

**ADVANCED MODULES
IN SECTOR PLASTIC PROCESSING**

Upgradation of ITIs into Centres of Excellence

Sector/Area: **Plastics Processing**

**Advanced Modules in II Year
Modules – 1 to 4**

| Sl.No. | NAME OF THE MODULE |
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| 1. | INJECTION MOULDING PROCESS , |
| 2. | BLOW MOULDING PROCESS, |
| 3. | EXTRUSION PROCESS |
| 4. | COMPRESSION MOULDING AND ANCILLARY PROCESS |

Upgradation of ITIs into Centres of Excellence-
Broad guidelines for implementation of Advanced Module of Sector
“Plastic Processing”

These Centres will be providing multiskill training to meet the skill requirement of particular sector of industry with their active involvement in all aspects of training. The training will be provided in three parts as given below:

- ◆ Training in Basic skill areas for a period of one year.
- ◆ Training in Advanced modules of six months duration after Broad based basic Training(BBBT)
- ◆ Testing & Certification both for the Broad Based Basic Training & Advanced Module Training during subsequent six months will be conducted under the aegis of NCVT .
- ◆ Training in specialized modules mainly by the industry (The course curricula, duration etc will be designed in consultations with the IMC/local industry). The trade testing & certification for specialized module will be done jointly by the State Government & Industry. Said certificate will have recognition from NCVT
- ◆ As per the recommendations of the EFC, Training in the shop floor should constitute atleast 25-40% of the curriculum.

The training programme will have multi-entry and multi-exit provisions as given below:

- trainee can opt to go to the labour market after completing broad based basic training of one year duration or after completing advanced module/s.
- multi-entry and multi-exit provisions would enable a trainee to take admission for advanced/ additional advanced /specialized module as per his/her need .

Guidelines for Training in Advanced modules

- › A minimum of three modules would be essentially needed , so as to ensure that all the 96 trainees are accommodated in the three modules may be selected in consultation with IMC for which in two shifts .
- › If it is felt that available modules for which the course curricula has been developed at National Level are not sufficient to cater to the needs of local industry in a particular state, States are free to select module as per need in consultation with industry . They may develop suitable module(s) accordingly in consultations with the industry clearly indicating tool & equipment list , instructor qualifications , space norms etc. & forward the same to DGE&T for seeking approval of NCVT.
- › A trainee at a time can opt only for one Advanced Module .
- › Admission Criteria, Space requirement, Qualification of instructor of the various modules of “**Plastic Processing**” sector are attached herewith.

Admission to Advanced Module for the graduates of ITI in related trades:

There is a provision for lateral entry for graduates of ITIs (NTC /NAC passed out from conventional system) of the related trades subject to availability of seats in Advanced Module. Trades of conventional system mentioned against each advanced module in the enclosed statement, could be offered admission in Advanced Module .

| MODULE NO. | NAME OF THE MODULE | Admission criteria | Min Space requirement | Duration In Weeks | Qualification/ Status Of Instructor |
|------------|---|---|-----------------------|-------------------|--|
| PPAT-01 | INJECTION MOULDING PROCESS , | Completed BBT in Sector Plastic Processing OR NTC/NAC in PPO trade. | 100 sq m | 24 weeks | Degree in Plastic Processing Engineering with minimum two years teaching/industrial experience in the relevant field OR Diploma in Plastic Processing with min four years teaching/industrial experience in the relevant field |
| PPAT-02 | BLOW MOULDING PROCESS, | Completed BBT in Sector Plastic Processing OR NTC/NAC in PPO trade. | | | |
| PPAT-03 | Extrusion Process | Completed BBT in Sector Plastic Processing OR NTC/NAC in PPO trade. | | | |
| PPAT-04 | COMPRESSION MOULDING AND ANCILLARY PROCESS | Completed BBT in Sector Plastic Processing OR NTC/NAC in PPO trade. | | | |

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| | | 4 | - Nomenclature, Types of screw, Ring-Plunger assembly, Screw drive etc. |
| 5&6 | <u>SCRAP GRINDING:</u> M/c study in IRO, specification of M/c, Study of parts and function, line diagram of M/c Operation – practice with different materials and output study in Kg/Hr for different materials | 5&6 | <u>MOULDS</u> Nomenclature of Moulds, Types of moulds used, Hot Runner Moulds, Mould material etc. |
| 7-10 | <u>INJECTION MOULDING M/Cs – AUTOMATIC</u> Study of M/c parts and function, study of clamping systems in M/cs, Technical specifications of Machine, study of process sequence in machine, study and 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 and mould clamping arrangements. Definitions of all processing parameters and study of controls in M/cs | 7 | <u>MATERIAL SELECTION</u> Types of Materials and Grades Materials Identification by Simple Methods Criteria for selection of materials, Importance of Pre-drying of Plastics Materials Material handling Special care for Engineering plastics etc. CLAMPING SYSTEMS & CONTROL SYSTEMS Manual, Toggle, Hydraulic, Hydro-Mechanical & Tie-Bar less clamping etc. |

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| | | 8 | Control Systems – Thermocouple/Pyro Meter, Valves, Pumps, Limit Switches, Timers etc. |
| | | 9 | <u>HYDRAULIC MACHINE OPERATIONS:</u> Oil requirements Functioning of Valves and Other Accessories |
| | | 10 | <u>MACHINE SELECTION:</u> Based on clamping unit and Injection unit Machine Specifications and its selection |
| 11-14 | <u>AUTOMATIC INJECTION MOULDING M/C:</u> Idle-run observation (IRO) & study of Injection Unit, Clamping knobs, Safety Precautions, Start-up Procedure, Shut-down Procedure, Sketch of Machine Platens, Clamping, system, type of nozzle used in M/c etc., study of Hydraulic System used in used in the M/Cs. M/c Operation practice, Process parameter setting for a particular | 11 | <u>CALCULATION OF:</u> _Projected Area, Clamping Force Shot Weight, etc. <u>MELT BEHAVIOR</u> Processing behavior of different |

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| 19&20 | <u>MOULD STUDY:</u> Study of different Types of Moulds, Injection Moulds, Mould Maintenance and Storage | 18&19 | <u>BASIC PRINCIPLES & FEATURES OF ADVANCE INJECTION MOULDING MACHINES:</u> Thermoset Injection Moulding Process All electrical Injection Moulding Machines Multi injection Moulding Machines Robotic operations etc. |
| 21 & 22 | <u>INTRODUCTION TO MAINTENANCE:</u> Basic knowledge of Hydraulic and Pneumatic systems, Electrical system, Definition of terms – Hydraulic Fluid, Viscosity, Different Types of Valves, Resistance, Current, voltage, Power, Hydraulic pumps- Types and function, electrical heaters, thermocouples and temperature control parameters and timers, electrical motors-types and function, electrical heaters, thermocouples and temperature control parameters and timers, electrical motors – types and function | 20,21 & 22 | <u>PROCESS PRINCIPLES & FEATURES OF ADVANCE INJECTION MOULDING PROCESSES:</u> Gas & Water Assist Injection Moulding Thin Wall Injection Moulding, Mucell Injection Moulding Foam moulding etc. Process Principle and Features. |
| 23 & 24 | <u>MAINTENANCE WORK ON PROCESSING M/Cs:</u> Practical exposure to the preventive | | Ancillary Machineries requirements |

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| | <p>maintenance check points for all processing M/Cs. Daily start up and shut down maintenance checks, house keeping checking hydraulics and electrical circuit for safety, routine fault and remedies.</p> | 23 & 24 | <p>Processing defects, causes, remedies and trouble shooting</p> <p>Product Dimensions</p> |
| 25 & 26 | <p>Review & case study</p> <p>Industrial visits</p> <p>Examinations</p> | 25 & 26 | <p>Review & case study</p> <p>Industrial visits</p> <p>Examinations</p> |

UPGRADATION OF ITI'S INTO CENTRES OF EXCELLENCE

Sector/Area: Plastics Processing

Advanced Modules in II Year

MODULE : 2- Blow Moulding Process (26 weeks)

CONTENTS:

| Weeks | PRACTICALS | Weeks | THEORY |
|-------|--|-------|---|
| 1-8 | <u>BLOW MOULDING MACHINES – SEMI AUTOMATIC</u> Technical specification of Machine, Mould Clamping on Machines, Operation practice with different moulds, Familiarization with control – switches/valves on the machine, Cycle-time analysis & procedure of operation of Machine. Die-centering practice by trainees Operation of Blow Machines, to produce components observations, Cycle-time analysis procedures of operations and observations | 1 & 2 | Introduction of Blow Moulding Processes Principles of Blow Moulding Methods Blow Moulding Machines – its parts & Construction, Specifications, Limitations, Selection, Ancillary Machines requirements etc. |
| | | 3 | Plastics Material for blow moulding and its Grades, Processing Behaviour, Properties etc. Material Predrying (Hot Air Oven or dehumidifying Oven for different types of Plastics) |

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| | | 4,5 & 6 | <p>Extrusion Blow Moulding Process</p> <p>Process Description</p> <p>Various types of Extrusion Blow Moulding Process</p> <p>Continuous Blow Moulding Process</p> <p>Intermittent Extrusion Blow Moulding Process</p> <p>Extruder parts and Function</p> <p>Parison Programming</p> <p>Parison Wall Thickness Control</p> <p>Parison Programming</p> <p>Die Shaping</p> <p>Melt Temperature in Extrusion Blow Moulding</p> <p>Blowing Air</p> <p>Shrinkage</p> <p>Pinch of Design</p> <p>Blow Moulding Cycle</p> |
| | | 7&8 | <p>Injection Blow Moulding</p> <p>Injection Blow Moulding Process</p> <p>Advantages & Disadvantages of Injection Moulding Process</p> <p>Moulds for Injection Blow Moulding</p> |

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| | | 16&17 | <p>Blow Moulding of Engineering Thermo Plastics</p> <p>Machines and Process Methods</p> <p>Parison Programming</p> <p>Moulding for Engineering Thermoplastics</p> <p>Mould Temperature Control</p> <p>Advantage of Engineering Thermo Plastics</p> <p>Application</p> |
| 19-20 | <p><u>SCRAP GRINDING:</u></p> <p>M/c. study in IRO, specification of M/c, Study of parts and function, line diagram of M/c. Operation – practice with different materials and output study in Kg/hr for different materials</p> | 18 | <p>Controls in Blow Moulding Operation, Machine and Mould Maintenance</p> |
| 21-22 | <p><u>MOULD STUDY</u></p> <p>Study of different types of Blow Moulds Mould Materials Mould Maintenance and Storage</p> | 19-21 | <p>Materials and Part Handling and Finishing</p> <p>Auxiliary Equipment</p> <p>Stripper</p> <p>Neck Finishing</p> <p>Post Moulding and Finishing Operation</p> <p>Decoration Methods</p> |

UPGRADATION OF ITI'S INTO CENTRES OF EXCELLENCE

Sector/Area: **Plastics Processing**

Advanced Modules in II Year

MODULE : 3- Extrusion Process (26 weeks)

CONTENTS:

| Weeks | PRACTICALS | Weeks | THEORY |
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| 1-4 | EXTRUSION PROCESSES – EXTRUDERS Study of extruders in IRO, Free Sketch of Machines, Their parts and its functions, list of products manufactured by Extrusion Process. Study of different types of Extrusion Process | 1&2 | Introduction Development of Extrusion Process Fundamentals of Extrusion Classification of Extruders Extrusion plant, Specifications, Rating, Selection etc. |
| | Operations practice by trainee on setting up of process – parameters to produce Blownfilm on film-plant, observations on Extruder output, Size of film produced and technical specifications of machines to be recorded | 3 | <u>Plastics Materials</u> Plastics Materials Characteristics requirements, Grades for Extrusion Materials used for various Extruded Products Processing Behavior of Various Plastics Importance of Pre-drying Materials Plastics Materials Identification by Simple Methods |

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| 5-9 | <p><u>SCRAP REUSE /RECYCLE & AGGLOMERATION</u></p> <p>M/c study in IRO, specification of Machine, Study of parts and function, line diagram of machine</p> <p>Operation – practice with different materials and output study in Kg/hr for different materials</p> <p>Waste collection, segregation, size reduction and recycling</p> | 7-8 | <p>Single-screw Extruders (SSE)</p> <p>Introduction Feed Hopper Barrel Drive System (motor, gear box, transmission) Thrust Bearing Heating and Cooling Systems Breaker Plate and Screen Pack Die Design Extrudate Swell Melt Fracture Temperature and Pressure Controls Factors influencing Extruder Output</p> <p>TWIN SCREW EXTRUDERS (TSE)</p> <p>Evolution and classification of TSE Diversity of TSE operations Main types of TSE Counter – Rotating Non-intermeshing (CRNI) Intermeshing Counter – Rotating (ICRR) Co-rotating Intermeshing (CORI) Comparison between SSE and TSE Performance</p> <p>Ancillary Machine Requirements Maintenance of Extrusion Plant</p> |
| | <p>BLOW FILM EXTRUSION PROCESS</p> <p>Study of Blown Film Machine Parts and Functions</p> | 9-13 | <p>Film Extrusion Process</p> <p>Introduction Blown Film Extrusion</p> |

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| | <p>Procedure for setting up of process parameters Eg. Temperature on different zones, Screw- Speed, Nip-Roller Speed, Wider Speed, Blow Ratio, Control of Cooling the Bubble, Air Pressure inside the Bubble, Methodology and Practice by trainees to fix the Blown Film Die on Machine, Familiarization, of Die-parts and their function, Practice of operating machine to produce different sizes of Blown Film</p> <p>Practice of Die setting on the machine, Procedure for setting up of parameters and operation practice in running the machine to produce film.</p> | 14&15 | <p>Definition of Terms Cooling the Film Control of Blown Film Extrusion Flat film Extrusion Comparison of Blown and Cast Film Processes Tubular-Quench (TQ) Film Extrusion Orientation of film Expanded films Co-extruded film & sheets Oscillating platform/niproller Processing parameters/factors, defects, causes and remedies Corona treatment, printing, cutting and sealing</p> <p>Tapes /Woven Sacks Manufacturing Line Mono-Filaments Extrusion Process</p> <p>Materials used Equipments Process Description</p> |
| | <p>PIPES/TUBES EXTRUSION PROCESS</p> <p>Study of the pipe machine-parts and functions</p> <p>Procedure for setting up of process parameters. Eg.- Temperature on different zones, Screw-Speed, Haul off unit speed, Methodology and Practice by trainees to fix the die on machine, Familiarization of Die-parts and their function, Practice of operating machine to produce different sizes on pipes</p> | 16 | <p>Extrusion Coating</p> <p>Materials used Reasons for Coating Pretreatment/surface treatment Coating Process</p> <p>Sheet Extrusion Process</p> <p>Materials used Process Description Haul of Units and Dies</p> |

UPGRADATION OF ITI'S INTO CENTRES OF EXCELLENCE

Sector/Area: Plastics Processing

Advanced Modules in II Year

MODULE : 4- Compression Moulding and Ancillary Process (26 weeks)

CONTENTS:

| Weeks | PRACTICALS | Weeks | THEORY |
|-------|--|-------|--|
| 1&2 | IRO of Automatic Compression Moulding Machine parts and function Safety Precautions Process Observation Mould Loading/Un-loading/setting Operating Controls and its functions | 1 | Introduction to Compression Moulding Process Thermoset materials, Grades, processing Characteristics, Properties and Applications Raw Material Preparation and Handling Compression Moulding Machine Selection and Specifications Compression Moulding Process Description, Press Mould and Ancillary Equipments Advantages of reforming and Preheating Process Variables-Inter relating between Flow Properties, curing Time-Mould Temperature and Pressure requirements Common Moulding Faults and Remedies |
| 3&4 | <ul style="list-style-type: none"> • Setting up process in Manual Mode • Setting up of process in Semi Automatic • Observation of effects of process variables • Processing of Different Thermoset materials | 7-8 | <ul style="list-style-type: none"> • Principles of transfer moulding • Types of transfer Moulds • Limitations and advantages of transfer moulding • Trouble shooting • Maintenance of machines and moulds • Post operations • Compression Moulding of Thermoplastics • Quality control tools-SPC, SQC |
| 5&6 | <ul style="list-style-type: none"> • Trouble shooting in Compression | | <ul style="list-style-type: none"> • Basic Principles of Thermoforming /vacuum |

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| | <p>Moulding Process</p> <ul style="list-style-type: none"> Recording observations | 9-13 | <p>forming</p> <ul style="list-style-type: none"> Materials used in Thermoforming/Vacuum Forming Types:Free Vacuum Forming, Plug Assist Vacuum Forming and Drape Forming Process Machines and Mould Maintenance Significance of process Variables and its effects Advantages and Limitations of Thermoforming/Vacuum forming Post operations Concepts of Inline Thermoforming Techniques Quality Control, SPC, SQC |
| 7-8 | <ul style="list-style-type: none"> Processing of Thermoplastics in compression Moulding Exercises | 14-18 | <ul style="list-style-type: none"> Introduction to Roto Moulding Materials used for Roto Moulding and its applications Roto Moulding Process Mould and Machine Maintenance Comparison of Roto Moulding with other processes and its advantages and Limitations, post operations and Quality Assessment |
| 9-10 | <ul style="list-style-type: none"> Study of Compression Moulds and Transfer Moulds | 19-22 | <ul style="list-style-type: none"> Hot Gas Welding Process and its applications High Frequency Welding Process its advantages and limitations Introduction to Ultra Sonic Welding Testing and Quality Control of Welded Products |
| 11-14 | <ul style="list-style-type: none"> IRO of Thermoforming Machine and its parts and functions | | <ul style="list-style-type: none"> Working & uses of Auxiliary equipments like Scrap Grinder, Air Compressor, Chilling Plant, Cooling |
| | <ul style="list-style-type: none"> Process Control and its functions Processing of different Vacuum formed | | Tower and Quality Measuring Tools/Equipments |

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| | <p>Products</p> <ul style="list-style-type: none"> • Study of Vacuum Forming/Thermoforming Moulds | 23&24 | |
| 15-18 | <ul style="list-style-type: none"> • IRO of Roto Moulding Machine and its parts and functions • Roto Moulding Process Controls • Study of Roto Moulds | | |
| 19-20 | <ul style="list-style-type: none"> • Working on <ul style="list-style-type: none"> (a) Hot Gas Welding (b) High Frequency Welding\ (c) Ultra Sonic Welding | | |
| 21-24 | <p>INTRODUCTION TO MAINTENANCE</p> <p>Basic knowledge of Hydraulic and Pneumatic systems, Electrical System, Definition of terms – Hydraulic Fluid, Viscosity, different types of valves, Resistance, Current, Voltage, power, Hydraulic pumps- types and function, electrical heaters, thermocouples and temperature control parameters and timers, electrical motors – types and function</p> <p>MAINTENANCE WORK OR PROCESSING M/Cs</p> <p>Practical exposure to the preventive maintenance check points for all processing machines. Daily start up and shut down maintenance checks, house keeping checking hydraulics and electrical circuit for safety, routine faults and remedies</p> | | |
| 25&26 | <ul style="list-style-type: none"> • Review and case study • Industrial visits | 25&26 | <ul style="list-style-type: none"> • Review and case studies • Examinations |

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| | <ul style="list-style-type: none">• Examinations | | <ul style="list-style-type: none">• Industrial visits |
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