

**POST GRADUATE DIPLOMA
IN
PLASTICS PROCESSING AND TESTING
(PGD-PPT)**

**SYLLABUS
&
CURRICULUM**

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POST GRADUATE DIPLOMA IN PLASTICS PROCESSING & TESTING (PGD-PPT)

SEMESTER - I

Theory							
S. No.	Subject	CH	TH	EH	Marks		
					INT	EXT	TOTAL
PPT 101	Plastics Materials and its Applications I	43	11	03	40	60	100
PPT 102	Plastics Processing Technology - I	43	11	03	40	60	100
PPT 103	Fundamentals of Plastics Product and Mould Design	21	06	1.5	20	30	50
PPT 104	Plastics Testing – I	21	06	1.5	20	30	50
PPT 105	Fundamentals of Polymer Science	21	06	1.5	20	30	50
PPT 106	Additives and Compounding	21	06	1.5	20	30	50
Total Theory Hours <u>(18 weeks- 12 hrs a week)</u>		170	46	12	160	240	400
		216					
Practical Work							
PPTL 101	Practical – I - Plastics Processing Lab – <u>(18 weeks- 9 hrs a week)</u>	162		08	100	100	200
PPTL 102	Practical – II - Plastics Testing Lab – <u>(18 weeks- 6 hrs a week)</u>	108		04	100	100	200
	Library – <u>(18 weeks- 3 hrs a week)</u>	54		--	-	-	-
Total Hours <u>(18 weeks- 18 hrs a week)</u>		324		12	200	200	400

SEMSETER -II

Theory							
S. No.	Subject	CH	TH	EH	Marks		
					INT	EXT	TOTAL
PPT 201	Plastics Materials and its Applications II	43	11	03	40	60	100
PPT 202	Plastics Processing Technology - II	43	11	03	40	60	100
PPT 203	Plastics Testing – II	43	11	03	40	60	100
PPT 204	Machine Maintenance	43	11	03	40	60	100
PPT 205	Quality Management	21	06	1.5	20	30	50
PPT 206	Costing and Industrial Management	21	06	1.5	20	30	50
Total Theory Hours <u>(18 weeks- 15 hrs a week)</u>		214	56	15	200	300	500
		270					
Practical Work							
PPTL 201	Practical –III - Plastics Processing Lab – <u>(18 weeks- 4½ hrs a week)</u>	81		08	100	100	200
PPTL 202	Practical – II - Plastics Testing Lab – <u>(18 weeks- 4½ hrs a week)</u>	81		06	100	100	200
PPTS 203	Seminar – <u>(18 weeks- 3 hrs a week)</u>	54		-	100		100
	Library – <u>(18 weeks- 3 hrs a week)</u>	54		-	-	-	-
Total <u>(18 weeks- 15 hrs a week)</u>		270		12	200	200	500

**PGD-PPT
SEMSETER –III**

S. No.	Subject	CH	TH	EH	Marks		
					INT	EXT	TOTAL
PPTP	Project Work/ In plant training in industry **	<u>540</u>	-	-		-	
Total Hours - <u>(18 weeks 30 hours per week)</u>		<u>540</u>	-		-	-	
PPTP 301	Project Evaluation & Viva voce	-	-	8	100	100	200
PPTP 302	Industrial Training Report	-	-		100		100
	Total	<u>540</u>	-		100	200	300

** Minimum of 6 weeks

CH-Contact Hours

TH- Tutorial Hours

EH-Examination Hours

**PGD-PPT
SEMESTER -I**

PPT 101- PLASTICS MATERIALS AND ITS APPLICATIONS - I (54 Hours)

Unit – I Natural Polymers (5½ Hours)

History – basic chemistry of polymers - nomenclature of Polymers – Sources of Raw Materials – Methods of Manufacture – General Characters & Properties, processing behaviour and applications of natural polymers such as Shellac Resin – Natural Rubber – Casein.

Thermoplastic Materials

Unit – II : Commodity Plastics - Olefin & Styrene Plastics (16½ Hours)

Sources of Raw Materials – Method of Manufacture – General Characteristics Structure & Properties – Processing Behaviour and applications in key sectors agriculture, aerospace, automobiles, building & construction, electrical, electronics, telecommunication, packaging, medical, sports, water management,

Low Density Polyethylene, Linear Low Density Polyethylene, High Density Polyethylene, High Molecular weight High Density Polyethylene, Polypropylene (Homo & Copolymer), Polystyrene, High Impact Polystyrene, Acrylonitrile Butadiene Styrene , Styrene Acrylonitrile Expanded Polystyrene

Unit – III Commodity Plastics - Vinyl & Cellulosic Plastics (13½ Hours)

Sources of Raw Materials – Method of Manufacture – General Characteristics & Properties – Processing Behaviour and applications for the following Plastics materials

Polyvinyl chloride & Chlorinated Polyvinyl chloride, Polyvinylidene Chloride, Polyvinyl Acetate, Polyvinyl Alcohol, Cellulose Nitrate, Cellulose Acetate, Cellulose Acetate Butyrate, Regenerated Cellulose, Polymethyl Methacrylate, Polyacrylonitrile

Unit – IV Engineering Plastics (18½ hours)

Sources of Raw Materials – Method of Manufacture – General Characteristics Structure & Properties – Processing Behaviour and applications in key sectors aerospace, automobiles, building & construction, electrical, electronics, telecommunication, medical, sports, water management etc. for the following Plastics materials

Polyoxymethylene, Polyamide (PA6, PA66, PA610, PA11, PA12 and PA46), Polyesters (PET, PBT), Poly Carbonate , Polyphenylene Oxide, UHMWHDPE, Polytetrafluoroethylene, Polyvinyl fluoride, Polyvinylidene fluoride, Thermoplastics Polyurethane

Text/ Reference Books

1. Plastics Materials – J.A. Brydson.
2. Plastic Materials Hand Book – A.S. Athalye

Note: Minimum of one assignment is mandatory from each unit.

**PGD-PPT
SEMESTER-I**

PPT 102: PLASTICS PROCESSING TECHNOLOGY – I

(**54** hours)

Unit – I

Introduction

(**6** Hours)

Basic Principles of Melt Processing of Thermoplastics – Effect of Polymer Properties on Processing - Thermal Behaviour of Polymer Melt, flow behaviour of polymer melts - Rheology of Ideal Fluids and Polymers – Newtonian & Non-Newtonian fluids, Different Types of Processes and Limitations - Process Flow Charts – Selection of Process – Degradation – molecular orientation – Processing advantage of Plastics over conventional Materials and different grades of plastics.

Unit – II

Injection Moulding Process

(**18** hours)

Basic Process Principles, Machine rating and Specifications - Types of Machines – Construction - Parts and its functions – Start up and shut down procedure - Operation procedure - projected area , Press capacity, clamping system Type of Screws and its function- Process variables - Heating System - Ejection system – Back Pressure - Suck back - Drooling - Nozzle Types - Moulding cycle - Shot weight -Purging - Material recommendation - grades

Microprocessor controlled Injection Moulding- Interaction of process variables- injection moulding operation- theoretical concepts and their relationship to processing- Shrinkage – Annealing - Dimensional Control - Moulding Records - Trouble Shooting – handling of finished products

Advance Injection Moulding- structural foam moulding-gas assisted injection moulding-faults, causes and remedies-Thin wall product moulding, multi material and multi colour moulding, thermo set injection moulding, All Electric Injection Moulding, Statistical quality control and process control

Thermoset Injection Moulding – Processing behaviour of thermosets, process principles, variables, Automation - Troubleshooting –

Injection Moulds: Types of Injection Moulds - Two Plate Mould - Three Plate Mould - Cavity & Core finishing – Gate Types - Runners – Hot Runner Moulds –Insulated Runner Mould system.

Unit III

(**16½** hours)

Extrusion

Introduction - principles - classification of extruders –drive mechanism - single screw extruder - specification - screw nomenclature - types of screws - L/D ratio, compression ratio-back pressure - factors governing back pressure - output and factors affecting output-heating & cooling systems - breaker plate - screen pack & its functions - screw & hopper cooling-die entry effects and die exit instabilities - shark skin, melt fracture & bambooning.

Twin screw extruder - principle - types - process - merits & demerits - Vented barrel extruder - hopper loading devices - Drying equipments - Process, machinery - downstream equipments- Tube/pipe-sizing take off equipment, extrusion coating, wire & cable covering, , cooling, takeoff equipment - dies for producing products such as - film - blow film, cast film - Sheets - Tubes and pipes, corrugated pipes - Mono filaments - Box strapping - Wire & Cable Coating - Lamination, Printing on film, sealing and bag making

Unit IV**(7½ hours)****Blow moulding**

Basic principles – Process - Construction , Parts and functions , Material requirement – Specification - Types of Blow Moulding - Processing parameters - Parison Programming - machine features - Design guideline for product performance & Appearance – Dies construction - Cycle time – Limitation - Part trimming & handling – blowing the parison - Melt Behavior – Clamping - Heating & cooling system -Faults - Causes & Remedies.

Injection Blow Moulding-Stretch Blow Moulding -parison control, blow mould construction, cooling methods, mould venting, blow moulding of complex shapes like fuel tanks, irregular shaped containers with handles, limitation in blow moulding, decoration of blow moulding products, hot stamping-multi colour printing-faults, causes and remedies, advanced blow moulding techniques

Unit V**(6 hours)****Automation**

Use of Robots in part handling, Robotics used in high production moulding process, Automated Conveyor system, Automatic material handling systems,

Text / Reference Books

1. Injection Moulding Theory & Practice – Rubin, Irvin.
2. Plastics Engineering Hand Book – Society of Plastic Industry Inc.
3. Plastics Processing Data Hand Book – D.V. Rosato.
4. Plastics Materials & Processing – Brent Strong.
5. Industrial Robot Handbook - Richard K. Miller, CMfg.E, Springer Science+Business Media, LLC
6. Total Quality Process Control for Injection Molding, 2nd Edition, M. Joseph Gordon, Jr.

Note: Minimum of one assignment is mandatory from each unit.

**PGD-PPT
SEMESTER -I**

PPT 103: FUNDAMENTALS OF PLASTICS PRODUCT AND MOULD DESIGN (27 hours)

Unit 1 (6 hours)

Engineering Drawing Concepts - Orthographic views – 1st angle and 3rd angle projections, conversion of pictorial view into orthographic view, Dimensioning techniques, Sectional views and assembly drawing. Blue print reading

Unit – II (7½ hours)

Product Design - Plastics product design - Concepts - Essential factors - Principles - Methodical approach - Detailed Design theory, tooling aspects on product design – process variables vs product design – product design appraisal. Uniform and symmetrical wall thickness - part geometries - draft angle- Ribs - internal sharp corners and notches - Bosses - Holes -Threads - undercuts - Hinges - metal inserts - parting line -Tolerances.

Unit – III (9 hours)

Injection Mould Design - Methodical approach to mould design - Mould construction- Mould design concepts - mould elements - parting line and parting surface- construction of core and cavities-Bolsters - mould alignment, Feed system- Sprue, runner, gate & position of gate - runner & gate balancing, Ejection, types of ejections - mould cooling -venting- ancillary parts - Bill of materials, Two plate mould - direct sprue injection - single impression - multi impression - determination of economical number of cavities - side gated – three plate mould.

Split moulds - external undercut- split cavities, Side cores, Split and side core actuation-Finger cam-Dog leg cam - cam track - delayed action - hydraulic, internal undercut-form pin-collapsible core - loose cores, threaded inserts - internal and external threads.

Unit – IV (4½ hours)

Blow Mould design - Types of blow moulds - injection and stretch blow moulds - blow ratio -, parison control parts, pinch off design, Neck designs, parting line – mould venting, cooling and alignments,

Compression Mould Design Types of compression moulds, semi-positive, positive moulds , types of loading chambers, flash thickness, pot design, projected area, Number of impressions, Venting

Text / Reference Books

1. Plastics Product Design Beck, R
2. Injection Mould Design – Pye R.G.W
3. Injection Moulds 130 Proven Design Gashtrow

Note: Minimum of one assignment is mandatory from each unit.

**PGD-PPT
SEMESTER-I**

PPT 104: PLASTICS TESTING - I (**27** hours)

Unit – I Concepts of Testing & Identification of Plastics (**4½** hours)

Basic concepts of testing - Specification and Standards - National and International Standards - Test specimen preparation - Pre-conditioning and test atmosphere, measuring instruments Vernier Calliper, Micrometer, Thickness Gauge, Pie Tape, Go No Go Gauges etc.

Identification of plastics by simple tests - Visual examination - Density - Melting point - Solubility test - Flame test and burning characteristics - Chemical tests.

Specific gravity - Density by density- gradient column - Bulk density - Particle size by sieve analysis - Moisture analysis

Unit – III Mechanical Properties (**9** hours)

Short-term Mechanical Properties: Tensile properties - Flexural properties - Compressive properties - Shear properties - Impact properties - Tear resistance - Hardness tests - Abrasion resistance - Friction properties

Long-term Mechanical Properties - Creep - Stress relaxation.

Unit – IV Thermal Properties (**9** hours)

Introduction – Short Term Test – Determination of Heat Distortion Temperature (HDT), Vicat Softening Temperature (VST) – Long Term Heat Resistant Tests – Thermal Conductivity – Thermal Expansion – Brittleness Temperature, DSC, TGA, DMA

Unit – II Material Characterization (**4½** hours)

Introduction - Melt Flow index – Viscosity – Dilute Solution Viscosity –Molecular weight calculation, Material Characterization Test for Thermosets – Apparent (bulk) Density, Bulk Factor, Cup & Spiral Flow Test, Dynamic Viscosity (Brook field viscometer)

Text / Reference Books

1. Text Book on Fundamentals of Plastics Testing - Prof. (Dr.) S.K..Nayak
2. Plastics Testing Technology Hand Book – Vishu Shah
3. Simple Methods for Identification of Plastics – Brawn R. B.

Note: Minimum of one assignment is mandatory from each unit.

**PGD-PPT
SEMESTER-I**

PPT 105: Fundamentals of Polymer Science (27 hours)

Unit 1 (6 hours)

Introduction to Polymer Science

The science of large molecules – Definitions – Monomers & its requirement- Broad Classification of Polymers - Types based on Structure, Processing and Applications - Molecular Force and Chemical Bonding in Polymers – Polymer structure – Homo Polymers and Copolymers – Geometric Isomerism – Tacticity – Nomenclature – Molecular Weight and Distribution and its effect on Properties and Processing of Polymers- Thermal Transition – T_g & T_m.

Unit 2 (7½ hours)

Polymerisation

Chain growth Polymerization – Addition Polymerisation – Reaction Mechanism - Free Radical Reaction – Ionic Reaction – Coordination Polymerization – Ring – Opening Polymerization - Condensation Polymerization – Degree of Polymerisation – Polymerization Techniques – Bulk, Solution, Suspension, Emulsion Polymerization Techniques and Co-polymerization.

Unit 3 (7½ hours)

Polymer Structure and Properties

Structure – Property Relationship – Molecular Weight and Poly Dispersity Index (PDI) - Effect of Polymerization on PDI – Polymer solutions and solubility – General Rules for Polymer solubility – solubility Parameters, Properties of Dilute solutions - Solid state properties – State of Polymer – Crystalline, Amorphous, Semi-crystalline, Liquid crystalline – Requirement of Crystallinity – factors affecting crystallinity. Deformations in Polymer – Mechanical properties - Stress – Strain behavior – Polymer Fracture and Toughness – Cracking & Crazing – Thermal & Electrical properties.

Unit 4 (6 hours)

Polymer Characterization

Identification and Characterization of Polymers – Simple Spectroscopic Methods – Molecular Weight Determination – Measuring Dilute Solution Viscosity – Gas Chromatography – Gel Permeation Chromatography – Melt Flow Characteristics – Thermal characteristics DSC, TGA, dynamic mechanical analysis

Text / Reference Books

1. Polymer Science – Gowariker V.R. & others.
2. Text book of Polymer Science – Billmeyer F.W.

Note: Minimum of one assignment is mandatory from each unit.

**PGD-PPT
SEMESTER-I**

PPT 106: ADDITIVES AND COMPOUNDING (**27** hours)

Unit 1 (**6** hours)

Introduction to Additives

Introduction -- technical requirements, objectives – classification, chemistry and mechanism, limitations of polymeric materials, additive types , general effect on properties

Unit 2 (**7½** hours)

Additives

Antioxidants - Stabilizers (Heat & UV) - Processing aids and flow promoters, Plasticizers - Impact Modifiers - Lubricants - Slip and Anti-block agents - - Blowing agents - Flame Retardants - Anti-static & Conductive additives - Nucliating agents - Colourants - Additives for Recycling

Fillers & Reinforcement for composites – Natural Fiber – Cellulose, Jute, Coir, Linen, Vegetable Fiber, Banana fibre etc. properties and applications

Synthetic Fibers : Glass Fiber , Carbon Fiber , Aramide Fiber, Polymeric Fiber , Metallic Fiber etc. Properties & Applications – Coupling Agents – Curing Agents Nano fillers

Unit 3 (**6** hours)

Compounding of additives

Selection of polymers - selection of compounding ingredients - methods of incorporation of additives into polymeric materials- possibilities and limitations of mixing and compounding, Compounding of PVC, PE and PP - mixing types, solid additives, morphology of filler, compatibilizers – mechanism and theory, filler surface modification and interfacial agents, dispersion of polymer and nanoparticles in polymer melt.

Unit 4 (**7½** hours)

Mixing machinery and devices

Mixing and mixing equipments. Principles - Operating characteristics - Machine construction - Specifications - Process control systems and working details of Batch mixers and continuous mixers - High speed mixer - Two roll mill - Banbury Mixer - Ribbon blender - Planetary mixers - Single Screw extruder - Twin Screw extruder

Continuous mixers, co-kneaders, mixing mechanism in kneaders, residence time and distribution, feeders, distributive mixing sections, cavity mixers, pin mixers, slotted flight mixers, variable mixers, dispersive mixing, blister ring, planetary gear mixers, CRD mixers.

Text / Reference Books

- 1.Hand Book on Plastics Additives.
- 2.Plastic Materials - J.A. Brydson

Note: Minimum of one assignment is mandatory from each unit.

**PGD-PPT
SEMESTER-I**

**PPTL 101- PLASTICS PROCESSING LAB
(18 weeks 9 hrs a week)**

Sl. no.	Name of M/c/ Equipment/ Mould	Description of Practical Exercise to Hours	Exercise Code No.	No. of Hours	Remarks
1.	Introduction	Introduction to Plastics Processing Machineries	PP 01	<u>6</u>	
2.	Shop-floor and Machine safety	Machine, mold, tools handling and safety measures on the shop-floor.	PP-02	<u>8</u>	
3.	Hand operated Injection Moulding Machine	(i) Study of Machine in Idle-Run Observation (IRO) , Parts & functions, operating principle, Free sketch of Machine-parts eg. Nozzle, Torpedo, Hopper, Rack & Pinion Barrel etc., shot capacity definition	PP-03	<u>6</u>	
		(ii) Operation practice to produce moulding on different hand injection moulds. Recording the observation and results in practical record books.	PP-04	<u>8</u>	
4.	Injection Moulding Semi Automatic	(i) Study of Semi Automatic Injection Moulding M/cs of all types in IRO. Comparative study of Pneumatic type & Hydraulic type of M/cs, Operating Principle of M/cs. Line-diagrams of M/cs with nomenclature of parts, M/cs specifications.	PP-05	<u>6</u>	
		(ii) Operation of Pneumatic & Hydraulic type of Semi automatic Injection moulding M/cs, to produce components in different moulds. Cycle-time analysis, observations of Process-Parameters & Procedure to be recorded	PP-06	<u>8</u>	
5.	Injection Moulding M/c.- Automatic	(i) Study of M/c Parts & function, Study of clamping systems on M/cs, Technical specification of Machine, study of process sequence in Machine, Study & definitions of terms related to M/c operation e.g. M/c Day light, Locating-Ring Dimensions, ejector-stroke, Tie-Bar distance, M/c Platen sizes & mould clamping arrangements. Definitions of all Processing Parameters & study of controls in M/cs.	PP-07	<u>15</u>	
		(ii) Idle-run observation (IRO) & study of Injection Unit, Clamping Unit, Process- Control knobs, safety precautions, start-up Procedure, Shut-down Procedure, Sketch of Machine	PP-08	<u>9</u>	

		Platens, Clamping system, type of nozzle used in M/c etc., study of Hydraulic System used in the M/c. M/c Operation-Practice, Process parameter setting for a particular mould on the Machine, Operation of Machine in Hand, Semi Automatic & Automatic-mode to produce components, observations of all parameters, cycle-time analysis, use of different plastics material for moulding & comparison, Moulding faults analysis for causes and remedies.		
6.	Extrusion Processes on Extruders	(i) Study of Extruders in IRO, Free sketch of machines, their parts and parts-function, List of products manufactured by Extrusion-Process. Study of different types of extrusion process. (ii) Operation-Practice by Trainee on setting up of Process-parameter to produce Blown-Film on Film-plant, observations on extruder output, size of film produced and technical specifications of machines to be recorded.	PP-09 PP-10	<u>8</u> <u>6</u>
7.	Blow Moulding Hand Operated	(i) Study of Hand Blow Moulding M/cs, Free-sketch of M/c with parts & study of part-function, Specification of M/c, Study of Parison-die with sketch. (ii) Die-centering practice by Trainees, operation of Hand Blow Machines, to produce components observations, cycle-time analysis Procedure of operation and observations.	PP-11 PP-12	<u>2</u> <u>8</u>
8.	Blow-Moulding Semi Automatic	Technical specification of M/c, Mould clamping on M/c, operation Practice with different moulds, Familiarization with control-switches/ valves on the M/c, cycle-time analysis & procedure of operation of M/c.	PP-13	<u>12</u>
9.	Scrap Grinding Hopper Drier, MTC, Chiller, other auxiliary equipment.	(i) M/c Study in IRO, specification of M/c, study of parts & function, Line Diagram of M/c. Operation-practice with different materials and output study in Kg/hour for different materials. (ii) Study of Hopper drier, Mold Temperature controller, Chillers & other ancillary equipments and water quality	PP-14 PP-15	<u>6</u> <u>8</u>

10.	Introduction to Maintenance	Basic knowledge of Hydraulic & Pneumatic systems, Electrical system, Definition of terms- Hydraulic fluid, viscosity Directional Valves, Resistance, Current, Voltage, Power, Hydraulic Pumps - Types & function, electrical heaters, thermocouples and temperature control parameters and timers, electrical Motors - Types & function.	PP-16	<u>16</u>
11.	** Introduction to Moulds, Tool Room Machines & Drawing Practice	Study of Different Types of Moulds & its Parts and function, free hand drawing practice, exposure to tool room machines.	PP-17	<u>24</u>
12.	-----	<u>Practical tests on processing</u>	---	<u>6</u>
				<u>162</u>

* Practical exercises on operation of machines shall be done as per the operating-manual instruction of the respective M/cs

** The exercise shall be done in tool room department

**PGD-PPT
SEMESTER-I**

PPTL 102- PLASTICS TESTING LAB

Sl. no.	Experiment/Exercise	Exercise Code No.	No. of Hours	Remarks
1.	Familiarization with measuring instruments	PT-01	<u>4</u>	
2.	Identification of plastics by simple method	PT-02	<u>8</u>	
3.	Determination of Viscosity and Molecular weight	PT-03	<u>6</u>	
4.	Determination of K-value for PVC resin	PT-04	<u>4</u>	
5.	Determination of Melt flow index of plastics materials	PT-05	<u>6</u>	
6.	Determination of Ash Content	PT-06	<u>6</u>	
7.	Determination of Moisture Content	PT-07	<u>6</u>	
8.	Determination of Filler Content	PT-08	<u>6</u>	
9.	Study of Mechanical properties of plastics & test methods	PT-09	<u>8</u>	
10.	Study of Weathering properties.	PT-10	<u>6</u>	
11.	Determination of Density.	PT-11	<u>6</u>	
12.	Determination of Bulk density for powder material	PT-12	<u>4</u>	
13.	Determination of Burst strength & tear strength of films	PT-13	<u>6</u>	
14.	Determination of Hardness (Rockwell, shore A&D, Barcol)	PT-14	<u>6</u>	
15.	Specimen preparation by Injection moulding, contour cutting, compression moulding, contour punching, etc.	PT-15	<u>10</u>	
16.	Testing of Electrical and Optical properties of Plastics materials	PT-16	<u>10</u>	
17.	Practical tests on testing	----	<u>6</u>	
			<u>108</u>	

**PGD-PPT
SEMESTER-II**

PPT 201: PLASTICS MATERIALS AND ITS APPLICATIONS – II (54 hours)

Unit I (13½ Hours)

Thermoset Plastics

Source of Raw Materials – Methods of Manufacture – General Characters & Properties – Processing Behaviour and Applications of Phenol Formaldehyde – Urea Formaldehyde – Melamine Formaldehyde – Unsaturated Polyesters – Alkyd Resins – Epoxy Resin – Polyurethane – Silicones

Unit II

Speciality Polymers (13½ Hours)

Sources of Raw Materials – Method of Manufacture – Special Characteristics and Properties – Processing Behaviour and applications of

Polysulphone, Polyphenylene sulphide, Polyarylsulphone, Polyether Ketone, Polyether Ether Ketone, Polyimide, Polyamideimide, Liquid Crystal Polymers and Metallocene Polymers etc.

Unit III (10½ Hours)
hours)

Thermoplastic Elastomers

Polyurethane Elastomers, Polyolefin Elastomers, Polyester Elastomers, Styrene Elastomers
Polyamide Elastomers

Unit IV (9 Hours)

Polymer blends and alloys

Introduction to polymer blends and alloys - Definitions and nomenclature - advantages of blends and alloys, how to select blend components , preparation of blends and alloys, economy of blending, properties and applications, parameters for compatability, PVC-Nitrile rubber, ABS-PVC and PP-EPDM etc.

Unit V (7½ Hours)

Bio degradable and Bio Plastics

Principle and Mechanism of Plastics degradation, Natural Bio-degradable Polymers - Synthetic Bio-degradable Polymers - Water soluble Polymers. Bio plastics types, properties and applications

Case studies on applications of above materials

Text/ Reference Books

3. Plastics Materials – J.A. Brydson.
4. Plastic Materials Hand Book – A.S. Athalye.

Note: Minimum of one assignment is mandatory from each unit.

**PGD-PPT
SEMESTER-II**

PPT 202: PLASTICS PROCESSING TECHNOLOGY – II

(54 hours)

Unit 1

(13½ Hours)

Compression moulding & Transfer moulding

Principle – Process - Machine Specification - Material Recommendation and flow properties - Bulk factor - Moulding powders - Preforms & Preheating Techniques - Process Variables - Pressure requirements, Flash Mould - Positive mould - Semi Positive mould - Flow Characteristics & Curing Time - Mould Heating & Cooling System - Types of Processes - moulding faults, correction and Trouble Shooting - Moulding of Thermoplastic & Thermoset Material, Finishing of mouldings

Principles of transfer moulding-advantages over compression moulding-Equipment used-Types of Transfer moulding, Moulds, Press capacity-Integral moulds and auxiliary ram moulds-Moulding cycles-Tool costs-Moulding tolerances - Materials Theoretical calculation of pressures-Line pressures- Injection ram pressure-clamping-Heating requirements-Finishing of moulded parts— Moulding faults - causes and remedies .

Unit 2

(6 hours)

Rotational Moulding

Basic principle - Material selection and Estimation through trial analysis - Type of machines - Process variables - Charge size - wall thickness control - Heating and Cooling system Process requirement for the moulding of water tank - Dust Bin etc. Application of Rotational Moulding - Ejection and Finishing – Faults - Causes and Remedies - Merits and Demerits of Rotational Moulding Process

Unit 3

(12 Hours)

Thermoforming

Basic principles – Advantages - Material Selection - Thermoforming machine – Single Stage - Multi Stage - Sheet fed machines - Packaging Machines - Mould Material - Thickness Control - Types of Forming – Vacuum Forming – Free Forming - Plug-assist-forming - Drape forming - Matched die forming - Snap back forming - Dual sheet forming - Skin & Blister pack forming - Types of heating - process variables - Forming of Disposal Cups & tumblers - Refrigerator Panels & Automobile Body – Faults - Causes & Remedies

Calendering

Basic principles-Process variables- Process Description - Materials used - Advantages - Types of Calender Rolls - Heating & Cooling System - Roll Bending - Complete Description of Calendering line with their function — Winding Types and Method - Finishing – Trouble Shooting and applications

Unit 4

(13½ Hours)

Fibre Reinforced Plastics

Introduction - FRP processing methods - contact moulding - hand layup, spray up method - vacuum bag and pressure bag moulding, filament winding, centrifugal casting, pultrusion, matched die moulding and advanced techniques.

Secondary Processing Techniques: powder coating, casting, machining & joining of plastics-Decoration of Plastics-Metalizing-Printing & Painting etc-Post moulding operations techniques , In mould labelling

Unit 5**(9 Hours)****Plastics waste management**

Basic principles-mechanical recycling-chemical recycling-incineration, Pyrolysis -mixed waste recycling-value addition, application and development for recycled materials.

Text / Reference Books

1. Compression Moulding – Iyesaw, A.I.
2. Technical Manual on Plastics Processing –
3. Plastics Engineering Hand Book – Society of Plastics Industry Inc.
4. Plastics Materials & Processing – Strong A Brent.

Note: Minimum of one assignment is mandatory from each unit.

**PGD-PPT
SEMESTER-II**

PPT 203: PLASTICS TESTING – II
Unit – I

(54 hours)
(10½ Hours)

Electrical & Optical Properties

Dielectric strength - Dielectric constant and Dissipation factor - Insulation resistance - Volume and Surface resistivity - Arc resistance - Antistatic tests.

Refractive index - Luminous transmittance - Clarity and Haze - Photo-elastic properties - Colour measurements and Gloss.

Unit – II

(13½ Hours)

Chemical & Permanance Properties

Introduction –Resistance to chemicals - Immersion test – Stain Resistance of Plastics – Environmental Stress Cracking Resistance (ESCR), Water absorption-gas permeability-water vapour permeability.

Flammability

Introduction – Flammability - UL94 Flammability Test – Ignition Properties – Limited Oxygen Index Test– Smoke Density Test — Flammability of Cellular Plastics

Unit – III

(10½ Hours)

Weathering Properties

Introduction – environmental factors affecting plastics – Accelerated weathering tests – outdoor weathering of plastics – Resistance of plastics to biological systems.

Bio-degradability Testing

Test methods and standards for bio-degradable plastics - Criteria used in evaluation of bio-degradable plastics - Description of current test methods.

Unit – IV

(13½ Hours)

Product Testing

Plastics Pipes – Films – Wovensacks – Water Tanks – Containers & Plastic Foams.

Unit V

(6 hours)

Failure Analysis

Introduction – Types of failure – Analyzing Failures – Non Destructive Testing (NDT) – Ultrasonic methods & its application in plastics, Gamma & Beta Transmission – Laser – X-ray Fluorescence.

Text / Reference Books

1. Text Book on Fundamentals of Plastics Testing - Prof. (Dr.) S.K. Nayak
2. Plastics Testing Technology Hand Book – Shah Vishu

Note: Minimum of one assignment is mandatory from each unit.

PGD-PPT
SEMESTER-II

PPT 204: MACHINE MAINTENANCE**(54 hours)****Unit I****Introduction to Maintenance****(9 hours)**

Importance and Objectives of Maintenance, Preventive Maintenance, Breakdown Maintenance, Predictive Maintenance, Schedule Maintenance, Maintenance Planning, Factors to be considered for Installation, Erection and Commissioning of Plastics Processing & Testing Machinery, General Method of Alignments and Levelling.

Unit II**(10½ Hours)****Mechanical**

Screw, Barrel, Parts of Screw , clearance between screw and barrel, Non return valve, Thrust Bearing Unit, Gear Boxes, Calendar roll, Mill roll – platens flatness measurements, Platen parallelism measurement , Moving parts maintenance and lubrication – Transmission system i.e. Gears, V-belts, Chains

Unit III**(13½ Hours)****Hydraulics**

Valves, Valve sequences, Pressure control valves-Pilot operated relief valve- pressure reducing valve- Control Valves- Throttle Valve – Solenoid Valves, Metering in flow control- Metering out flow Control-Bleed off flow control - Directional control valve-Check valve-pilot operated check valve -Two way direction control valve (Hand operated and solenoid operated) - Four directional way control valve (solenoid operated pilot operated)

Gear motors-Vane motors- inline Piston motor-Bent-axis piston motor-Positive and variable Hydraulic motors - Hydraulic actuators- servo motors- Hydraulic symbols , industrial hydraulic circuits-Hydraulic Circuits for injection moulding machine, strainers-heat exchanger- hydraulic air venting valve-Heat exchangers, Filters, Compressors, Oil seals, O - Rings - Central Lubrication System , Oil quality monitoring, filtration

Principles-Positive and variable displacement pumps – Gear pump, Vane pumps Piston Pump, Radial / Axial Pump and Screw Pump

Unit IV**(10½ Hours)****Pneumatics**

Fundamentals of pneumatics, Characteristics of air, Air generation and distribution, Pneumatic Valves, Actuators and output devices, pneumatic elements , power components & Pneumatic Systems, Symbols and descriptions of components, Safety requirements for pneumatic systems, Trouble shooting of pneumatic systems malfunctions and Maintenance

Unit V**(10½ Hours)****Electrical & Electronics**

Repair and maintenance of the electrical equipments – Electrical induction motors, Variable Speed Motors, their characteristics and speed control, motor starters-DOL and star delta, Drives-safety rules. PLC based systems, Distributed I/O based systems for machine control

Maintenance of Starter, Circuit Breakers (Air Circuit Breakers and Miniature Circuit Breakers), circuits, PLC system used in plastics processing & Testing Machineries

Limit Switches & Timers, Relays, Heaters-types, Measurement of temperature, Temperature Controllers, on-off, PID type and Thermocouples, Heaters (mica and ceramic type) – Study of safety rules and regulations Hot runner systems, Hot sprue, Manifold etc. Electrical controls devices -Protective devices-Relays (EMR and SSR), merits and demerit and switches

Text / Reference Book

1. Manuals on Hydraulics & Pneumatics – Vickers.

Note: Minimum of one assignment is mandatory from each unit.

**PGD-PPT
SEMESTER-II**

PPT 205: QUALITY MANAGEMENT (**27 Hours**)

Unit 1 (**6 hours**)

Introduction to Quality - Basic concepts Quality– Definitions - Quality of Design vs Conformance; Quality costs; variation concept; Investigational methods; quality assurance functions and their evaluations,.

Unit 2 (**9 hours**)

Total Quality Management - Concepts of Quality Management, Evolution of TQM, Quality circles, organization of TQM, ISO 9000 and TQM, Concept of TPM, TQM, Kaizen, - PDCA, Total Employee Involvement (TEI), POKAYOKE, Failure proofing, JIT manufacturing, Six sigma

Seven QC Tools-Histograms-Cause and effect diagram-Check sheets-Pareto diagrams-Graphs-Control charts-Scatter diagrams

Quality Circles - concept, characteristics, Brain storming method for solving Q.C. Problems.

Unit 3 (**6 hours**)

Concepts of Sampling – Method of sampling inspection, acceptance sampling, assessment of sampling scheme, statistical inference, Attribute characteristics, Single, Double Sampling Plans-OC curves, A.O.Q.L., Explanation of IS – 2500 Standard tables- Introduction to Statistical design of experiments for product quality improvement.

Unit 4 (**6 hours**)

ISO 9000 & Implementation: ISO standards for quality systems, Concept and role of ISO 9000, elements of ISO 9000, steps for implementation of quality system - preparatory step, implementation step, registration & quality system certification. Quality Audit - objectives, types of audits, Benefits of becoming an ISO 9000 company.
ISO/IEC 17025, , OSHAS, ISO-TS 16949 procedures and documentation

Text / Reference Books

1. Total Quality Management by S K Bhat
2. Quality control and Total Quality Management by P L Jain

Note: Minimum of one assignment is mandatory from each unit.

**PGD-PPT
SEMESTER-II**

PPT 206: COSTING AND INDUSTRIAL MANAGEMENT (**27 Hours**)

Unit 1 (**7½ hours**)

Costing

Basic Principle of Costing – Direct Cost – Indirect Cost – Labour Costing – Stores Organization – Factory Overhead Costs – Costing Methods.

Standard and Marginal Costing – Break – Even Point Control Functions – Cost Reduction – Value Analysis – Cost Audit – Costing as related to mould and mouldings.

Profoma for Cost Estimation – Product Cost – Mould Cost – Processing Cost – Project Costing – Direct Cost – Indirect Cost – Break Even Point.

Cost management system: cost accounting system, operational control system,. Factors affecting cost management. The role of cost accountant.

Unit 2 (**7½ hours**)

Principles of Management: Introduction - Management as a process, Management as an activity, Management and administration – Development of management theory: - Taylor's Scientific Management.

Functions of Management: Planning, Organizing, Staffing, Directing, Controlling, Decision making.

Organizational Structure: Definition of organization, different types of organizational structure: - Line Function, Line & Staff Organization (brief description with advantages & disadvantages), Leadership, Motivation and Communication.

Human Resource Management: Concept of HR Management – Development of HR Management – Components of HRD – Job Analysis – Job Description – Job Specialization , Manpower Planning – Requirements of Manpower Planning – Factors Affecting the Manpower Planning – Job Evaluation – Steps Required for Job Evaluation – Methods for Job Evaluation – Merit Rating – Objectives and Methods – Performance Appraisal. Training – Importance of Training – Methods of Training – Advantages of Training

Unit 3 (**6 hours**)

Behavioural Science & Personality development

Introduction – Behavioural science – organisation behaviour –, individual behaviour.

Personality – self concept, self esteem & self-efficacy – immaturity to maturity, socialisation process – perception.

Attitudes - Nature and dimension of attitude, components of attitude, function and changing attitude, organisation commitments & winning attitude – values & business ethics.

Motivation meaning – need for motivation – theories of motivation – nature of motivation. Group behaviour – organisational conflict, job satisfaction, job stress – group dynamics, interpersonal dynamics.

Communication – importance, process, barriers, methods to reduce barriers, principles of effective communication.

Leadership – styles, qualities of leadership, leadership skills, role of first line supervisor, goal setting.

Unit 4

(6 hours)

Entrepreneurship

Entrepreneur – qualities of entrepreneur – entrepreneurship – need for EDP – Steps required to start small scale industry, procedure for registration (provisional and permanent registration) – sources of financial assistance, Govt. assistance for development of SSI, Tax - an overview of income tax – excise duty, sales tax – procedure to be followed for sales tax - project report preparation – evaluation – planning for starting an unit – requirements, conducting market survey, Environmental aspects, Integrated Safety

Text / Reference Books

1. Industrial Engineering Management – Khanna O. P.
2. Cost Accounting Principles & Practice – Nigamlal & Jain J. C.
3. Personal Management & Industrial Relations – Davar R. S.

Note: Minimum of one assignment is mandatory from each unit.

**PGD-PPT
SEMESTER-II**

PPTL 201- PLASTICS PROCESSING (81 Hours)
(18 weeks 4 ½ hrs a week)

Sl. No.	Name of M/c/ Equipment/ Mould	Description of Practical Exercise to be done*	Exercise Code No.	No. of Hours	Remarks
1.	Microprocessor Controlled Injection Moulding M/C	Study of Basic concepts of Microprocessor control, Comparison of Micro Processor-Controlled M/cs with Conventional M/Cs, Machine Setting Procedure, Procedure for Process-Parameter-setting on monitor or control Panel. Operation of M/c with Mould fixing & setting on the M/c with different plastics materials, cycle-time analysis, Analysis of Product defects, causes & remedies during M/c operation, listing of important operating procedure points, safety precautions through M/C Instruction/Manual operating.	PP-18	<u>6</u>	
2.	Extrusion process on Blown Film Extruder Pipe/Tube Extruder	Procedure for setting up of Process-Parameters eg. Temperature on different zones, Screw-Speed, Nip-roller speed, Winder Speed, Blow-ratio, control of cooling-Air on bubble, Methodology & practice by trainees to fix the Blown Film die on M/C familiarization of Die-parts & Their function, Technical specification Of M/cs, defects, causes & remedies, Practice of operating M/c to produce different sizes of Blown Film. Study of the Machine-parts & function from Screw drive to the Cater pillar. Practice of Die setting on the machine, SIZING TECHNIQUES, Procedure for setting up of parameters & operation practice in running the Machine to produce pipe/tube/film	PP-19	<u>6</u>	
3.	Automatic Blow Moulding Machine	Machine-setting Procedure, Parameter-setting Procedure, Method of Mould fixing & parison-die setting on the M/c, Practice by trainees to remove & fix the parison die to produce on appropriate Parison for blowing, type of blowing systems, operation-practice on different moulds, cycle-time analysis, process-faults & remedies.	PP-20	<u>6</u>	
4.	Compression moulding – Hand Operated	(i) Study of Hand compression M/c in IRO Free sketch of parts & study of part-function, comparison of compression	PP-21	<u>6</u>	

		<p>moulding M/c with Injection Moulding M/c. Compression moulding processes.</p> <p>(ii) Operating Principle of Hand Compression Press, mould setting-procedure & parameter setting, operation practice on different compression moulds, M/c specification observations and recording</p>	PP-22	<u>2</u>	
5.	Compression & Transfer Moulding-Semi Automatic	<p>(i) Technical specification of M/c, Mould clamping on M/c, Parameter setting, operation-practice on different compression & Transfer Moulds, Cycle-time analysis, observation & Procedure of start-up & shut down of M/c.</p> <p>(ii) Setting up procedure for operation of M/c, safety precautions, Type of Mould Clamping arrangement available on M/c-Platen, Mould Clamping procedure on M/c, Operation of M/c by setting the optimum Temperature, curing time, clamping force, ejector-stroke etc. on continuous basis, Analysis of Product defects & remedies, Analysis of Cycle-time, Practice on operation of compression & Transfer moulds with thermoset materials.</p>	PP-23	<u>6</u>	
			PP-24	<u>2</u>	
6.	Thermoforming (Vacuum forming)	Study of Process Principle, type of moulds & material used, Familiarization with the M/c controls for operation, Operation Practice by trainee, observation on Cycle-time, processing-defects & remedies.	PP-25	<u>7.5</u>	
7.	Rotational Moulding	Machine-study in IRO, Process Principle & sequence of operation, Raw materials used, Mould-clamping practice on the M/c, operation practice to produce Roto moulded components, Cycle-time analysis, Comparison of process with other processing processes.	PP-26	<u>7.5</u>	
8.	Plastics-coating. Sealing, Welding & Screen-Printing	Principle of coating equipments, Process-method, type of material used, sequence of Operation in Coating. Principle of Operation of Heat-Sealing equipments, High frequency Welding & Hot stamping operation. Familiarization of screen printing process, methodology for screen preparation, type of inks used.	PP-27	<u>6</u>	

9.	Moulds Study	Study of different types of moulds injection moulds, Mould maintenance & storage	PP-28	<u>6</u>	
10.	FRP Demonstration Facility	Study of types of Resin, fibres used in the process, sequence of Process operation in Hand-lay up process, operation Practice for Hand-lay up Process for producing FRP-products, Precautions during the process, Process-defects & analysis for the remedies.	PP-29	<u>6</u>	
11.	Maintenance Work on Processing M/cs.\	Practical exposure to the preventive maintenance check-points for all processing M/cs. Daily startup and shut down maintenance checks, housekeeping checking hydraulics and electrical circuit for safety, routine fault and remedies. Study of Pneumatic circuits	PP-30	<u>10</u>	
	-----	Practical tests on processing	----	<u>4</u>	
				<u>81</u>	

* Practical exercises on operation of machines shall be done as per the operating-manual instruction of the respective Machines

**PGD-PPT
SEMESTER-II**

PPTL 203: PLASTICS TESTING

(18 weeks 4½ hrs a week)

(81 Hours)

Sl. No.	Experiment/Exercise	Exercise Code No.	No. of Hours	Remarks
1.	Introduction to product testing	PT-17	<u>4.5</u>	
2.	Testing of HDPE/RPVC Pipes	PT-18	<u>9</u>	
3.	Testing of Water Storage Tanks/Containers	PT-19	<u>6</u>	
4.	Testing of Films/Sheets	PT-20	<u>6</u>	
5.	Testing of HDPE/PP Woven Sacks/Tapes	PT-21	<u>9</u>	
6.	Testing of Bottles/Vanaspati, Ghee, Milk Packing	PT-22	<u>4.5</u>	
7.	Testing of Plastics Products for Determination of Mechanical, Thermal, Electrical & Chemical Properties	PT-23	<u>9</u>	
8.	Determination of Carbon Black Content and Dispersion in Olefinic Plastics	PT-24	<u>6</u>	
9.	Determination of environmental stress cracking resistance for Polyethylene	PT-25	<u>6</u>	
10.	Determination of Melt Flow Index of different Plastics Materials and Grades	PT-26	<u>6</u>	
11.	Compounding, Blending using Two Roll Mill	PT-27	<u>4.5</u>	
12.	Specimen preparation	PT-28	<u>4.5</u>	
13.	Maintenance of test records in industries as per BIS	PT-29	<u>02</u>	
	Practical test on Testing	----	<u>04</u>	
			<u>81</u>	
