NATIONAL SKILL QUALIFICATION FRAMEWORK (NSQF)
QUALIFICATION FILE

SYLLABUS & CURRICULUM

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

(Duration: 1½ Years, Full Time)

Implemented from Academic Year: 2020-21

Academic Cell
Central Institute of Plastics Engineering & Technology
(Department of Chemicals & Petrochemicals,
Ministry of Chemicals & Fertilizers, Govt. of India)
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NATIONAL SKILL QUALIFICATION FRAMEWORK QUALIFICATION FILE

CONTACT DETAILS OF THE BODY SUBMITTING THE QUALIFICATION FILE

Name and address of submitting body:

Central Institute of Plastics Engineering & Technology (CIPET)
Department of Chemicals & Petrochemicals (DCPC)
Ministry of Chemicals & Fertilizers, Govt. of India
T.V.K.Industrial Estate, Guindy, Chennai-32

Name and contact details of individual dealing with the submission:

Name and contact details of individual dealing with the submission

Name	:	Prof. (Dr.) S. K Nayak
Position in the organization	:	Director General
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List of documents submitted in support of the Qualifications File:

1. **Curriculum Document**
2. **Evaluation (Marking) Scheme**

1. SUMMARY

Qualification Title	**Post Diploma in Plastics Mould Design with CAD/CAM (PD-PMD with CAD/CAM)**
Qualification Code	**CIPET/PD-PMD/01**
Nature and purpose of the qualification	**Nature:** Post Diploma Course **Purpose:** Learners who attain this qualification are competent in Plastics Mould and Die Design techniques like Injection Mould, Extrusion Die, Blow Mould, Compression Mould, etc. and also in mould making technologies They can get a job in tooling industries in design as well as in production or they can become entrepreneurs.
Body/bodies which will award the qualification	**Central Institute of Plastics Engineering & Technology (CIPET), Guindy, Chennai**
Body which will accredit providers to offer courses leading to the	**AICTE**
Body/bodies which will carry out assessment of learners	**Central Institute of Plastics Engineering & Technology (CIPET), Guindy, Chennai**
Occupation(s) to which the qualification gives	**Design Engineer / Production Engineer / Tool Room Supervisor**
Licensing requirements	**Not Applicable**
Level of the qualification in the NSQF	**Level 6**
Anticipated volume of training/learning required to complete the qualification	**1620 Hours**
Entry requirements and /or recommendations	**3 Years Diploma** (Diploma in Mechanical/ Plastics/ Polymer/ Tool/ Production/ Mechatronics/ Automobile /Tool & Die Making/ Petrochemicals/ Industrial/ Instrumentation Engineering/ Technology or DPMT / DPT (CIPET) or equivalent)
Progression from the qualification	**Job Progression:** After completion of two semesters of theory and practical training, students have to undergo six months industrial training cum project work with stipend and after the completion of training they can work as a Design Engineer / Production Engineer. After 5 years of experience they can become Manager in the tool & die making, automobile/ defence/ aerospace components, high precision manufacturing industries, etc.
Planned arrangements for the Recognition of Prior learning (RPL)	**Yes**
International comparability where known	**Not Known**
Date of planned review of the qualification.	**January 2021**

SEMESTER – I

S. No.	Code	Subject	LH	TH	PH	EH	Marks			Credit
							INT	EXT	TOTAL	
THEORY										
1	PD 101	Plastics Materials	40½	0	0	3	40	60	100	02
2	PD 102	Plastics Product Design	51	3	0	3	40	60	100	03
3	PD 103	Plastics Mould Design – I	51	3	0	3	40	60	100	03
4	PD 104	Plastics Processing Technology	40½	0	0	3	40	60	100	02
Total (18 weeks - 10½ hours a week)			**183**	**6**	**0**	**12**	**160**	**240**	**400**	**10**
			189							
PRACTICAL WORK										
1	PDL 105	Plastics Testing & QC Lab	0	0	27	4	50	50	100	01
2	PDL 106	Plastics Processing Lab	0	0	27	4	50	50	100	01
3	PDL 107	Design Lab – I	0	0	270	8	200	200	400	06
4		Library – (18 weeks- 1½ hours a week)	0	0	27	--	-	-	-	00
Total (18 weeks – 19½ hours a week)			**0**	**0**	**351**	**16**	**300**	**300**	**600**	**08**

SEMESTER – II

S. No.	Code	Subject	LH	TH	PH	EH	Marks			Credit
							INT	EXT	TOTAL	
THEORY										
1	PD 201	Plastics Mould Design – II	51	3	0	3	40	60	100	03
2	PD 202	Mould Manufacturing Technology	27	0	0	3	40	60	100	02
3	PD 203	Reverse Engineering & Rapid Prototyping	27	0	0	3	40	60	100	02
4	PD 204	Process Planning & Cost Estimation	27	0	0	3	40	60	100	02
Total (18 weeks - 7½ hours a week)			**132**	**03**	**0**	**12**	**160**	**240**	**400**	**09**
			135							
PRACTICAL WORK										
1	PDL 205	Mould Manufacturing Practice	0	0	108	8	100	100	200	03
2	PDL 206	Design Lab - II	0	0	270	8	200	200	400	06
3		Library (18 weeks - 1½ hours a week)	0	0	27	-	-	-	-	00
	Total (18 weeks – 22½ hours a week)		**0**	**0**	**405**	**16**	**300**	**300**	**600**	**09**

SEMSETER – III

S. No.	Code	Subject	LH	TH	PH	EH	Marks			CREDIT
							INT	EXT	TOTAL	
1	PDL 301	Seminar (2 weeks - 4 hours a day)	40	0	0	0	100		100	2
2	PDL 302	Industrial Training Report	0	0	0	0	100		100	2
3	PDL 303	Project Work/In-Plant Training in Industry (16 weeks - 30 hours per week) Project Evaluation & Viva voce	0	0	480	6	200	200	400	8
		Library (2 weeks - 2 hours a day)	0	**0**	20					
		Total	**40**	**0**	**500**	**6**	**600**		**600**	**12**

LH - Lecture Hours **TH - Tutorial Hours** **PH - Practical Hours** **EH - Examination Hours**

Formal structure of the qualification				
Sl. No	**Title and Identification Code of Component**	**Mandatory / Optional**	**Estimated Size of Learning Hours**	**Level**
I Semester				
01	Plastics Materials	Mandatory	40½	
02	Plastics Product Design	Mandatory	54	
03	Plastics Mould Design – I	Mandatory	54	
04	Plastics Processing Technology	Mandatory	40½	
05	Plastics Testing & QC Lab	Mandatory	27	
06	Plastics Processing Lab	Mandatory	27	
07	Design Lab – I	Mandatory	270	
II Semester				
01	Plastics Mould Design – II	Mandatory	54	
02	Mould Manufacturing Technology	Mandatory	27	
03	Reverse Engineering & Rapid Prototyping	Mandatory	27	
04	Process Planning & Cost Estimation	Mandatory	27	
05	Mould Manufacturing Practice	Mandatory	108	
06	Design Lab – II	Mandatory	270	
III Semester				
01	Seminar	Mandatory	40	
02	Project Work/In-Plant Training in Industry	Mandatory	480	

SECTION 1

ASSESSMENT

Body/Bodies which will carry out assessment:

Academic Cell, CIPET Head Office, Chennai.

How will RPL assessment be managed and who will carry it out?

Learners who have met the requirements of any Unit Standard that forms part of this qualification may apply for recognition of prior learning to the relevant Education body. The applicant must be assessed against the specific outcomes and with the assessment criteria for the relevant Unit Standards.

Describe the overall assessment strategy and specific arrangements which have been put in place to ensure that assessment is always valid, reliable and fair and show that these are in line with the requirements of the NSQF.

1. ASSESSMENT GUIDELINE:

- Criteria for assessment based on each learning outcomes, will be assigned marks proportional to its importance.
- The assessment for the theory and practical part is based on completed assignments, two mid-term examinations / unit tests, regular assessment of jobs done at laboratories & practical record books and a centralized semester exam wherein the questions are set by faculties and approved by Academic Cell, CIPET Head Office, Chennai.
- For each individual batch, Academic Cell creates unique question papers for theory part as well as practical for each candidate at each examination.
- To pass the Qualification, every trainee should score a minimum of 40% in each Theory and 50% in each Practical subject.

Assessment comprises the following components:

- Completed assignments
- Mid Term Exam / Unit tests
- Answer sheet of assessment
- Job carried out in laboratories / workshop
- Record book
- Viva–voce
- Attendance and punctuality

2. ASSESSORS:

CIPET faculty teaching the Post Diploma in Plastics Mould Design with CAD/CAM, also assesses the students as per guidelines set by Academic Cell of CIPET Head office. Faculties are been trained from time to time to upgrade their skills on various aspects such as conduction of assessments, teaching methodology, etc.

3. ELIGIBILITY TO APPEAR IN THE EXAM:

Minimum 80% attendance is compulsory for the students to appear for the assessments.

4. MARKING SCHEME:

Please refer Annexure - I for marking / evaluation scheme.

5. PASSING MARKS:

Passing criteria is based on marks obtained in attendance record, assignments, performance in practical, viva or oral examination, mid–semester examination / unit tests, practical examination and semester examination.

Minimum Marks to pass in semester theory examination – 40%

Minimum Marks to pass in semester practical examination – 50%

Minimum Marks to pass in mid-term examination / unit test – 40%

Minimum Marks to pass in seminar / industrial training / project and viva-voce exam – 50%

6. RESULTS AND CERTIFICATION:

The assessment results are backed by evidences collected by assessors. Successful trainees are awarded the certificates by Academic Cell, CIPET Head Office.

ASSESSMENT EVIDENCE

ASSESSMENT EVIDENCE

Assessment evidence comprises the following components documented in the form of records:

1. Internal assessment book for both Theory and Practical subjects
2. Answer sheet of periodical and midterm test assessment
3. Theory & Practical Examination – Answer Sheet
4. Job carried out in laboratories / workshop
5. Record book
6. Viva–voce
7. Attendance and punctuality
8. General Behavior

TITLE OF COMPONENT		POST DIPLOMA IN PLASTICS MOULD DESIGN WITH CAD/CAM	
Sl. No.	**OUTCOMES TO BE ASSESSED**	**ASSESSMENT CRITERIA FOR THE OUTCOME**	**No. of Hours**
1	**PLASTICS MATERIALS**	1.1 Introduction to polymers, Natural polymers – Polymerization – types of polymerization techniques. Types of plastics – Thermoplastics & Thermosets – Amorphous & crystalline polymers. Introduction to thermal, mechanical, electrical, chemical & optical properties. Basics of plastics identification and testing.	08 Hours
		2.1 Commodity Plastics - General properties, advantages, limitations and applications of Polyethylene - Polypropylene and their copolymers - Vinyl polymers and copolymers - Polystyrene and copolymers - Acrylic and copolymers - Cellulose polymers. Manufacturers & availability of various grades.	7½ Hours
		3.1 Engineering Plastics - General properties, advantages, limitations and applications of Acrylonitrile Butadiene Styrene – Polyamides - Polycarbonates - Polyacetal & Copolymers - Thermoplastic Polyesters - Polyphenylene oxide – Polysulfones - Fluoropolymers - Thermoplastic Polyurethane. Manufacturers & availability of various grades.	7½ Hours
		4.1 Specialty Plastics - General properties, advantages, limitations and applications of Polyphenylene Sulfide - Polyphenylene ether - Polyether ether ketone - Polyimide and related polymers - Liquid Crystal Polymers - Conductive Polymers. Manufacturers & availability of various grades.	07 Hours
		5.1 Polymer Composites, Blends & Alloys: Definition, Properties, Limitations, Advantages & Applications.	03 Hours
		6.1 Thermosetting Plastics - Additives - Curing and cross-linking agents - General properties, advantages, limitations and applications of Phenol Formaldehyde - Urea Formaldehyde - Melamine Formaldehyde - Unsaturated Polyesters - Epoxy resins - Polyurethane and Silicones. Manufacturers & availability of various grades.	7½ Hours
2	**PLASTICS PRODUCT DESIGN**	2.1 Concept to commercial products – Product specification – Material selection – Process selection – Design for Manufacture & Assembly (DFMA). Tooling Aspects on Product Design – Product Design Appraisal.	05 Hours
		2.2 GD & T – Introduction, Features and Rules, Form, Datum System, Orientation, Position, Run-out, Concentricity, Symmetry, Profile, Standards and Practical Applications.	05 Hours
		2.3 Product design criteria – Structural, Environmental,	05 Hours

		Assembly, Aesthetics & Decoration. Product design check list, Good design practices, Safety in product design. CAD/CAM/CAE applications in product design.	
		2.4 Shrinkage, Wall thickness – variations in wall thickness – suggested wall thickness for various plastics materials – Tapers or draft angles. – Design of radii, fillets, ribs and bosses. Undercuts – External & Internal –. Moulded Holes - through holes – blind holes – threaded holes – side holes – holes parallel to draw – nearness of holes to each other and side wall – moulding holes not parallel to draw – drilled and tapped holes.	10 Hours
		2.5 Design of integral hinges, hinges and snap fits for boxes and assembly of moulded parts. Types of threads - Moulded threads. Interference between the threads. Inserts – materials – selection of metal for inserts – minimum wall thickness of material around inserts – anchorage - relieving moulding stresses around inserts – location of inserts in the part – moulded inserts – pressed-in inserts.	10 Hours
		2.6 Design of joints – bolted joints – bonded joints, etc. Designing with plastics for load bearing applications like gears, bearings, springs. Designing Plastic Parts for Assembly – Mechanical fasteners.	8½ Hours
		2.7 Concepts of composite product design – Design requirements – functional – safety – reliability – cost effectiveness. Design constraints – factor of safety for uncertainties in design – design failure criteria – optimization in design. Design data – physical, mechanical and functional properties of composites – code of practice of loading on structures – structure and property relation of composites.	10½ Hours
3	**PLASTICS MOULD DESIGN – I**	3.1 Types of moulds, Basic construction of injection mould – Types of injection moulds - Two Plate and Three Plate Mould Design – Mould parts – mould plates, sprue bush, locating ring, core and cavity, Guide pillar and Guide bush, Bolsters, Types of Bolsters, Mould clamping methods, Mould lifting arrangements - DFMA of Moulds – Shrinkage considerations – Design requirements for quality moulding – Mould lifecycle – CAD/CAM applications in mould design.	12 Hours
		3.2 Feed System - Sprue, Runner & Gate – cross section and size of runner –runner layout – balancing of runners – types of gates for various materials – cross section of gate – gate balancing. Empirical formulae.	4½ Hours
		3.3 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	1½ Hours

		forms – Mould Venting.	
		3.4 Ejection System - Types of ejector grid – Ejector plate assembly – Guiding & Supporting ejector plate assembly - Types of ejection – position & critical area of ejection – pin ejection – stepped pin-part of pin - “D”-Pin – blade ejection – sleeve ejection – stripper ring ejection – stripper plate ejection – air ejection – double ejection – Delayed action ejection – Types of sprue pullers – calculation of support pillar requirements. Calculation of Ejection force, ejection stroke, etc.	06 Hours
		3.5 Mould Temperature Control System - Mould cooling – Integer type cavity and core plates cooling, angled hole systems, baffled hole systems, stepped circuit – Types of bolster cooling – Insert cooling, Deep chamber design, Bubbler cooling, Baffle cooling, spiral cooling – cooling circuits – Principle of heat pipe, heat rod, capillary tube and its applications – Cooling for sprue bush – O-rings – cooling nipples – Calculation of cooling efficiency, cooling time. Mould heating methods, Mould temperature controller – Conformal cooling – Sequential cooling.	06 Hours
		3.6 Injection Moulding Machine Selection criteria – dry cycle time and its application in Mould Design. Calculating No. of impressions –projected area, injection pressure, clamping tonnage, Lay-out of impressions.	03 Hours
		3.7 Mould Design Standards - Standard Mould Base - Advantages and limitations – manufacturers - Standard parts - ejector pins - guide pins - bushes, mould date indicators - mould springs - cooling baffles – nipples - parting locks - Selection of mould base and accessories through software and web portals.	06 Hours
		3.8 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 impressions by technological method - heating system - types of heaters - heat loss - heat requirement - heater capacity - design related calculations.	09 Hours
		3.9 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.	06 Hours

4	**PLASTICS PROCESSING TECHNOLOGY**	4.1 Injection Moulding - process variables - moulding cycle - cylinder temperatures - shear and orientation - runner systems - balancing of impressions - injection nozzles - insulated nozzles - hot runner moulds - insulated runner moulds – semi-automatic and automatic moulds - operation and maintenance.	06 Hours
		4.2 Types of injection moulding machines – specifications – shot capacity – shot weight – plasticizing capacity – projected area – locking forces – platen details – maximum and minimum daylight – nozzle details – locating mould on machines– ejection systems – Machine platen locking methods - mould clamping - basic principles of hydraulics - hydraulic control - oil requirements - routine maintenance - safety rules.	03 Hours
		4.3 Mould setting – effect of variables on mouldings - shrinkage - quality control aspects - faults - causes and remedies.	1½ Hours
		4.4 Thermoset injection moulding, automation and robotics in injection moulding – advantages and disadvantages, scientific injection moulding - applications, smart factory.	03 Hours
		4.5 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.	4½ Hours
		4.6 Extrusion - 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 and their construction - sizing units – haul-off units - process control systems - process variables - quality control and safety.	06 Hours
		4.7 Compression & Transfer Moulding: Fundamental principles - bulk factor - flow properties - processing temperatures - mould temperature control - moulding pressure - press tonnage - limitations - curing time - influence of processing parameters on	06 Hours

		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.	
		4.8 Thermoforming - methods - dies - equipment description - temperature control - cycle time - defects, causes and remedies - quality control and safety.	1½ Hours
		4.9 Roto-Moulding – principle of bi-axial rotation – equipment description – temperature control systems – cycle time – defects, causes and remedies.	1½ Hours
		4.10 Post Moulding Operations - Feed system de-gating, Printing and decoration of moulded items - films - pipes - sheets, etc. - hot stamping - pad printing - screen printing – rotogravure printing - heat ceiling - ultrasonic welding - adhesive bonding - fastening with metal inserts - limitations of post-moulding operations - their advantages.	03 Hours
		4.11 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.	1½ Hours
		4.12 Structural foam moulding - principles - process description - process control - defects and remedies - quality control.	1½ Hours
		4.13 Resin transfer moulding - principles - process description - process control - defects and remedies - quality control.	1½ Hours
5	**PLASTICS TESTING & QC LAB**	5.1 Chemical Lab	2 Hours
		5.2 Specimen Preparation Lab	2 Hours
		5.3 Thermal Lab	6 Hours
		5.4 Mechanical Lab	6 Hours
		5.5 Electrical & Optical Lab	2 Hours
		5.6 Product Testing Lab	3 Hours
		5.7 Rheological Lab	3 Hours
		5.8 Characterization Lab	3 Hours
6	**PLASTICS PROCESSING LAB**	6.1 Injection moulding machines: - Hand operated - Semi-automatic & Automatic - Microprocessor controlled automatic	10 Hours

		6.2 Blow moulding machines: - Hand operated, Semi-automatic & Automatic	02 Hours
		6.3 Compression & Transfer moulding machines: - Hand operated, Semi-automatic & Automatic	02 Hours
		6.4 Extrusion: a) Pipe & profile extrusion b) Blown film extrusion c) Multi-layer blown film extrusion	09 Hours
		6.5 Roto-moulding machine	1 Hour
		6.6 Thermoforming machine	1 Hour
		6.7 Fibre reinforced plastics processing	2 Hours
7	**DESIGN LAB – I** (7.3 to 7.10 shall be carried out by using any one CAD software preferably opensource or free educational version of Autodesk products)	7.1 Introduction and practice of 2D drafting using AutoCAD	20 Hours
		7.2 Introduction and practice of 3D modeling using any one CAD software	40 Hours
		7.3 Design and detailing of standard mould base	20 Hours
		7.4 Design of hand injection mould for single impression	08 Hours
		7.5 Design and detailing of single impression two plate injection mould	32 Hours
		7.6 Design and detailing of multi impression two plate injection mould	36 Hours
		7.7 Design and detailing of three plate injection mould (Multi-impression)	40 Hours
		7.8 Design and detailing of compression mould – Open flash	24 Hours
		7.9 Design and detailing of compression mould – Semi-positive and Positive	26 Hours
		7.10 Design and detailing of transfer mould	24 Hours
8	**PLASTICS MOULD DESIGN – II**	8.1 Split moulds - External undercuts - splits – guiding and retention of splits – finger cam and dog leg cam actions – cam track – spring – hydraulic actuation – side cores and side cavities – calculation of split movement – split safety arrangements – angled lift split – form pin and angled pin action – split cores – collapsible core. Moulds for threaded components – automatic unscrewing – various unscrewing methods – inline layout – pitch circle layout – mould movements – hydraulic and pneumatic core systems for mould movement. Design related calculations.	21½ Hours
		8.2 Water assisted and gas assisted injection mould – multi-colour moulding – insert moulding – outsert moulding – stack mould – two and three level.	4½ Hours
		8.3 Runnerless moulds – hot runner moulds – Types of manifold block, primary nozzle & secondary nozzle design – flow way system – types of shut-off valve system – standard parts for the hot runner type	08 Hours

		moulds. Design related calculations.	
		8.4 Selection of hot runner systems and design of hot-runner moulds through software and web portals.	02 Hours
		8.5 Blow Mould Design - Mould materials - 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. Design related calculations.	06 Hours
		8.6 Extrusion Die Design - Principles of extrusion - Die materials - 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. Design related calculations.	06 Hours
		8.7 Rotational moulds – Mould materials – Mould design: Mould frame, Moulded-in inserts, Moulded handles, Movable cores – Mould venting – Mould cooling. Design related calculations.	03 Hours
		8.8 Thermoforming moulds – Mould materials – Mould frame – Mould venting – Mould cooling. Design related calculations.	03 Hours
9	**MOULD MANUFACTURING TECHNOLOGY**	9.1 Ferrous and non-ferrous materials - their significance as a materials for mould making - miscellaneous materials - mould steel - alloying elements - material selection for different parts of the mould and their heat treatment, IS standards, British standards for mould materials.	7½ Hours
		9.2 Conventional tooling machines - shaper - planner - lathe – drilling - milling – jig boring - grinding - pantograph engraving - their applications and limitations - machining operations and accuracy - Machining related calculations.	7½ Hours
		9.3 Different types of CNC machine tools - Lathe, Milling, VMC, HMC, EDM, Wire EDM - CAM.	4½ Hours
		9.4 Tool room inspection - measuring instruments - coordinate measuring machine - taper and angle measurement techniques – visual measuring systems.	1½ Hours
		9.5 Surface roughness, basics of polishing technology - effect of mould materials on polishability, types of polishing tools, methods of polishing - basic information on ultrasonic polishing – principles of electro-deposition in damaged moulding surfaces - protective coatings.	1½ Hours
		9.6 Surface Texturing of Moulds – Process description, methods of texturing, applications and limitations, types of patterns and mould shapes, metals that can be etched, mould preparation.	1½ Hours
		9.7 Mould assembly check list, fitting and assembly of	

		various mould elements - core inserts, cavity inserts, sprue bush, etc., ejection system assembly, blue matching and die spotting, venting, final inspection, fitting of locating ring and carrier bar, mould trial, mould life, mould cycle count.	03 Hours
10	**REVERSE ENGINEERING AND RAPID PROTOTYPING**	10.1 Types of geometric models and solid models - Reverse engineering, 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 model reconstruction, applications and case studies.	06 Hours
		10.2 Rapid Prototyping - development of RP systems – RP process chain - impact of rapid prototyping and tooling on product development – benefits, applications and limitations.	03 Hours
		10.3 Liquid, Solid and Powder based Rapid Prototyping Systems, Metal RP systems - Working Principles, details of processes, products, materials, advantages, applications and limitations.	12 Hours
		10.4 Rapid Tooling - Soft and hard tooling - direct and indirect tooling – fabrication processes, vacuum casting - materials, advantages, applications and limitations.	06 Hours
11	**PROCESS PLANNING & COST ESTIMATION**	11.1 Introduction to Process Planning and Control – objectives & importance – process planning – scheduling & control of production – process selection & analysis – steps involved in manual planning and computer aided process planning – merits and demerits.	1½ Hours
		11.2 Process Planning Activities for Mould Manufacturing - 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 mould components.	7½ Hours
		11.3 Costing– meaning, types of costing and cost accounting methods – elements of mould costing - material cost - determination of material cost - labour cost - determination of direct labour cost - expenses - cost of product (ladder of cost) - illustrative examples.	06 Hours
		11.4 Analysis of overhead expenses - factory expenses - depreciation - causes of depreciation - methods of calculating depreciation - administrative expenses - selling and distributing expenses - allocation of overhead expenses.	03 Hours
		11.5 Functions of estimation - importance and aims of cost estimates - difference between costing and estimation - importance of realistic estimates – mould estimation procedures.	03 Hours

		11.6 Proforma for cost estimation – product cost – estimation of machining time & costs - mould cost - Processing cost - project costing.	06 Hours
12	**MOULD MANUFACTURING PRACTICE**	12.1 Conventional Machining Operations (Turning, Step Turning, Chamfering, Thread Cutting, Milling, Drilling, Boring, Reaming, Tapping, Grinding, Grinding Wheel Trueing, Dressing, Balancing)	24 Hours
		12.2 EDM (including electrode preparation)	10 Hours
		12.3 Wire EDM - Programming & Machining	10 Hours
		12.4 CNC Milling - Programming & Machining	10 Hours
		12.5 CNC Lathe - Programming & Machining	10 Hours
		12.6 CNC EDM - Programming & Machining	10 Hours
		12.7 CAM Software	10 Hours
		12.8 Inspection & CMM	8 Hours
		12.9 Reverse Engineering	8 Hours
		12.10 Rapid Prototyping	8 Hours
13	**DESIGN LAB – II** (13.1 shall be done using Routsis Plastics Training, i GET IT or equivalent online training software and 13.2 to 13.11 shall be carried out by using free educational version of Autodesk products)	13.1 Computer based interactive training on Product and Mould Design Concepts	12 Hours
		13.2 Demonstration and practice on mould flow software with results interpretation	24 Hours
		13.3 Mould Design for Internal Threaded Components (Automatic Unscrewing)	22 Hours
		13.4 Design and Detailing of Split Injection Mould – without Delayed Action	32 Hours
		13.5 Design and Detailing of Split Injection Mould – with Delayed Action	32 Hours
		13.6 Design and Detailing of Injection Mould for Internal Undercut Components	32 Hours
		13.7 Design and Detailing of Hot Runner Mould	32 Hours
		13.8 Extrusion Die Design and Detailing	21 Hours
		13.9 Design and Detailing of Blow Mould	21 Hours
		13.10 Rotomould Design and Detailing	21 Hours
		13.11 Thermoform Mould Design and Detailing	21 Hours

14.	**SEMINAR**	14.1 Each student shall present a case study with part drawing and mould design as part of seminar in the classroom in front of the students and shall be evaluated by the committee of faculties including Course In-charge, Training In-charge and Heads of Design/Tool Room and CAD/CAM departments. 14.2 Seminar topic may be selected by student from recent developments and advancements relevant to the subject or may be allocated by Faculty / Course In-charge. Students may be encouraged to select automobile, textile, electrical / electronic and other engineering / industrial products. 14.3 Seminar shall be completed in the first two weeks of semester. Students shall submit the seminar presentation in both hard and soft (in CD/DVD) copies for assessment and allotment of marks. 14.4 The scheme of evaluation for seminar presentation by students shall be done in accordance with LT/R-08.	40 Hours
15.	**IN-PLANT / INDUSTRIAL TRAINING**	15.1 The training shall be arranged by Placement In-charge or by students and it should focus on enhancing entrepreneurship, industrial/project management and interpersonal skills of the students. It will also help the students to understand the industry requirements for selection of product and executing the project. 15.2 Attendance report from the industry shall be submitted by the students every month without fail. Training report should be submitted by the students after successful completion of the same along with a certificate from the industry which shall be evaluated by the Placement In-charge. 15.3 This training shall be carried out along with project work in industry.	(To be done with Project Work)
16.	**PROJECT WORK IN INDUSTRY**	16.1 Project work shall be carried out by the students individually or in a group comprising of 3 to 4 members. The type of project shall be selected by the Course In-charge / Guide in consultation with the industries. 16.2 The scope of the project work in industry 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 Mould Cost Estimation Sheet.	480 Hours

		4. Preparing Project report highlighting features of Product Design and steps followed in development of Mould Design, report on Mould Flow result analysis and cost estimation details. 5. Students shall be encouraged to involve themselves in the mould development process also. 6. The final assessment will be through a Viva-voce by a committee of officials working in industries, internal guides and department officials. 7. Students shall submit additional master copies of hardbound project report for library and department along with student's copy. 8. Plagiarism in project report is strictly prohibited as per AICTE guidelines. 16.3 Project work progress shall be reviewed through online video meetings on completion of every 120 hours and a progress report log sheet shall be maintained on cloud for continuous monitoring. 16.4 Project work allocation, evaluation and conduct of viva voce shall be done in accordance with LT/QP-21.	

PD-PMD WITH CAD/CAM

Semester - I

List of text books/Reference books

1. Plastics Materials

1. Hand Book of Plastic Materials & Technology, Rubin Irwin J
2. Plastics Materials, Brydson J.A
3. Plastics Materials & Processes , Schwartz & Goodman
4. Text book of Polymer Science, Fred W Billmeyer
5. Polymer Science, V.R. Gowariker
6. Principles Polymer Science, P.Bahaabur & N.V. Sastry
7. Fundamentals of Plastics Testing, S K Nayak
8. Identification of Plastics and Plastic Products Materials, EIRI

2. Plastics Product Design

1. Fundamentals of Plastics Mould Design, S K Nayak
2. Plastic Product Design, Ronald D. Beck
3. Plastic Part Design Hand Book, Rosato
4. The Complete Part Design Hand Book, E. Alfredocampo
5. Designing Plastic Parts for Assembly, Paul A. Tres
6. Fundamentals of Geometric Dimensioning and Tolerancing, Alex Krulikowski
7. Industrial Design of Plastics Products, M. Joseph Gordon Jr.
8. Product Design and Manufacturing, A. K. Chitale, R. C. Gupta

3. Plastics Mould Design – I

1. Fundamentals of Plastics Mould Design, S K Nayak
2. Injection Mould Design, Pye R.G.W
3. Injection Mold Design Engineering, David O. Kazmer
4. Injection Moulds 130 Proven Design, Gastrow

4. Plastics Processing Technology

1. Fundamentals of Plastics Processing (Vol. 1) – Injection & Blow Moulding, S K Nayak
2. Hand Book of Plastic Materials & Technology, Rubin Irwin J
3. Plastics Materials, Brydson, J.A
4. Plastics Materials & Processes, Schwartz & Goodman
5. Plastics Processing, Beadle

PD-PMD WITH CAD/CAM

Semester - II

List of Text books/Reference books

1. Plastics Mould Design – II

1. Fundamentals of Plastics Mould Design, S K Nayak
2. Injection Mould Design, Pye R.G.W
3. Injection Moulds 130 Proven Design, Gastrow
4. Injection Mold Design Engineering, David O. Kazmer
5. Hot Runners in Injection Moulds, Daniel Frenkler
6. Rotational Molding Technology, R.J. Crawford
7. Fundamentals of Plastics Thermoforming, Peter Klein
8. Thermoforming: A Plastics Processing Guide, Geza Gruenwald

2. Mould Manufacturing Technology

1. How to Make Injection Molds, Menges
2. Mold Making Handbook, Stoeckert
3. Plastic Molds and Dies, Sors
4. Injection Molds, V.D.I
5. Mold Finishing and Polishing Manual, S.P.E
6. Computer Numerical Control Machines (CNC), Radhakrishnan, P
7. Fundamentals of Numerical Control, Lock Wood F.B
8. CNC Setting & Operation Workbook, Renshaw, Tom

3. Reverse Engineering and Rapid Prototyping

1. Tool Design, Cyril Donaldson
2. Production Technology, P C Sharma
3. Production Technology, R K Jain
4. Rapid Prototyping: Principles and Applications, Chua C K
5. Rapid Tooling: Technologies and Industrial Applications, Peter D. Hilton
6. Rapid Prototyping, Andreas Gebhardt
7. Rapid Prototyping and Engineering Applications: A Toolbox for Prototype Development, Fuewen Frank Liou
8. Rapid Prototyping: Theory and practice, Ali K Kamrani

4. Process Planning & Cost Estimation

1. Process Planning and Cost Estimation, R. Panneerselvam, P. Sivasankaran
2. Industrial Engineering Management, O. P. Khanna
3. A Text Book of Mechanical Estimating and Costing, O. P. Khanna
4. Mechanical Estimating and Costing, T. R. Banga, S. C. Sharma
5. Mechanical Estimating and Costing, B. P. Sinha
6. Operations Management, Roberta S. Russell, Bernard W. Taylor
7. Product Design and Manufacturing, A. K. Chitale, R. C. Gupta
8. A Textbook of Production Technology (Manufacturing Processes), P. C. Sharma
9. Production Engineering Estimating and Costing, M Adithan, B. S. Pabla

SECTION 2 EVIDENCE OF LEVEL

Title/Name of Qualification/Component: **POST DIPLOMA IN PLASTICS MOULD DESIGN WITH CAD/CAM**			
NSQF Domain	**Outcomes of The Qualification/ Component**	**How the Job Role Relates to The NSQF Level Descriptors**	**NSQF LEVEL**
Process	• Selection of Plastics Materials for Products. • Selection of Plastics Processing Methods for Products. • Plastics Product Design using CAD/CAE Software. • Plastics Mould / Die Design using CAD/CAM/CAE Software. • Inspection of components using measuring instruments and CMM. • Selecting right grade steels and non-ferrous metals/ materials for moulds. • Can determine which type of tooling/ machining is required for mould making. • Carrying out basic tests and quality evaluation of the Raw Materials and finished Products. • Understanding of work order and requirement of customers.	• Job holder is aware of safety aspects and ensures compliance with health and safety measures as laid down by safety department. • Job holder is best suited to work in any organization which is involved in Product/ Tool Development, ITES, Mould/ Die/ Tool making industries, Tool Rooms, OEMs of automotive, electronics and consultancies. • Job holder has to carry out the specific operations required to design the products and moulds using CAD/CAM/CAE software with good understanding in available standards. • Job holder has to design details of mould/Die parts. Its working mechanism and other require system for manufacturing & measuring the quality standards of the plastics production process. • Job holder shall use various measuring instruments including CMM for the inspection of components for quality assurance. • Job holder shall release production drawings of product, mould and bill of materials (BOM). • Job holder's responsibility is to consider the various properties and characteristics of plastics materials and mould materials to develop product and mould to execute the order which includes receiving inquiry from customer, preparing quotation, gathering of information from valid sources e.g. Purchase Order, Product Drawing, Contract Terms of customer, etc. • Job holder shall also prepare and submit reports.	Level 6

Title/Name of Qualification/Component: **POST DIPLOMA IN PLASTICS MOULD DESIGN WITH CAD/CAM**			
NSQF DOMAIN	**OUTCOMES OF THE QUALIFICATION/ COMPONENT**	**HOW THE JOB ROLE RELATES TO THE NSQF LEVEL DESCRIPTORS**	**NSQF LEVEL**
Professional Knowledge	The job holder is well versed with • The plastic material used for producing plastics products. • Product design concepts and related software. • Mould design process and related software. • Plastics processing technologies and selection of process. • Mould Manufacturing methods and machinery. • Reverse Engineering, Rapid Prototyping and Rapid Tooling Concepts • Product development and mould development process planning. • Product evaluation and cost estimation for mould development. • sdradnats lairtsudnI • tnemeganaM ytilauQ metsyS • sdradnats ytefaS	The job holder should be • Technically skilled in the areas of design, tool room, processing & testing. He/She should be able to understand the trouble or defect and should be able to resolve it. • Possessing overall knowledge in the field of tooling, Mould and Die Casting. • Able to identify the specification of the machine. • Able to apply his/her comprehensive knowledge on types of Jigs & fixture, Mould and Die Casting Die, locating principle and methods in jigs & fixture, Mold, and possess the fundamental knowledge of Jigs & Fixture, Mould tool and Die casting Die. • Able to use CAD/CAM/CAE software effectively to develop product and mould/ die. • Able to convert the existing metallic products into plastic products to meet the functional requirements. • Aware of system and procedures and accordingly work on it. • Able to do quality analysis as per various national and international standards. They should be able to understand what the standard says. • Prone to new technologies or newer versions of the software. • Able to decide and prepare the process planning, product layout in the mould • They should be aware of maintenance of moulds. • Capable of meeting customer requirements.	Level 6

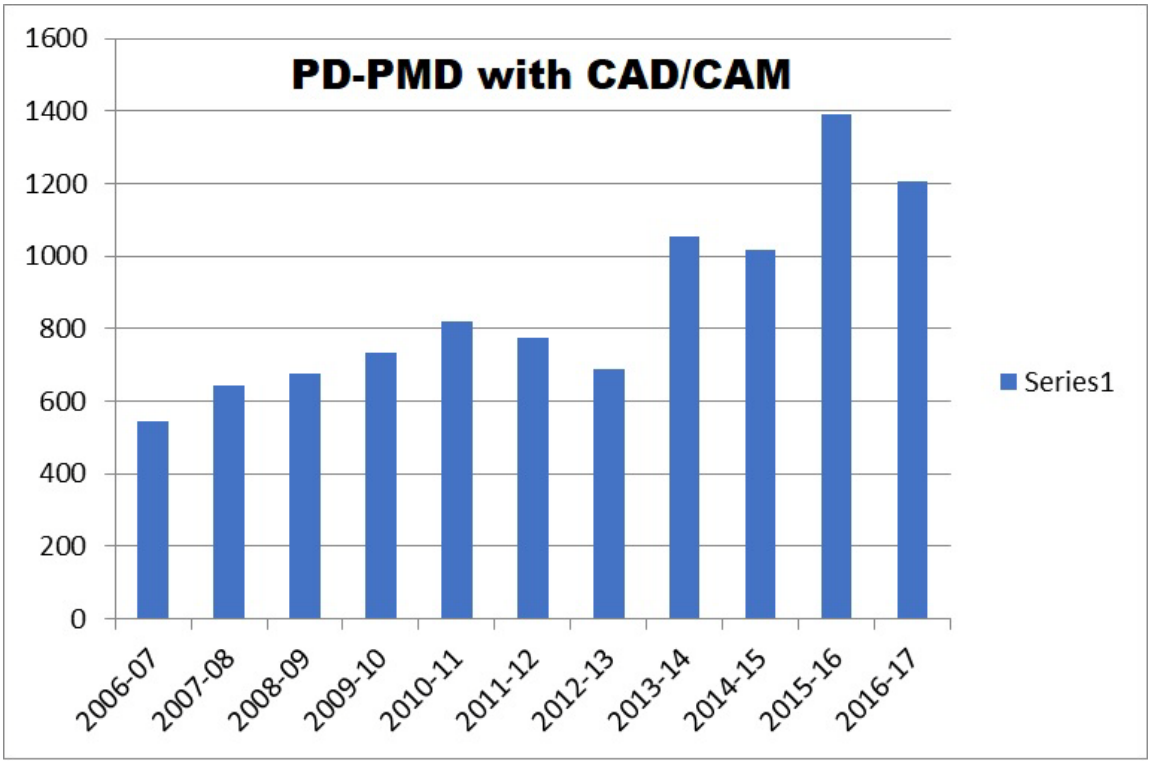
Title/Name of Qualification/Component: **POST DIPLOMA IN PLASTICS MOULD DESIGN WITH CAD/CAM**			
NSQF DOMAIN	**OUTCOMES OF THE QUALIFICATION/ COMPONENT**	**HOW THE JOB ROLE RELATES TO THE NSQF LEVEL DESCRIPTORS**	**NSQF LEVEL**
Professional Skills	• Identifying product and mould design requirements. • Developing process plan for product and mould development. • Developing product using CAD & CAE software. • Developing mould using CAD/CAM/CAE software. • Reverse Engineering the existing products. • Assess process efficiency. • Assess product quality using different validation methods. • Develop quality consciousness concept. • Troubleshooting the problems.	• Job holder should be able to demonstrate his capabilities during the technical meeting and discuss about the product and mould development and troubleshooting the problems. • Job holder should know all the factors effecting the design during the process and be ready for any alternative design. • Job Holder shall look for improvements wherever possible. • Job holder shall suggest improvements (if any) in process based on knowledge and experience. • job holder shall manage time and human resource effectively. • Job holder shall Ability to provide proper training to team members. • Job holder shall handle emergency situations effectively. • Job holder shall motivate the team and report team members issues to HR department that is beyond his control.	Level 6

Title/Name of Qualification/Component: **POST DIPLOMA IN PLASTICS MOULD DESIGN WITH CAD/CAM**			
NSQF DOMAIN	**OUTCOMES OF THE QUALIFICATION/ COMPONENT**	**HOW THE JOB ROLE RELATES TO THE NSQF LEVEL DESCRIPTORS**	**NSQF LEVEL**
Core Skills	Job holder should be able to • Use basic health and safety practices at the workplace. • Work on project development. • Find production price of the product/ mould/ production cost. • Decide the cycle time on the base of design prepared. • Collect the data, organize the information and document the work. • Find economic no. of production of the articles, its accounting procedure. • Principles applied in the skills for which they are qualified. • Able to question all the queries which is required for the mould design. • Can supervise the mould development and can assess process and troubleshoot. • Develop entrepreneurship skills. • Communicate effectively and logically.	The job holder should be • Technically skilled in the area of design, tool room. • Able to decide the software on which the design work has to be carried out. • Able to identify the specification of the computer workstation and software. • Aware of system and procedures and accordingly work on it. • Able to read and understand manuals, health and safety instructions, memos, reports, job cards, images, graphs, diagrams, technical drawings etc. • Able to easily inform about the production stage and its completion with maintaining the quality standards. • Capable of maintaining drawings and records. • able to communicate effectively and logically with team members and with management. • able to implement safety procedures as per standards • able to resolve any difficulties in relationships with colleagues, or get help from an appropriate person, in a way that preserves goodwill and trust. • Able to understand how to practice honesty with respect to company property and time.	Level 6

NSQF Domain	Outcomes of the Qualification/Component	How the job role relates to the NSQF level descriptors	NSQF Level
Responsibility	Work under guidance or independently and guide team members with full responsibility of output of group and development of organization.	• Job holder shall prepare work plan with time line and accept job responsibilities as part of a team. • Job holder shall strive for continuous learning and development by time to time discussing with them various issues of project like tool / die suitability to specified machine, new development in software and standards, selection of material, new development in the materials, design and manufacturing processes. • Job holder should be responsible for the outcome of product and mould design and should be open to take responsibility for required design changes, process plan, mould making process to till the successful production of product. • Job holder should be responsible for production design and drawings and consecutive updates/upgrades on them. • Job holder should be responsible for implementing QMS and other techniques for continuous improvement. • He should be responsible to control online quality control and quality assurance of the finished products. • Job holder shall follow work standard, specific norms and procedures laid down by the organization. • Job holder shall develop moral, values and ethical practices in business operation.	Level 6

SECTION 3 - EVIDENCE OF NEED

What evidence is there that the qualification is needed?



The qualification, **Post Diploma in Plastics Mould Design with CAD/CAM (PD-PMD with CAD/CAM)** is in existence since 2004 and CIPET has trained more than 9,000 trainees in the last 10 years. All trainees are placed in industries through campus placement.

What is the estimated uptake of this qualification and what is the basis of this estimate?

Skills Gap analysis Reports for industry demand and secondary research data, though these do not lend to accurate demand projection. The link to NSDC Human Resource & Skills Requirement in Capital Goods Sector is

http://cgsc.in/Humanresource_skill_requirement.pdf

What steps were taken to ensure that the qualification(s) does (do) not duplicate already existing or planned qualifications in the NSQF?

- The qualification is originally designed by curriculum committee comprising the training head, industrial experts, academicians and professional experts.
- The work group under the guidance of curriculum development committee already conducted desk search as well as referred to the qualification packs as a supporting document for mapping of the curriculum.
- As per the search it is found that, the **Post Diploma in Plastics Mould Design with CAD/CAM (PD-PMD with CAD/CAM)** course is not available for the skill development of the candidates in Capital Goods Sector Skill Council.

What arrangements are in place to monitor and review the qualification(s)? What data will be used and at what point will the qualification(s) be revised or updated?

- The curriculum committee meeting for review will be in the month of January 2022 which comprising industrial expert, university professors with subject specialization.
- The data used for revision or update will be impact analysis (student and industries) and new subject area opportunities, multiple entry and exits incorporated or RPL strategy implementations..
- The curriculum review and updates, in consultation with industries and experts of respective domain, NOS approved by NSDA will also be referred to from time to time.

SECTION 4
EVIDENCE OF PROGRESSION

What steps have been taken in the design of this or other qualifications to ensure that there is a clear path to other qualifications in this sector?

Qualifying trainee will obtain CIPET Post Diploma in Plastics Mould Design with CAD/CAM (PD-PMD with CAD/CAM). After completion of course and after 3 years of field experience, the job holder can work as Senior Design Engineer; and after 5 years of experience, the job holder can work as Manager (Design). After 10 years of experience the job holder can work as Specialist in Product & Mould Development. Also, he/she can become an entrepreneur in this job.

The diagram shown below represents the vertical mobility for the job holder as a job progression in capital goods sector.

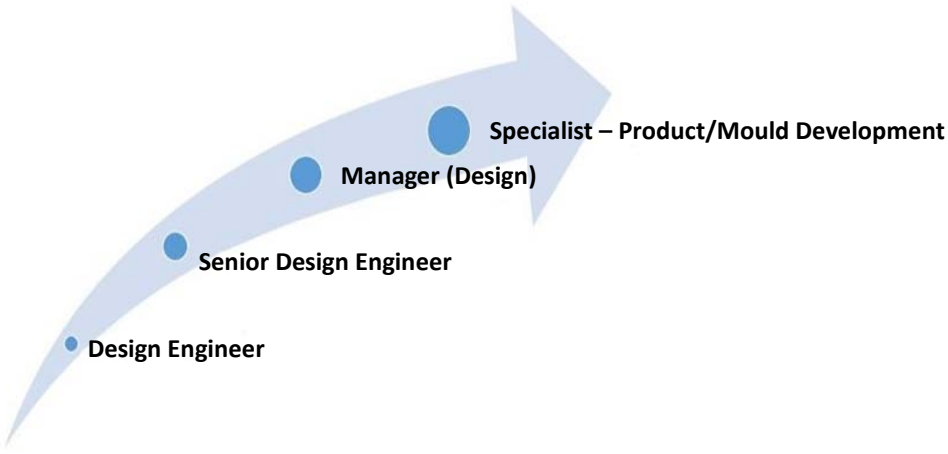


Fig. 1. Career Progression of PD-PMD with CAD/CAM Job Holders