD Software
2. Checking the Mould Design using Mould Flow Analysis
3. Preparing Project report highlighting features of Product Design and steps followed in development of Mould Design and report on Mould Flow analysis
4. Students shall be encouraged to involve themselves in the mould development process
5. The final assessment will be through a Viva-voce by a committee of officials working in industries and department officials.
PDL 302 – INPLANT / INDUSTRIAL TRAINING: (54 Hours)

A report should be submitted by the student after successful completion of the same along with a certificate from the Industry. It will help the student to understand the Industry requirement for selection of product and executing the Project.
PDL 303 SEMINAR - CASE STUDIES ON PRODUCT & MOULD DESIGN  (54 Hours)

Each student shall present a case study with part drawing and mould design as part of seminar in the class room in front of the students and shall be evaluated by the faculty. Suggested topics are given below for selection by faculty and allocation to the student. Student maybe encouraged to select automobile, electrical and other engineering products.

1. Two Plate Injection Mould
2. Three Plate Injection Mould
3. Multi Cavity Injection Mould
4. Stripper Plate Mould
5. Standard Mould Bases
6. Split Cavity Mould
7. Core Puller Mould
8. Collapsible Mould
9. Cooling System
10. Submarine Gate multi Cavity Mould
11. Automatic Unscrewing Mould
12. Gas assisted Injection Mould
13. Hot Runner Mould
14. Stack Mould
15. Multi Stage Injection Mould
16. Metal to Plastic replacement
17. Insert Moulding
18. Two layer two colour Injection moulding concept
19. Injection Blow moulding Process and Design
20. Stretch Blow moulding process and design
21. Thermoforming moulding process and design
22. Rotational moulding process and design
23. Mould elements – material selection process
24. Various heat treatment process for Mould elements
25. Mould Polishing & Mould maintenance
26. Product design features and requirement
27. Fastening / Assembly / Welding / joining of Plastics
29. Rapid prototyping techniques
30. Reverse Engineering
31. Dealing with undercuts – Lifter / Collapsible core / Angle pin / Dog leg cam
32. Shrinkage Analysis for various plastic materials

*****************************