

1.

Curriculum

For

“Assistant foreman in Metallurgy and Metal Casting”

(Level -3)

24th to 28st May



**National Vocational & Technical
Training Commission**

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Introduction

Definition/ Description of the training programme for *Metallurgy and Cast metal technology*

Merchandiser is the interface between Buyer & Manufacturer/Producer. He/she is monitoring client's order during the entire production process, starting from ordering to shipment. Merchandising is the department which mediates marketing and production departments. Pricing is part of the merchandising department's duties.

Purpose of the training programme

The purpose of this training is to develop a range of skills and techniques, personal skills and attributes essential for successful performance in merchandising sector in accordance with industry requirements. Graduates of this program may find employment in local and international textile/ garment industries

Overall objectives of training programme

The main objective of this training program is to improve the employability of young graduates through qualifying job-related training in the merchandiser sector, and to train them so that they can prove to be an asset to this sector.

Competencies to be gained after completion of course

- Maintain Personal Health, Hygiene and Safety
- Perform Basic Communication Skills
- Perform Basic Computer Application
- Handle the Documents
- Organize Store Merchandising
- Dispose the Waste Materials

Possible available job opportunities available immediately and later in the future

- Merchandiser
- Senior Merchandiser
- Retail Merchandiser
- Merchandiser (Part-Time)
- Merchandise Coordinator
- Catalogue Production Manager
- Fashion Buyer

- Merchandise Display Artist
- Production Development Manager
- Retail Store Manager
- Stock Clerk
- Stock Supervisor
- Quantity Surveyor
- Retail Planners

Trainee entry level

Matric (with English, Urdu and Numeracy reading and writing skills)

Minimum qualification of trainer

Teaching staff should have at least three years' experience in the role of Merchandiser. They should also hold or be working towards a formal teaching qualification.

Other formal qualifications in the textile industry would be useful in addition to the above.

Recommended trainer: trainee ratio

The recommended maximum trainer: trainee ratio for this programme is 1 trainer for 25 trainees.

Medium of instruction i.e. language of instruction

Instruction will be Urdu and English.

Duration of the course (Total time, Theory & Practical time)

This curriculum comprises 6modules. The recommended delivery time is 480 hours. Delivery of the course could therefore be full time, 5 days a week. Training providers are at liberty to develop other models of delivery, including part-time and evening delivery.

The full structure of the course is as follow:

Module	Theory¹ Days/hours	Workplace² Days/hours	Total hours
Module 1:	20	10	30
Module 2:	20	10	30
Module 3:	20	30	50
Module 4:	40	60	100
Module 5:	100	140	240
Module6:	10	20	30

¹ Learning Module hours in training provider premises

² Training workshop, laboratory and on-the-job workplace
Curriculum _ Raw Material Inspector (Level 2)

Pattern Designer

Module 1: Manage graphic user interface

Objective of the module: The aim of this module to get knowledge, skills and understanding required to install software, create new file and basic drawing.

Duration: 30 hours **Theory:** 9 hours **Practical:** 21 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Install software and Create New File	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Install latest software version 2. Create New Template 3. Save the File 4. Create Drawing 5. Select units as per requirements 6. Select drawing Limits 	<p>Define template file</p> <p>Explain different formats of drawing files.</p> <p>Practical Activity:</p> <p>Install AutoCAD software and make a template file.</p>	<p>Total:7hrs</p> <p>Theory: 2 hrs</p> <p>Practical: 3 hrs</p>	<ul style="list-style-type: none"> ❖ Computer with all accessories ❖ AutoCAD software disk ❖ Models 	Computer lab
LU2. Create Basic Drawings	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Select Coordinate System as per requirements 2. Draw a rectangle 	<p>Define coordinate systems</p> <p>Explain the types of coordinate systems</p> <p>Practical Activity:</p> <p>Draw a cylindrical shape</p>	<p>Total: 7hrs</p> <p>Theory: 2 hrs</p> <p>Practical:</p>	<ul style="list-style-type: none"> ❖ Computer with all accessories ❖ AutoCAD software disk ❖ Models 	Computer lab

	<p>using line command</p> <p>3. Draw an ARC</p> <p>4. Draw a circle with given requirements</p> <p>5. Draw a circle with 3-P touching outer corner of Equilateral Triangle</p> <p>6. Use the Erase Command</p>	<p>by using two-point circle</p>	<p>3 hrs</p>		
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Module 2: Develop 2D drawings

Objective of the module: The aim of this module to get knowledge, skills and understanding of Developing 2D objects

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Develop 2D Objects	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Setup drawing interface for required specifications 2. Setup user interface settings for required specifications 3. Save AutoCAD drawing files in different file formats (DWG, PDF, and JPG). 4. Create 2D Objects with given measurements 5. Edit 2D Objects to meet set standards 	<p>Define coordinate system</p> <p>Define object snap</p> <p>Differentiate between absolute, relative and polar system</p> <p>Define Hatching</p> <p>Explain the purpose of hatching</p> <p>Define the types of arrays</p> <p>Practical Activity:</p> <p>Develop a required 2D drawing and save it in DWG, PDF, and JPG formats.</p>	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> ❖ Computer with all accessories ❖ AutoCAD software disk ❖ Models 	Computer lab
LU2. Prepare Final Set of 2D Drawings	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Use appropriate command and tools to develop 	<p>Differentiate between CHAMFER and FILLET command</p> <p>What is purpose of offset</p>	<p>Total: 7hrs</p> <p>Theory:</p>	<ul style="list-style-type: none"> ❖ Computer with all accessories ❖ AutoCAD software disk 	Computer lab

	<p>2D Drawing</p> <ol style="list-style-type: none"> 2. Develop 2D Drawing with given project specifications and measurements 3. Create title block layout as required 4. Plot drawing on scale according to required size and orientation. 	<p>Practical Activity:</p> <p>Prepare a sheet with a title block and plot it on A4 size page.</p>	<p>5hrs</p> <p>Practical:</p> <p>2 hrs</p>	<p>❖ Models</p>	
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Module 3: Develop 3D pattern design

Objective of the module: The aim of this module to get knowledge, skills and understanding to develop 3D objects, manipulate and Edit 3D objects and render 3D objects.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Develop 3D Objects	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Setup & save 3D drawing interface for required specifications. 2. Setup 3D user interface settings for required specifications. 3. Create 3D objects with given measurements. 	<p>Define</p> <ul style="list-style-type: none"> ❖ solids ❖ surfaces ❖ meshes ❖ Wireframe objects. <p>Differentiate between Surface Modelling and Solid Modelling.</p> <p>Practical Activity: Draw 3D model of given pattern</p>	<p>Total:7hrs Theory: 5 hrs Practical: 2 hrs</p>	<ul style="list-style-type: none"> ❖ Computer with all accessories ❖ AutoCAD software disk ❖ Models 	Computer lab
LU2. Manipulate 3D objects using 3D Editing Tools	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Modify 3D objects in line with the requirements. 2. Make customized 3D models according to the requirement of given job. 	<p>Define 3D face and Edges</p> <ul style="list-style-type: none"> ❖ Boolean operation concepts ❖ Subtraction ❖ Intersection ❖ Union <p>Practical Activity: Covert that 3D model in single mesh object</p>	<p>Total: 7hrs Theory: 5hrs Practical: 2 hrs</p>	<ul style="list-style-type: none"> ❖ Computer with all accessories ❖ AutoCAD software disk ❖ Models 	Computer lab

		3. Convert 3D Face objects into a single mesh objects. Ensure the calibration of mechanical machines				
LU3. Render 3D Model		<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Apply material to required 3D Model as per given specification 2. Apply lights to get the requisite scene of required 3D model 3. Assign cameras to execute different views of required 3D Model. 	<ul style="list-style-type: none"> • Define 3D Navigate control • Explain Function of different camera setting <p>Practical Activity: Apply different material to the given 3D model and make rendered images.</p>		<ul style="list-style-type: none"> • Computer with all accessories • AutoCAD software disk • Models 	

Pattern Maker

Module 1: Manufacture Pattern on CNC Router

Objective of the module: This module covers the skills and knowledge required about pattern and its types, layout of the pattern ,advantages and disadvantages of different type of patterns, allowances used in pattern making, pattern making tools and equipment, and finishing of pattern

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place

<p>LU1: Interpret Drawing of given Pattern</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. interpret the Pattern drawing 2. Recognize basics of lines used in pattern drawings 3. Identify manufacturing requirements according to drawings 	<ol style="list-style-type: none"> A. Knowledge of Drawing B. Knowledge of pattern and pattern types C. Knowledge of pattern materials D. Knowledge of pattern allowances 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2hrs</p>	<ul style="list-style-type: none"> ○ Hacksaw ○ Tri square ○ Steel tape ○ Vernier caliper ○ Wood work lath ○ Chisels ○ Wood work files ○ CNC router machine 	<p>Class room</p>
<p>LU2: Prepare layout of pattern</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Identify wood for pattern layout using full scale 2. Add allowances (shrinkage, machining, draft,) as required 3. Add core prints, pattern in layout as per requirements 4. Mark Top, Bottom, 	<ol style="list-style-type: none"> A. Knowledge of pattern and pattern types B. Knowledge of pattern allowances C. Knowledge of pattern materials D. Knowledge of core E. Knowledge of core prints F. Knowledge of CNC operation 	<p>Total: 7hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> ○ Hacksaw ○ Drawing ○ Tri square ○ Steel tape ○ Vernier caliper ○ Wood work lath ○ Chisels ○ Wood work files 	

	<p>Side, and elevation view on layout</p> <p>5. Use appropriate tool for required job (drilling, cutting tapping, flat, round edges)</p>			<ul style="list-style-type: none"> ○ CNC router machine 	
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<p>LU3: Construct wooden match plate pattern</p>	<p>The trainee will be able to:</p> <p>6. Ensure wooden plate size according to mold box</p> <p>7. Adjust guide pin bush according to mold box</p> <p>8. Mount wooden pattern on wooden plate</p> <p>9. Mount runner and in-gate on wooden plate in alignment with pattern</p> <p>10. Add 5-10 degree draft allowance on in-gate and runner bar as per required</p> <p>11. Create in-gate neck on</p>	<p>G. Knowledge of pattern and pattern types</p> <p>H. Knowledge of pattern allowances</p> <p>I. Knowledge of pattern materials</p> <p>J. Knowledge of core</p> <p>K. Knowledge of core prints</p> <p>L. Knowledge of CNC operation</p> <p>M. Knowledge of pattern gating system</p>	<p>Total:</p> <p>7hrs</p> <p>Theory:</p> <p>5hrs</p> <p>Practical:</p> <p>2 hrs</p>	<ul style="list-style-type: none"> ○ Hacksaw ○ Lathe machine ○ Tri square ○ Steel tape ○ Vernier caliper ○ Wood work lath ○ Chisels ○ Wood work files ○ CNC router machine
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	pattern side 12. Assemble pattern parts as per specifications 13. Ensure safety practices to avoid any incident			
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Module 2: Manufacture Pattern on CNC Router

Objective of the module: This competency standard covers the skills and knowledge required about pattern and its types, layout of the pattern, advantages and disadvantages of different type of patterns, allowances used in pattern making, pattern making tools and equipment, and finishing of pattern

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: CAD/CAM Data	The trainee will be able to: 1. Prepare the drawing in CAD system 2. Add allowance as per requirement 3. Send the drawing in CAD/CAM system	A. Knowledge of Drawing B. Knowledge of pattern and pattern types C. Knowledge of pattern materials D. Knowledge of pattern allowances	Total: 7hrs Theory: 5 hrs Practical: 2hrs	<ul style="list-style-type: none"> ○ Hacksaw ○ Tri square ○ Steel tape ○ Vernier caliper ○ Wood work lath ○ Chisels ○ Wood work files ○ CNC router machine 	Class room

LU2: Perform CNC Operation	The trainee will be able to: <ol style="list-style-type: none"> 1. Arrange a wood block as per required size 2. Clamped the wooden block on the table of CNC router 3. Select the cutting tool as per material and operation. 4. Enter the raw material detail 5. Check the tool off setting 6. See the simulation before starting the work 7. Locate the pattern. 8. Press the push bottom to start the operation 9. Draw out pattern from fixture 10. Operate the 	<ol style="list-style-type: none"> A. Knowledge of pattern and pattern types B. Knowledge of pattern allowances C. Knowledge of pattern materials D. Knowledge of core E. Knowledge of core prints F. Knowledge of CNC operation 	Total: 7hrs Theory: 5hrs Practical: 2 hrs	<ul style="list-style-type: none"> ○ Hacksaw ○ Tri square ○ Steel tape ○ Vernier caliper ○ Wood work lath ○ Chisels ○ Wood work files ○ CNC router machine 	
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	machine as per SOP				
	11. Practice standard health and safety procedures				

Melter

Module 1: Work Safely with Molten Metal

Objective of the module: This module covers the skills and knowledge required to identify the need for personal protective equipment, Adhere to emergency procedures with molten metal, Identify hazardous conditions at Workplace, Observe good OHS practices.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Identify the need for personal protective equipment(PPE)	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Use appropriate personal protective equipment as specified in standard operating procedures (SOP). 2. Interpret regulations & guidelines specific to Melting process. 3. Interpret common safety rules and tips. 4. Identify employer safety rules and 	<ol style="list-style-type: none"> 5. Hazardous materials and hazard control measures associated with molten metal 6. Procedures relevant to raising OH&S issues 7. Designated personnel responsible for OH&S 8. Applicable personal protective equipment 9. Safety signs, symbols and labels 10. Procedures for correct inspection and service of equipment including PPEs 11. Routine maintenance procedures for equipment 12. Workplace procedures for working in hazardous areas 13. Consequences of not 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2hrs</p>	<ul style="list-style-type: none"> ❖ Steel-toed footwear ❖ Hard hat ❖ Safety gloves ❖ Appropriate safety glasses ❖ Site emergency response plan ❖ Fire extinguishers ❖ Fire blankets ❖ Fire hoses 	Class room / Workshop

	policies.	maintaining a clean and safe working environment			
LU2: Adhere to emergency procedures with molten metal	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Use emergency equipment located in accordance with workplace policies and procedures. 2. Response to emergency procedures as demonstrated in approved safety procedures and instructions. 	<ol style="list-style-type: none"> 14. Safe manual handling procedures 15. Location of emergency equipment including first aid facilities 	<p>Total: 7hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>	•	Class room / Workshop
LU3: Identify hazardous conditions at Workplace	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Identify hazards and report to maintain a healthy and safe work environment. 2. Follow workplace procedures and work 		<p>Total 7 hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2hrs</p>	•	Class room / Workshop

	instructions for controlled risks accurately.			
LU4: Observe good OHS practices	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Identify hazardous areas and materials associated with molten metal and risks associated. 2. Identify safety signs and symbols displayed. 3. Use PPE equipment according to the specifications and standard operating procedures. 4. Inspect 		<p>Total: 9hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 4 hrs</p> <ul style="list-style-type: none"> • 	Class room / Workshop

	<p>personal protective equipment to maintain in a good order for reuse.</p> <p>5. Identify hazardous items associated with hot material area.</p> <p>6. Perform housekeeping duties according to standard operating procedure to maintain a safe working environment.</p>				
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Module 1: Melt Ferrous Material (Cast Steel) in Induction Furnace

Objective of the module: This module covers the skills and knowledge required to to Read and Understand to Identify required specifications for melting, Select materials, Verify metal charges to melting, Charge furnace, Monitor furnace operation, Take sample of molten metal, Perform refractory repair to crucible, Monitor tapping of molten metal, Tap the furnace, Control hazards.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Identify required specifications for melting	<p>The trainee will be able to:</p> <p>P1. Identify mould requirements</p> <p>P2. Identify any special melting requirements for the job</p> <p>P3. Identify safety procedures for the required melting operation</p> <p>P4. Follow regulations relevant to foundry and individual melting</p>	<p>P5. types of alloy additions and their effects on casting behavior and finished product</p> <p>P6. induction furnace melting and refractories suitable for steelmaking</p> <p>P7. Influence of carbon and silicon contents</p> <p>P8. the grades of steel and their applications including carbon steel and alloy steels</p> <p>P9. methods of controlling physical properties</p> <p>P10. advantages/disadvantages of density of each type of ferrous metal</p> <p>P11. the influence of melting points on production processes</p> <p>P12. the shrinkage percentage of the types of ferrous metals</p> <p>P13. how to control metal fluidity</p>	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2hrs</p>	<ul style="list-style-type: none"> ❖ Induction melting Furnace ❖ Immersion type Thermo-couple (1300 C° min.) ❖ Transfer ladle ❖ Iron rods ❖ Weighing scale (10, 50, 100, 500, 1000 Kgs capacity) ❖ Charging hoist (1 ton capacity) ❖ Charging box (200Kgs capacity) ❖ Optical Pyro-meter (for 	Class room / Workshop

		<p>P14. casting temperature</p> <p>P15. make a selection of ferrous metal based on required properties</p> <p>P16. conduct metal analysis on ferrous metal</p> <p>P17. types and pouring characteristics of metals</p> <p>P18. types and characteristics of ladles</p> <p>P19. procedures for maintaining condition and integrity of ladle</p> <p>P20. procedures for safe handling and transference of molten metal</p> <p>P21. metal treatments, applications and procedures for making additions to melt</p> <p>P22. slag and dross removing procedures</p> <p>P23. techniques for sampling and testing molten metal</p> <p>P24. metal identification and tagging procedures</p> <p>P25. use and application of personal protective equipment</p> <p>P26. hazards and control measures associated with pouring molten metal</p>		<p>ferrous metals)</p> <ul style="list-style-type: none"> ❖ Coating for metal ❖ handling tools ❖ PPE kit 	
LU2: Select materials	The trainee will be able to: P27. Raise requisition	•	Total: 7hrs	•	Class room / Workshop

	<p>as required according to standard operating procedures.</p> <p>P28. Take charge analysis in accordance with standard operating procedures.</p> <p>P29. Convert charge analysis to furnace charge weight using standard operating procedures.</p> <p>P30. Weigh the charge according to standard operating procedures.</p>		<p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>		
LU3: Verify metal charges to melting	The trainee will be able to:	•	Total 7 hrs	•	Class room / Workshop

	<p>P31. Select required components to give the required metal specification</p> <p>P32. Calculate required charge of each component</p> <p>P33. Recommend changes/additions to the charge</p> <p>P34. Monitor the preparation of the charge including checking for contaminants</p>		<p>Theory: 5hrs</p> <p>Practical: 2hrs</p>		
LU4: Charge furnace	<p>The trainee will be able to:</p> <p>P35. Follow emergency/safety procedures as necessary.</p> <p>P36. Pre-Heat</p>	•	<p>Total: 9hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 4 hrs</p>	•	Class room / Workshop

	<p>materials if required according to standard operating procedures.</p> <p>P37. Charge materials into furnace using standard operating procedures.</p> <p>P38. Identify suitable areas for emergency unloading of molten metal and kept available.</p>				
LU5: Monitor melting process	<p>The trainee will be able to:</p> <p>P39. Check furnace is in operational condition</p> <p>P40. Maintain furnace at optimum operating</p>	<ul style="list-style-type: none"> • 			

	<p>condition to standard operating procedures.</p> <p>P41. Identify metal/alloy specification for required melting</p> <p>P42. Charge batches of scrap periodically to attain required melt quantity</p> <p>P43. Monitor melt to ensure the product meets specification</p>				
<p>LU6: Take sample of molten metal</p>	<p>The trainee will be able to:</p> <p>P44. Take sample for chemical analysis</p> <p>P45. Apply remedial action as required to</p>	<ul style="list-style-type: none"> • 			

	<p>standard operating procedures.</p> <p>P46. Hold furnace temperature to standard operating procedures.</p> <p>P47. Add alloying elements if required</p> <p>P48. Achieve final melt charge as per requirement</p> <p>P49. Check temperature of metal and adjustment if necessary.</p>				
LU7: Perform refractory repair to crucible	<p>The trainee will be able to:</p> <p>P50. Identify specific areas of the refractory if repair is required</p>	<ul style="list-style-type: none"> • 			

	<p>P51. Select appropriate refractory materials to meet specifications.</p> <p>P52. Install refractory using appropriate techniques and tools to meet the job specification.</p>				
<p>LU8: Monitor tapping of molten metal</p>	<p>The trainee will be able to:</p> <p>P53. Check pouring area is secure and that all non-essential personnel are excluded</p> <p>P54. Check all members of pouring crew are wearing appropriate and in good condition</p>	<ul style="list-style-type: none"> • 			

	<p>personal protective equipment</p> <p>P55. Ensure escape routes are known in advance by all members of the pouring crew</p> <p>P56. Check pouring is undertaken at correct temperature and in efficient order</p> <p>P57. Ensure moulds are ready to receive liquid metal</p> <p>P58. Ensure proper placing of ladle</p> <p>P59. Attach purging pipe to the ladle</p>				
<p>LU9: Tap the furnace</p>	<p>The trainee will be able to:</p> <p>P60. Identify quantity of the required</p>	<ul style="list-style-type: none"> • 			

	<p>metal</p> <p>P61. Carry out tap rate to standard operating procedures.</p> <p>P62. Tap heat safely according to standard operating procedures.</p> <p>P63. Perform purging operation</p> <p>P64. Remove purging pipe attached to ladle</p>				
<p>LU10: Control hazards</p>	<p>The trainee will be able to:</p> <p>P65. Identify hazards in the metal melting/pouring process</p> <p>P66. Assess the risks arising from those hazards</p> <p>P67. Implement</p>	<ul style="list-style-type: none"> • 			

	procedures to control those hazards in line with procedures and duty of care				
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Module 1: Melt Ferrous Material (Cast Iron) in Cupola Furnace

Objective of the module: This module covers the skills and knowledge required to Identify casting requirement, Select melting, Melt base iron materials, Perform duplexing with control activities, Perform inoculation procedure, Conduct gray iron casting inspection.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Identify casting Requirement	<p>The trainee will be able to:</p> <p>P1. Select base metal as per ASTM specifications</p> <p>P2. Identify type of cast iron as per requirement</p> <p>P3. Determine chemical and physical properties of cast iron from instruction sheet</p>	<p>P4. Foundry melting production process (from material selection to fettling and trimming).</p> <p>P5. Procedure of quality assurance and control system including inspection and testing.</p> <p>P6. Crucible conditions, faults and repair limits.</p> <p>P7. Metallic charge materials, ferro-alloys, additives, ladle additions.</p> <p>P8. Weighing procedure and scale types.</p>	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2hrs</p>	<ul style="list-style-type: none"> ❖ Cupola melting Furnace ❖ Immersion type Thermo-couple (1300 C° min.) ❖ Transfer ladle ❖ Chill mold (wedge) ❖ Weighing scale (10, 50, 100, 500, 1000 Kgs capacity) 	Class room / Workshop

		<p>P9. Thermocouple condition monitoring and adjustment mechanism.</p> <p>P10. Interpretation of carbon equivalent (thermal analysis) and wedge chill test result.</p> <p>P11. Coagulant agents, application and removal procedures.</p> <p>P12. Applicable industry standard, JIS, ASTM, SAE, DIN, BS, AS etc.</p> <p>P13. Metallic charge materials and its characteristics.</p> <p>P14. Metal composition and its effects on the mechanical physical properties of the metal.</p> <p>P15. Pouring temperature and its effect on the casting integrity.</p> <p>P16. Proper pouring techniques.</p> <p>P17. Effect of charge material on the mechanical / physical properties of the metal.</p> <p>P18. Effect of inoculation, ductile treatment, fade time or molten metal.</p> <p>P19. Use and application of personal protective</p>		<ul style="list-style-type: none"> ❖ Charging hoist (1 ton capacity) ❖ Charging box (200Kgs capacity) ❖ Degasser ❖ Modifier ❖ Grain refiner ❖ Inoculant (stabilizer) ❖ Inoculant (graphitizer) ❖ Optical Pyrometer (for ferrous metals) ❖ Coating for metal ❖ handling tools ❖ Slag coagulants ❖ PPE kit 	
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		equipments. P20. Safe work practice and procedures. P21.			
LU2: Select melting Materials	The trainee will be able to: 3. Select high-grade raw material consistent with quality 4. Undertake charge analysis and convert to appropriate furnace charge. 5. Complete requisitions as required according to standard operating procedures. 6. Weigh furnace charge according to standard operating procedures.	•	Total: 7hrs Theory: 5hrs Practical: 2 hrs	•	Class room / Workshop
LU3: Melt base iron	The trainee will be able to: 3. Prepare cupola furnace as per standard operating procedures. 4. Charge cupola furnace as per standard operating	•	Total 7 hrs Theory: 5hrs Practical: 2hrs	•	Class room / Workshop

	<p>procedures.</p> <p>5. Monitor cupola melt temperature</p> <p>6. Test chemical composition of melt as per standard operating procedures.</p> <p>7. Adapt corrective measures to attain required chemical composition.</p> <p>8. Conduct wedge chill testing as per standards</p> <p>9. Undertake rectification measures to attain desired results.</p> <p>10. Transfer molten metal to cupola fore-hearth as per standard operating procedures.</p>				
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<p>LU4: Perform duplexing with control activities</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 7. Desulfurized metal (0.02% max) if making nodular (Ductile) cast iron 8. Transfer molten metal to an induction furnace/duplexing furnace in accordance with standard operating procedures 9. Add required alloying elements to the melt as per standard operating procedures. 10. Undertake chemical composition analysis 11. Adjust composition of melt if required as per standard operating 	<ul style="list-style-type: none"> • 	<p>Total: 9hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 4 hrs</p>	<ul style="list-style-type: none"> • 	<p>Class room / Workshop</p>
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	<p>procedures.</p> <p>12. Raise metal temperature to tapping value</p> <p>13. Take wedge chill test as per standard operating procedures.</p> <p>14. Transfer molten metal to pouring ladle for inoculation</p> <p>15. Pour melt as per standard operating procedures.</p>				
LU5: Perform inoculation Procedure	<p>The trainee will be able to:</p> <p>P1. Select appropriate inoculants compatible with casting</p> <p>P2. Perform inoculation to improve metal properties in accordance with recommended inoculation procedures</p> <p>P3. Take wedge chill</p>	•			

	<p>value after inoculation as per standard operating procedures.</p> <p>P4. Control dead melt time as per standard operating procedures.</p> <p>P5. Control pouring time as per standard operating procedures.</p> <p>P6. Transport ladle to pouring station to pour metal into molds.</p>				
<p>LU6: Conduct gray iron casting inspection</p>	<p>The trainee will be able to:</p> <p>P1. Conduct visual inspection using color check</p> <p>P2. Perform file test to determine chills on casting edges.</p> <p>P3. Lead scrap diagnosis in coordination with process engineering personnel.</p>	<ul style="list-style-type: none"> • 			

Module 1: Melt Non-Ferrous Material in Pit Furnace

Objective of the module: This module covers the skills and knowledge required to identify job requirement, Perform melting of metal, Perform metal treatment process, Identify casting quality requirement, Identify defects cause by unsound melting, Recycle scraps / turnings.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Identify job requirement	<p>The trainee will be able to:</p> <p>16. Identify alloy melting requirements as per manufacturers/ suppliers instruction sheets.</p> <p>17. Cross check required specifications with corresponding international specification</p> <p>18. Determine casting method with available mold</p> <p>19. Determine metal treatment based on available product bulletin.</p> <p>20. Coat all tools which</p>	<p>22. Effects of chemical composition on integrity of the casting</p> <p>23. (strengths, ductility, surface finish)</p> <p>24. Charging sequence of metallic charges and melt treatment</p> <p>25. Pouring temperature range limits.</p> <p>26. Countermeasures to eliminate / minimize casting defects.</p> <p>27. Safety test applied to casting.</p> <p>28. Operation of emission spectrometer analyzer</p> <p>29. Safe work practice and procedures.</p> <p>30. Use and application of personal protective equipments.</p> <p>31. advantages/disadvantages of density of each type of non-ferrous metal</p> <p>32. methods of controlling tensile strength of non-ferrous metals</p>	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2hrs</p>	<ul style="list-style-type: none"> ❖ Pit Furnace ❖ Burners ❖ Iron rods ❖ Molds/dies ❖ Immersion type Thermo-couple ❖ Transfer ladle ❖ Weighing scale Charging hoist (1 ton capacity) ❖ Charging box (200Kgs capacity) ❖ Optical Pyrometer (for ferrous metals) ❖ Coating for metal ❖ handling tools ❖ repair tool kit 	Class room / Workshop

	<p>comes into contact with the melt to avoid melt contamination</p> <p>21. Select appropriate melting furnace as per required metal treatment and type of crucible (stationary/dip-out or tilting).</p>	<p>33. methods of controlling the hardness of non-ferrous metals</p> <p>34. influence of melting points on production processes</p> <p>35. shrinkage percentage of the types of non-ferrous metals</p> <p>36. how to control metal fluidity</p> <p>37. be able to make a refractory selection for non-ferrous alloys</p> <p>38. the use of degassing to control gas defects</p> <p>39. be able to take action to control grain size</p> <p>40. the grades of brass and their applications</p> <p>41. the grades of bronze and their applications</p> <p>42. the grades of gunmetal and their applications</p> <p>43. the grades of other copper based alloys and their applications</p> <p>44. the grades of aluminium based alloys and their applications</p> <p>45. the grades of lead based alloys and their applications</p> <p>46. the grades of zinc based alloys and their applications</p> <p>47. the grades of magnesium based alloys and their</p>		<ul style="list-style-type: none"> ❖ Slag coagulants ❖ PPEs kit 	
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		applications 48.			
LU2: Perform melting of metal	The trainee will be able to: 7. Feed Metal charges as per standard operating procedures. 8. Perform fluxing technique based on composition of metal charges (virgin ingot and recycled scrap). 9. Start furnace as per standard operating procedures. 10. Weigh specified amounts of scrap metal 11. Charge metal into furnace by hand or by directing crane operator 12. Regulate the injection of fuel and air into furnace 13. Apply appropriate degassing technique	•	Total: 7hrs Theory: 5hrs Practical: 2 hrs	•	Class room / Workshop

	<p>as per standard operating procedures.</p> <p>14. Add melt refining agent of the alloy as per standard operating procedures.</p> <p>15. Observe melt temperature with the help of thermocouple</p> <p>16. Take test sample of molten metal from crucible using hand ladle</p> <p>17. Record data from each melt on form</p>				
LU3: Perform metal treatment process	<p>The trainee will be able to:</p> <p>11. Apply structured modification of the alloy as per standard operating procedures.</p> <p>12. Monitor speed of melting to avoid oxidation.</p> <p>13. Control pouring temperature</p>	•	<p>Total 7 hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2hrs</p>	•	Class room / Workshop

	<p>corresponding to the alloy</p> <p>14. Apply filtration method and location corresponding to the alloy</p> <p>15. Tap metal from crucible with minimum turbulence to avoid oxide formations.</p> <p>16. Accompany pouring in accordance with OH & S requirements</p>				
LU4: Identify casting quality requirement	<p>The trainee will be able to:</p> <p>16. Identify content of contaminants, which will affect integrity of the casting in accordance with procedures.</p> <p>17. Apply structural modification in</p>	•	<p>Total: 9hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 4 hrs</p>	•	Class room / Workshop

	<p>accordance with procedures</p> <p>18. Carry out chemical analysis results in process control</p> <p>19. Follow written procedures during casting as per quality standards</p>				
LU5: Identify defects caused by unsound melting	<p>The trainee will be able to:</p> <p>P1. Identify remedial actions in accordance with standard operating procedures.</p> <p>P2. Show up defective castings with the respective sections in accordance with company procedures</p> <p>P3. Re-orient the correct melting and treatment of given alloy.</p>	•			
LU6: Recycle scraps / turnings	<p>The trainee will be able to:</p> <p>P1. Accomplish re-melting in accordance with company standard operating procedures</p>	•			

	<p>P2. Remove dross completely from the melt before pouring into molds.</p> <p>P3. Ensure label ingot type as per standard operating procedures</p> <p>P4. Enter production reports in performa with recommendation for future production reference.</p>				
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Molder

Module 1: Operate molding machine

Objective of the module: This module covers the skills and knowledge required to basic moulding /moulding machine with two piece pattern in sand molding for metal casting process.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Operate Muller mixture machine	<p>The trainee will be able to:</p> <p>49. Add sand in Muller mixture machine as required</p> <p>50. Add water in Muller mixture machine as required</p> <p>51. Add additives (binders) as required</p> <p>52. Operate the machine as per SOP</p> <p>53. Practice standard health and safety</p>	<ul style="list-style-type: none"> • Basic Molding • Molding and its types. • Properties of green sand 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2hrs</p>	<p>Muller mixture machine</p> <ul style="list-style-type: none"> • Shovel • Riddle • Lifter • Water • sand 	Class room / Workshop

	procedures 54. Unload the materials from machine				
LU2: Operate Jolt machine	The trainee will be able to: 18. Place the mold box on the surface of machine table 19. Place the pattern in mold box on the surface of machine table 20. Fill sand in the mold box on the surface of machine table 21. Perform jolting operation 22. Remove the mold from the machine 23. Operate the machine as per SOP 24. Practice standard health and safety procedures	<ul style="list-style-type: none"> • Molding accessories. • Repairing mould and its precautions. 	Total: 7hrs Theory: 5hrs Practical: 2 hrs	<ul style="list-style-type: none"> • Operate Jolt machine • Silica sand • Molding tools • Molding box • Pneumatic or electric jolt • Mold holder platform • 	Class room / Workshop
LU3: Operate squeeze	The trainee will be able to:	<ul style="list-style-type: none"> • Cleaning process • Molding machines 	Total 7 hrs	<ul style="list-style-type: none"> • Operate squeeze machine • Silica sand • Molding tools 	Class room / Workshop

<p>machine</p>	<p>17. Place the mold box on the surface of machine table</p> <p>18. Place the pattern in mold box on the surface of machine table</p> <p>19. Fill sand in the mold box on the surface of machine table</p> <p>20. Align the plate/rubber frame diaphragm with mold upper surface</p> <p>21. Apply pneumatic pressure on the surface of the loose sand in mold</p> <p>22. Remove the mold from the machine</p> <p>23. Operate the machine as per SOP</p> <p>24. Practice standard health and</p>		<p>Theory:</p> <p>5hrs</p> <p>Practical:</p> <p>2hrs</p>	<ul style="list-style-type: none"> • Molding box • Pneumatic or electric jolt • Mold holder platform 	
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	safety procedures				
LU4: Operate Jolt Squeeze Machine	<p>The trainee will be able to:</p> <p>20. Assemble the match plate pattern</p> <p>21. Place the assembled pattern on machine surface</p> <p>22. Place the drag upside</p> <p>23. Fill the drag with sand</p> <p>24. Perform machine as per SOP</p> <p>25. Rollover the assembled mold using hand</p> <p>26. Fill the cope with the sand</p> <p>27. Perform machine as per SOP</p> <p>28. Perform the vibrating operation</p> <p>29. Remove the mold from the machine</p>	<ul style="list-style-type: none"> • Molding techniques • Gating system 	<p>Total: 9hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 4 hrs</p>	<p>Operate Jolt Squeeze Machine</p> <ul style="list-style-type: none"> • Silica sand • Molding tools • Molding box • Pneumatic or electric jolt • Mold holder platform • 	Class room / Workshop

	30. Practice standard health and safety procedures				
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Module 2: Operate core making machine

Objective of the module: This module covers the skills and knowledge required to Basic core making / core making machines machine in sand molding for metal casting process.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Prepare Core sand	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Prepare sand for core making 2. Add additives (water, Binders) as required 3. Mix sand using hand tools/machine 	<p>Knowledge of :</p> <ul style="list-style-type: none"> • Types Silica sand • Molasses • Additives • Properties of molasses sand 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2hrs</p>	<p>Types Silica sand</p> <p>Molasses</p> <p>Additives</p> <p>Properties of molasses sand</p>	Class room / Workshop
LU2: Operate Core Shooter Machine	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Fill core pattern with core sand 2. Place sand filled core pattern in core shooter machine 3. Operate the machine as per SOP 4. Apply pressurized air to the core box 5. Remove the core box from machine 6. Extract core from the box 7. Practice standard 	<p>Knowledge of :</p> <ul style="list-style-type: none"> • Types Silica sand • Molasses • Additives • Properties of molasses 	<p>Total: 7hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>	<p>Types Silica sand</p> <p>Molasses</p> <p>Additives</p> <p>Properties of molasses sand</p>	Class room / Workshop

	health and safety procedure				
LU3: Operate Core Baking Oven	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Energize electric/gas fired baking oven 2. Place cores batch inside oven 3. Operate oven as per SOP 4. Remove batch of baked core from oven 5. Practice standard health and safety procedures 	<p>Knowledge of :</p> <ul style="list-style-type: none"> • Types Silica sand • Molasses • Additives <p>Properties of molasses</p>	<p>Total 7 hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2hrs</p>	<p>Types Silica sand</p> <p>Molasses</p> <p>Additives</p> <p>Properties of molasses sand</p>	<p>Class room / Workshop</p>

Furnace Operator

Module 1: Operate Non-Electric Melting Furnace

Objective of the module: This module covers the skills and knowledge required to operate Pit furnace for melting of suitable metallic material and operate the Cupola furnace for the melting of suitable metallic material.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
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<p>CU1. Operate Pit furnace for melting of suitable metallic material</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Inspect the lining of pit. 2. Repair the lining of pit, with suitable refractory material, if required. 3. Inspect the crucible. 4. Replace the crucible, if required. 5. Inspect the accessories (valves, flow meter gauges and pipes) of gas supply system. 6. Inspect the blower accessories (power supply, RPM and valves) 7. Place the empty crucible in the pit furnace on specific position for preheating. 8. Open gas valve and 	<ul style="list-style-type: none"> • Define refractory materials. • Describe different types of refractories. • Enlist different types of fuel used in pit furnace. • Discuss advantages and limitations of different types of fuels. • What is difference between coal and coke? • How coke is produced by coal. • Define slag. • Explain different types of slags produced during melting of non-ferrous metals. • Explain different types of slags produced during melting of cast iron and steel. • Describe different possible deterioration ways of furnace lining. • Explain different parts of pit furnace. • Explain safety parameters required to operate pit furnace. 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Pit Furnace • Crucible • Refractory material for lining • Crucible Tongs • Safety Accessories 	<p>Class room / Workshop</p>
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	<p>ignite gas in the pit furnace.</p> <p>9. Switch off furnace after suitable preheating time.</p> <p>10. Receive the metallic charge and put in crucible.</p> <p>11. Open the gas valve again and ignite gas in the furnace for melting.</p> <p>12. Place the cover on the pit.</p> <p>13. Switch ON the blower to increase the intensity of fire.</p> <p>14. Check the temperature of the charge with temperature gun after specific intervals of time during melting.</p> <p>15. Remove the slag with the help of crucible tongs.</p>				
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	<p>16. Switch off the furnace, after proper melting and heating of charge.</p> <p>17. Remove cover for picking out the crucible.</p> <p>18. Transfer molten metal to relevant person for mold filling.</p> <p>19. Repeat the necessary steps for the next heat.</p>				
<p>CU2. Operate cupola furnace for the melting of suitable metallic material</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Inspect the interior lining of the cupola furnace. 2. Inspect the condition of slag hole and tap hole. 3. Repair damaged areas of furnace with refractory material. 4. Close the bottom 	<ul style="list-style-type: none"> • Explain different parts of cupola furnace. • Describe charging and taping of a furnace. • Describe melting points and other properties of some common non-ferrous metals. • Explain safety parameters required to operate cupola furnace. 	<p>Total: 7hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Cupola Furnace • Crucible • Refractory material for lining • Crucible Tongs • Safety Accessories 	<p>Class room / Workshop</p>

	<p>door of furnace and put prop under it.</p> <p>5. Prepare coke bed on bottom plate of cupola with suitable slope towards tap hole</p> <p>6. Put soft wood pieces on the coke bed.</p> <p>7. Ignite wood pieces with cotton soaked in kerosene oil.</p> <p>8. Toss some coke on burning pieces of wood through charging door.</p> <p>9. Add more coke in cupola when it becomes red hot</p> <p>10. Add metallic charge on the red-hot coke.</p> <p>11. Add coke and metal charge periodically up to charging door.</p> <p>12. Wait for soaking time</p> <p>13. Close tap and slag</p>				
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	<p>hole</p> <p>14. Start air blast to increase the melting speed of molten metal.</p> <p>15. Pour out the slag from slag hole and close the slag hole.</p> <p>16. Pour molten metal into the ladle and close tap hole.</p> <p>17. Hand over the molten metal to relevant person for mold filling</p> <p>18. Repeat necessary steps for the next heat.</p>				
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Module 2: Operate Electric Melting Furnace

Objective of the module: This module covers the skills and knowledge required to operate induction furnace for melting of given metallic charge, operate direct arc furnace for melting of given metallic charge and operate indirect arc furnace for melting of given metallic charge.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
CU1. Operate induction furnace for melting of given metallic charge	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Inspect the lining of the crucible 2. Inspect the condition of induction coils 3. Fill the crucible of the induction furnace with raw material 4. Maintain the pressure of circulating water for cooling of induction coils. 5. Switch on the furnace power supply. 	<ul style="list-style-type: none"> • Define electric current. • Define electric induction. • Describe types of induction furnaces. • Describe types of refractories used in electric furnaces. • Explain different parts of an induction furnace. • Describe different safety precaution required to operate induction furnace. 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Electric induction furnace • Different instruments required to operate electric furnaces • Safety Accessories 	Class room / Workshop

	<p>6. Inspect the movement of trunnion and tilting bail.</p> <p>7. Adjust the frequency of thyristor according to the requirements.</p> <p>8. Reset control panel to delete the previous settings.</p> <p>9. Increase the amperes of the supply to maintain the required temperature.</p> <p>10. Tilt the furnace to pour out the slag as per requirement.</p> <p>11. Tilt the furnace to pour out the molten metal in ladle</p> <p>12. Hand over the molten metal to relevant person for filling of the molds.</p> <p>13. Repeat the</p>				
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	necessary steps for the next heat.				
CU2. Operate direct arc furnace for melting of given metallic charge	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Inspect the lining of electric furnace. 2. Inspect the condition of tap hole and slag hole of the furnace 3. Inspect the condition of electrodes and their movement 4. Inspect the oxygen supply accessories 5. Inspect the accessories associated with tilting mechanism of furnace 6. Allow to enter the charge to be melted into the electric arc furnace from an overhead crane 7. Follow the safety precautions of 	<ul style="list-style-type: none"> • Define electric Arc. • Describe different types of electric arc furnaces. • Explain different components of an electric arc furnace. 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Electric arc furnace • Different instruments required to operate electric furnaces • Safety Accessories 	Class room / Workshop

	<p>charging</p> <ol style="list-style-type: none">8. Place the lid containing the three electrodes into position.9. Adjust the position of electrodes to adjust proper distance between electrodes and charge.10. Allow the electric current to pass through the electrodes to carry out melting process11. Add alloying additions, during melting, if required.12. Allow the oxygen to enter into the melt at suitable time, to oxidize elements, if required.13. Tilt the furnace to one side to allow the slag to pour out.				
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	<p>14. Tilt the furnace to other side to allow the molten metal to pour out</p> <p>15. Handed over the molten metal to relevant person for filling of moulds.</p> <p>16. Repeat the necessary steps for the next heat.</p>				
<p>CU3. Operate Indirect arc furnace for melting of given metallic charge</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Inspect the lining of indirect arc furnace. 2. Inspect the charging door and lining of the door. 3. Inspect the condition of tap hole of the furnace. 4. Inspect the condition of electrodes. 5. Inspect and set the oxygen supply accessories 	<ul style="list-style-type: none"> • Explain different components of Indirect electric arc furnace. • Discuss material and dimensions of electrodes of electric arc furnaces. • Describe different safety precaution required to operate electric arc furnace. 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Electric Indirect arc furnace • Different instruments required to operate electric furnaces • Safety Accessories 	<p>Class room / Workshop</p>

	<ol style="list-style-type: none"> 6. Inspect the gas hole and other related accessories. 7. Charge the furnace with material to be melted through charging door. 8. Follow the safety precautions of charging. 9. Allow the electric current to pass through the electrodes to carry out melting process 10. Allow the oxygen to enter into the melt at suitable time 11. Remove the slag from the surface of molten metal with safety precautions. 12. Open the tapping hole to pour out the molten metal. 13. Handed over the 				
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	molten metal to relevant person for filling of moulds. 14. Repeat the necessary steps for the next heat.				
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Caster

Module 1: Operate Pressure Die Casting

Objective of the module: This module covers the skills and knowledge required to conduct pre-operational checks, Operate machine control panel, Monitor melt in furnace, Operate machine to produce castings, perform post casting operation.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
CU3. Conduct pre-operational checks	<p>The trainee will be able to:</p> <p>20. Start machine according to standard operating procedures.</p> <p>21. Clamp the two halves of the die inside the die casting machine as per SOP</p>	<ul style="list-style-type: none"> • procedures for pre-start checks • procedures for starting up the die casting machine • adjustments that can be made to ensure correct operation of the machine • the function of nitrogen and vacuum systems in the die casting process • the procedures for checking/ adjusting nitrogen and/or vacuum systems 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Dies • Clamping Unit • Die Assembly Unit • Molds • Die coats • Injection Unit 	Class room / Workshop

	<p>22. Inspect the opening and closing function of die as per SOP</p> <p>23. Inspect function of ejector and cooling system of die</p> <p>24. Adjust component gripper if necessary.</p> <p>25. Adjust die spray nozzles as necessary.</p>	<ul style="list-style-type: none"> procedures for adjusting the die spray nozzles 		<ul style="list-style-type: none"> Flasks 	
CU4. Operate machine control panel	<p>The trainee will be able to:</p> <ul style="list-style-type: none"> Set die opening limit Adjust shot size as per requirement Make functional check of the picking robot if required Adjust operating parameters of machine at given specifications 	<ul style="list-style-type: none"> Procedures for adjusting the shot size Procedures for adjusting the picking robot The function of nitrogen and vacuum systems in the die casting process The procedures for checking/ adjusting nitrogen and/or vacuum systems The function of a picking robot and the component gripper 	<p>Total: 7hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> Shot chamber Dies Molds 	Class room / Workshop
CU5. Monitor melt in furnace	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> Handle furnace according to standard operating procedures. Maintain liquid metal as per die operating condition 	<ul style="list-style-type: none"> Procedures to adjust and control the operation of the furnace during melting Procedure of handling liquid metal Safe work practices and procedures Use and application of personal protective equipment 	<p>Total 7 hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2hrs</p>	<ul style="list-style-type: none"> Furnace Tongs Clamping Unit Die coat Metal holding pot Transfer ladles 	Class room / Workshop

	<p>3. Control furnace temperature at optimum operating condition</p> <p>4. Ensure safe work practices in handling furnace</p>				
<p>CU6. Operate machine to produce castings</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Clean each die half as per requirement 2. Lubricate die to facilitate the ejection of part 3. Close two halves of the die and clamp mold together 4. Apply sufficient force to the die to keep it securely closed 5. Transfer molten metal into the chamber as per SOPs 6. Inject the molten metal with required pressure into the die/mold 7. Fill the entire cavity of die 8. Open the die after casting solidification 9. Eject the casting out of the die cavity 10. Clamp shut the die 	<ul style="list-style-type: none"> • procedures to adjust the operation of the die casting machine • procedures to remove runners from the die casting • procedures to inspect die castings • common faults in die castings and probable causes 	<p>Total: 9hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 4 hrs</p>	<ul style="list-style-type: none"> • Clamping Unit • Tongs • Die coat • Metal holding pot • Transfer ladles • Furnace 	<p>Class room / Workshop</p>

	for the next injection				
CU7. Perform Post Casting Operation	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Trim excess material along with any flash from castings 2. Ensure efficient flow of finished product i.e. breaking of runners, stacking baskets, bins, conveyors 3. Inspect castings visually for porosity, cracks, tears, splits, sinks, cold shuts, tinning and die surface crazing 4. Handle castings to minimise risk of damage to the casting and injury to personnel 	<ul style="list-style-type: none"> • Procedures to remove runners from the die casting • Procedures to inspect die castings • Procedure of removing excess material from casting • Damage that can be caused to castings through inappropriate handling and storage • Procedures for checking first-off castings for conformance to specification 	<p>Total: 9hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 4 hrs</p>	<ul style="list-style-type: none"> • Tongs • Clamping Unit • Die coat • Metal holding pot • Transfer ladles • Flask • Crucible 	Class room / Workshop

Module 2: Perform Centrifugal Casting Process

Objective of the module: This module covers the skills and knowledge required to Read and understand to prepare mold for casting, Cast the molten metal, carry out cooling process, Remove the castings from mold, Clean the cast metal, Undertake preventive maintenance.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
CU4. Prepare mold for casting	<p>The trainee will be able to:</p> <p>14. Apply refractory ceramic coating to cylindrical mold walls</p> <p>15. Perform rotation of mold to spread coating properly</p> <p>16. Perform drying of ceramic coat as per standard operating procedures</p> <p>17. Rotate mold about its axis at high speeds typically at 1000 RPM on casting machine rollers</p>	<ul style="list-style-type: none"> • Understand centrifugal casting process • types of centrifugal casting process • Identify various centrifugal casting process • Knowledge of true centrifugal casting • Knowledge of semi centrifugal casting • Knowledge of centrifuge centrifugal casting 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Dies • Clamping Unit • Die Assembly Unit • Molds • Die coats • Injection Unit • Flasks • Thermal insulation • PPEs 	Class room / Workshop
CU5. Cast the molten	The trainee will be able	<ul style="list-style-type: none"> • Understand centrifugal casting process 	Total: 7hrs	<ul style="list-style-type: none"> • Dies 	Class room /

<p>metal</p>	<p>to:</p> <p>17. Pour molten metal into the pouring tub with transfer ladle</p> <p>18. Transfer molten metal into the rotating mold at required temperature</p> <p>19. Avoid spillage of molten metal while pouring</p>	<ul style="list-style-type: none"> • types of centrifugal casting process 	<p>Theory:</p> <p>5 hrs</p> <p>Practical:</p> <p>2 hrs</p>	<ul style="list-style-type: none"> • Clamping Unit • Die Assembly Unit • Molds • Die coats • Injection Unit • Flasks • Thermal insulation • PPEs 	<p>Workshop</p>
<p>CU6. Carry out cooling process</p>	<p>The trainee will be able to:</p> <p>15. Perform continuous rotation of mold with the molten metal</p> <p>16. Allow melt to spread inside mold walls to let it cool</p> <p>17. Stop the mold rotation after the casting has cooled</p>	<ul style="list-style-type: none"> • Understand centrifugal casting process • types of centrifugal casting process • Identify various centrifugal casting process 	<p>Total:7hrs</p> <p>Theory:</p> <p>5 hrs</p> <p>Practical:</p> <p>2 hrs</p>	<ul style="list-style-type: none"> • Dies • Clamping Unit • Die Assembly Unit • Molds • Die coats • Injection Unit • Flasks • Thermal insulation • PPEs 	<p>Class room / Workshop</p>
<p>CU7. Remove the Castings from</p>	<p>The trainee will be able to:</p>	<ul style="list-style-type: none"> • Knowledge of melting & solidification of casting • Knowledge of removal of casting from 	<p>Total:7hrs</p> <p>Theory:</p>	<ul style="list-style-type: none"> • Dies • Clamping Unit 	<p>Class room / Workshop</p>

<p>mold</p>	<ol style="list-style-type: none"> 1. Perform solidification of melt to room temperature 2. Shake out the solidified casting from mold as per SOPs 	<p>mold</p>	<p>5 hrs Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Die Assembly Unit • Molds • Die coats • Injection Unit • Flasks • Thermal insulation • PPEs 	
<p>CU8. Clean the cast metal</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Remove less dense impurities at the inner surface of the casting as per SOP 2. Remove dross by machining/grinding operation 3. Perform shot blasting to smooth the inner diameter of the part. 	<ul style="list-style-type: none"> • Knowledge of shot blasting • Cleaning of surface of casting • Understanding machining and grinding operations 	<p>Total:7hrs Theory: 5 hrs Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Dies • Molds • Grinder • PPEs 	<p>Class room / Workshop</p>
<p>CU9. Undertake preventive maintenance</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Ensure general maintenance of the machine 2. Ensure no shut down of machines due to improper maintenance 	<ul style="list-style-type: none"> • Understand maintenance of machine • Understand cleaning of machines 	<p>Total:7hrs Theory: 5 hrs Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Machines • PPEs 	<p>Class room / Workshop</p>

	3. Perform regular cleaning process as prescribed by manufacturer				
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Assistant Heat Treatment Technician

Module 1: Perform quenching, annealing and normalizing operations.

Objective of the module: The aim of this module to get knowledge, skills and understanding to Perform Quenching, Annealing and Normalizing operations.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform quenching process	<p>The trainee will be able to:</p> <p>7. Handle the job as per SOP.</p> <p>8. Place the job in the heating furnace.</p> <p>9. Control the temperature of the furnace as per given job.</p> <p>10. Set standard soaking time of the</p>	<ol style="list-style-type: none"> 1. Types of carbon steel. 2. Explain the effect of carbon on hardness. 3. Explain Iron-Carbon diagram. 4. Explain the effect of heat treatment on the formation of different phases. 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Quenching bath <p>Non</p> <p>Consumable</p> <ul style="list-style-type: none"> • Heating furnaces • Long tonge • Insulating gloves 	Class room

	<p>heat treatment cycle as per given job.</p> <p>11. Turn off the furnace once the required temperature and soaking time is achieved.</p> <p>12. Remove the job from the furnace and quench into the quenching media.</p> <p>13. Clean the job and refer it to the next section.</p>				
<p>LU2: Perform annealing treatment on steel</p>	<p>The trainee will be able to:</p> <p>7. Handle the job as per SOP.</p> <p>8. Place the job in the heating furnace.</p> <p>9. Control the temperature of the furnace as per given job.</p>	<ol style="list-style-type: none"> 1. Types of carbon steel. 2. Explain the effect of carbon on hardness. 3. Explain Iron-Carbon diagram. 4. Explain the effect of heat treatment on the formation of different phases. 	<p>Total: 7hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Quenching bath <p>Non</p> <p>Consumable</p> <ul style="list-style-type: none"> • Heating furnaces • Long tonge • Insulating 	<p>Class room</p>

	<p>10. Set standard soaking time of the heat treatment cycle as per given job.</p> <p>11. Turn off the furnace, once the required temperature and soaking time is achieved.</p> <p>12. Let the workpiece to cool in the furnace.</p> <p>13. Remove the workpiece from the furnace, once the temperature drops to room temperature.</p> <p>14. Clean the workpiece and prepare observation data sheet.</p>			gloves	
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<p>LU3: Perform normalizing process</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Handle the job as per SOP 2. Place the job in the furnace 3. Control the temperature of the furnace as per given job. 4. Set standard soaking time of the heat treatment cycle as per given job. 5. Turn off the furnace, once the required temperature and soaking time is achieved. 6. Remove the job from furnace and let it cool in the air. 7. Clean the job and prepare 	<ol style="list-style-type: none"> 1. Types of carbon steel. 2. Explain the effect of carbon on hardness. 3. Explain Iron-Carbon diagram. 4. Explain the effect of heat treatment on the formation of different phases. 	<p>Total</p> <p>7 hrs</p> <p>Theory:</p> <p>5hrs</p> <p>Practical:</p> <p>2hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Quenching bath <p>Non</p> <p>Consumable</p> <ul style="list-style-type: none"> • Heating furnaces • Long tonge • Insulating gloves 	<p>Class room</p>
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	observation data sheet.				
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Module 2: Perform Heat Treatment of Non Ferrous Metals.

Objective of the module: The aim of this module to get knowledge, skills and understanding to Perform Heat Treatment of Non Ferrous Metals.

Duration: 30hours **Theory:** 20 hours **Practical:** 10 hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform Solution Treatment	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Handle the workpiece with appropriate care 2. Place the workpiece in the furnace 3. Adjust the temperature and soaking time of the furnace according to the material type and 	<ol style="list-style-type: none"> 1. Differentiate between ferrous and non-ferrous materials 2. Properties of Aluminum metal and its alloys 3. Properties of Copper metal and its alloys 4. Describe Soaking time 5. Purposes of heat treatment of non-ferrous alloys 6. Describe heat treatment furnace 7. Describe quenching media used for non-ferrous materials 8. Describe Aging. 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Quenching bath <p>Non Consumable</p> <ul style="list-style-type: none"> • Heating furnaces • Long tonge • Insulating gloves 	Class room

	<p>size.</p> <p>4. Turn of the furnace once the required temperature and soaking time is achieved.</p> <p>5. Remove the workpiece from the furnace and quench into the quenching media.</p> <p>6. Clean the workpiece and referred it to the next section.</p>				
LU2: Perform Aging	<p>The trainee will be able to:</p> <p>1. Handle the workpiece with appropriate care</p> <p>2. Place the workpiece in the furnace</p>	<p>1. Differentiate between ferrous and non-ferrous materials</p> <p>2. Properties of Aluminum metal and its alloys</p> <p>3. Properties of Copper metal and its alloys</p> <p>4. Describe Soaking time</p>	<p>Total: 7hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Quenching bath <p>Non</p> <p>Consumable</p> <ul style="list-style-type: none"> • Heating furnaces • Long tonge 	Class room

	<p>3. Adjust the temperature and soaking time of the furnace according to the type and size of the material.</p> <p>4. Turn of the furnace once the required temperature and soaking time is achieved.</p> <p>5. Let the workpiece to cool in the furnace.</p> <p>6. Remove the workpiece from the furnace, once the temperature drops to room temperature.</p> <p>7. Clean the workpiece</p>	<p>5. Purposes of heat treatment of non-ferrous alloys</p> <p>6. Describe heat treatment furnace</p> <p>7. Describe quenching media used for non-ferrous materials</p> <p>8. Describe Aging.</p>		<ul style="list-style-type: none"> • Insulating gloves 	
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	and referred it to the next section.				
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Basic Computer Operator

Complete list of tools and equipment

Sr#	Description	Quantity
1	Computer with internet	26
2	White board	1
3	Multimedia	1

List of consumable supplies

Sr no	Material	Quantity
1	Note book	25
2	Flip chart	25
3	Pencil	25
4	White sheets	25
5	Eraser	25
6	Sharpener	25
7	Pen	25

Credit values

The credit value of the National Certificate Level 2 in Textile Merchandizing is defined by estimating the amount of time/ instruction hours required to complete each competency unit and competency standard. The NVQF uses a standard credit value of 1 credit = 10 hours of learning (Following Higher Education Commission (HEC) guidelines.

The credit values are as follows:

Competency Standard	Estimate of hours	Credit
A. Maintain Personal Health ,Hygiene and Safety Guidelines	30	3
B. Perform Basic Communication Skills	30	3
C. Perform Basic Computer Operations	50	5
D. Handle the Documents	100	10
E. Organise Store Merchandising	240	24
F. Dispose the Waste Materials	30	3