

Curriculum
For
**“Foreman in Metallurgy and
Metal Casting”**
(Level -4)

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*

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 metallurgy and casting 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 metallurgy and metal 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

Possible available job opportunities available immediately and later in the future

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 metallurgy and metal casting industry. They should also hold or be working towards a formal teaching qualification.

Other formal qualifications in this 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	Theory ¹ Days/hours	Workplace ² 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

Sequence of the Modules

Each module covers a range of learning components. These are intended to provide detailed guidance to teachers (for example the Learning Elements component) and give them additional support for preparing their lessons (for example the Materials Required component). The detail provided by each module will contribute to a standardized approach to teaching, ensuring that training providers in different parts of the country have clear information on what should be taught. Each module also incorporates the industrial needs of Pakistan.

The distribution table is shown below:

Module 1:	Module 2:	Module 3:
Module 4:	Module 5:	Module 6:
Module 7:	Module 8:	Module 9:
Module 10:	Module 11:	Module 12:
Module 13:	Module 14:	Module 15:

Summary – overview of the curriculum

Module Title and Aim	Learning Units	Theory Days/hours	Workplace Days/hours	Timeframe of modules
Module 1: Perform Basic Manual Drawing Aim: After successful completion of this module, the trainee is competent in	LU1: LU2: LU3: LU4:			
Module 2: Construct different Engineering Curves Aim: After successful completion of this module, the trainee is competent in	LU1: LU2: LU3:			
Module 3: Construct multi-view drawings Aim: After successful completion of this module, the trainee is competent in	LU1: LU2: LU3: LU4:			
Module 4: Perform metal/bench work Aim: After successful completion of this module, the trainee is competent in	LU1: LU2:			

Module Title and Aim	Learning Units	Theory Days/hours	Workplace Days/hours	Timeframe of modules
Module 5: Perform cutting on metal circular and power hacksaw Aim: After successful completion of this module, the trainee is competent in	LU1: LU2:			
Module 6: Perform grinding operation Aim: After successful completion of this module, the trainee is competent in	LU1: LU2:			
Module 7: Perform basic lathe machine operations Aim: After successful completion of this module, the trainee is competent in				
Module 8: Perform Drilling Machine Operations Aim: After successful completion of this module, the trainee is competent in				

Module Title and Aim	Learning Units	Theory Days/hours	Workplace Days/hours	Timeframe of modules
Module 9: Perform shaper, planar and slotter Machining Operations Aim: After successful completion of this module, the trainee is competent in				
Module 10: Perform milling operations Aim: After successful completion of this module, the trainee is competent in				
Module 11: Aim: After successful completion of this module, the trainee is competent in				

Senior Caster

Module 1: Perform Shell Mold Casting

Objective of the module: This module covers the skills and knowledge required to Read and Understand to arrange pattern for casting, Create shell mold for casting, Assemble mold for casting, Cast molten metal in mold, Perform cooling process, Remove casting from mold.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
CU1. Arrange pattern for casting	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Handle a two-piece metal pattern in the shape of desired part 2. Use aluminum for low volume production of patterns / graphite for casting reactive materials 	<ul style="list-style-type: none"> • Understand shell mold casting process • Demonstrate shell mold casting • Mold creation techniques • Assembly of molding • Gating system • Knowledge of Pouring techniques 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Clamping device • Dump box • Shell • Mold • Dies • Transfer Ladles • Tongs • crucible • Dies • Metal holding pot • Furnace • Transfer ladles • PPE 	Class room / Workshop
CU2. Create shell	<p>The trainee will be able to:</p>	<ul style="list-style-type: none"> • Understand shell mold casting process 	Total:	<ul style="list-style-type: none"> • Clamping device 	Class room /

mold for casting	<ol style="list-style-type: none"> 1. Heat each pattern half to 175-370°C as per standard operating procedures 2. Coat pattern with a lubricant to facilitate removal process 3. Clamp the heated pattern to a dump box containing a mixture of sand and a resin binder 4. Invert the dump box allowing sand-resin mixture to coat the pattern 5. Create shell around the heated pattern while curing the mixture in an oven 6. Eject the shell from the pattern 	<ul style="list-style-type: none"> • Demonstrate shell mold casting • Mold creation techniques • Assembly of molding • Gating system • Knowledge of Pouring techniques 	<p>7hrs</p> <p>Theory:</p> <p>5hrs</p> <p>Practical:</p> <p>2 hrs</p>	<ul style="list-style-type: none"> • Dump box • Shell • Mold • Dies • Transfer Ladles • Tongs • crucible • Dies • Die coats • Metal holding pot • Furnace • Transfer ladles • PPE 	Workshop
CU3. Assemble mold for casting	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Insert cores in 	<ul style="list-style-type: none"> • Understand mold casting process • Demonstrate mold casting • Demonstrate joining of shell 	<p>Total</p> <p>7 hrs</p> <p>Theory:</p>	<ul style="list-style-type: none"> • Clamping device • Flask • Dump box 	Class room / Workshop

	<p>the mold as per requirement</p> <ol style="list-style-type: none"> Join the two shell halves together Clamp the halves to form a complete shell mold Place the shell mold into a flask supported by a backing material 	<p>halves</p> <ul style="list-style-type: none"> Mold creation techniques Assembly of molding Gating system Knowledge of Pouring techniques 	<p>5hrs</p> <p>Practical:</p> <p>2hrs</p>	<ul style="list-style-type: none"> Shell Mold Dies Transfer Ladles Tongs crucible Dies Die coats Metal holding pot Furnace Transfer ladles PPE 	
CU4. Cast molten metal in mold	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> Pour molten metal from ladle into the gating system Ensure the mold is securely clamped together while the molten metal is poured Fill the mold cavity completely 	<ul style="list-style-type: none"> Understand casting of molten metal mold casting process Demonstrate mold clamping Mold creation techniques Assembly of molding Gating system Knowledge of Pouring techniques 	<p>Total:</p> <p>9hrs</p> <p>Theory:</p> <p>5 hrs</p> <p>Practical:</p> <p>4 hrs</p>	<ul style="list-style-type: none"> Clamping device Dump box Shell Mold Dies Transfer Ladles Tongs crucible Dies Die coats Metal holding pot 	Class room / Workshop

	with the melt			<ul style="list-style-type: none"> • Furnace • Transfer ladles • PPE 	
CU5. Perform cooling process	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Allow molten metal to cool for standard time in the mold 2. Carry out solidification of melt into the shape of the final casting 	<ul style="list-style-type: none"> • Understand cooling process of mold casting process • Demonstrate shell mold casting • Mold dis-assembly of molding • Gating system 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Clamping device • Shell • Mold • Dies • Transfer Ladles • Tongs • crucible • Dies • Die coats • Metal holding pot • Furnace • Transfer ladles • PPE 	Class room / Workshop
CU6. Remove casting from mold	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Break the mold after the metal is cool down 2. Shake out any sand from the 	<ul style="list-style-type: none"> • Understand removing of casting from mold • Demonstrate breaking of mold after mold casting • Demonstrate inspection of casting • Demonstrate preparation of 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical:</p>	<ul style="list-style-type: none"> • Clamping device • Dump box • Shell • Mold • Dies • Transfer 	Class room / Workshop

	mold 3. Trim any excess metal from the feed system 4. Carry out visual inspection of casting 5. Prepare observation data sheet (ODS) and report to concerned department	Data Sheet and report	2 hrs	Ladles <ul style="list-style-type: none"> • Tongs • crucible • Dies • Die coats • Metal holding pot • Furnace • Transfer ladles • PPE 	
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Module 2: Perform Investment Casting

Objective of the module: This module covers the skills and knowledge required to Read and Understand to Arrange pattern for casting, Create mold for casting, Cast molten metal in mold, Perform post-casting operations.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
CU1. Arrange pattern for Casting	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Arrange wax patterns as per requirement 2. Use cores to form any internal features on the pattern if required 3. Attach patterns to a central wax gating system (sprue, runners, and risers) to form a tree-like assembly 	<ul style="list-style-type: none"> • Identification of precious metals and alloys • Calculations for proportions/quantities of alloys • Melting points of various metals/alloys • Furnace start-up and shut-down procedures • Housekeeping and equipment cleaning procedures • Safe work practices and procedures • Weighing metals and their alloys • Setting up, checking and operating equipment • Working within heating timeframe constraints 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Shell Coater • Engineered Drying machines • Slurry Tanks • Fluid-Bed Tanks • Shell Handlers • Casting Handlers • Cut-Off Machines • Automated Casting Finishing Cells • Casting Positioner 	Class room / Workshop
CU2. Create mold for	<p>The trainee will be able to:</p>	<ul style="list-style-type: none"> • Coating of wax pattern tree • Degassing of vacuum chamber 	<p>Total:7hrs</p>	<ul style="list-style-type: none"> • Shell Coater • Wax 	Class room /

casting	<ol style="list-style-type: none"> 1. Place wax tree-like assembly into mold flask 2. Prepare slurry by mixing ceramic powder with water and stir it homogenously 3. Perform degassing of slurry in vacuum chamber 4. Pour slurry into the flask to coat the wax pattern tree 5. Bake the shell as per standard to form a ceramic shell around the patterns and gating system 6. Remove the wax leaving a hollow ceramic shell that acts as a one-piece mold 	<ul style="list-style-type: none"> • Pouring of wax in the mold • Identification of precious metals and alloys • Calculations for proportions/quantities of alloys • Data recording procedures • Consequences of poor work practices • Melting points of various metals/alloys • Furnace start-up and shut-down procedures • Housekeeping and equipment cleaning procedures • Safe work practices and procedures • Weighing metals and their alloys • Setting up, checking and operating equipment • Maintaining furnace temperatures • Working within heating timeframe constraints 	Theory: 5 hrs Practical: 2 hrs	<ul style="list-style-type: none"> • Mold Flask • Engineered Drying machines • Slurry Tanks • Fluid-Bed Tanks • Shell Handlers • Casting Handlers • Barrel Sanders • Fluidized Bed Sanders • Cut-Off Machines • Automated Casting Finishing Cells • Casting Positioner 	Workshop
CU3. Cast molten metal in mold	The trainee will be able to: <ol style="list-style-type: none"> 1. Pre-heat mold in a furnace as per 	<ul style="list-style-type: none"> • Preheating of mold in a furnace • Protective coating types and its application on mold • Pouring of molten metal in mold 	Total: 7hrs Theory: 5 hrs	<ul style="list-style-type: none"> • Shell Coater • Engineered Drying machines 	Class room / Workshop

	<p>SOP</p> <ol style="list-style-type: none"> 2. Apply protective coating to mold as per standard 3. Pour molten metal from a ladle into the gating system of the mold 4. Carry out complete filling of the mold cavity with liquid melt as per standard operating procedure 	<ul style="list-style-type: none"> • Calculations for proportions/quantities of alloys • Data recording procedures • Consequences of poor work practices • Melting points of various metals/alloys • Furnace start-up and shut-down procedures • Housekeeping and equipment cleaning procedures • Safe work practices and procedures • Weighing metals and their alloys • Setting up, checking and operating equipment • Maintaining furnace temperatures 	<p>Practical:</p> <p>2 hrs</p>	<ul style="list-style-type: none"> • Fluid-Bed Tanks • Shell Handlers • Casting Handlers • Barrel Sanders • Fluidized Bed Sanders • Grinders • Cut-Off Machines • Automated Casting Finishing Cells • Casting Positioner 	
CU4. Perform post-casting operations	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Allow for adequate solidification time into the shape of the final casting 2. Break the ceramic 	<ul style="list-style-type: none"> • Breaking the mold and removing the casting • Separation of parts from grating system • Grinding and finishing operations • Identification of precious metals and alloys • Breaking of ceramic mold & 	<p>Total:7hrs</p> <p>Theory:</p> <p>5 hrs</p> <p>Practical:</p> <p>2 hrs</p>	<ul style="list-style-type: none"> • Shell Coater • Engineered Drying machines • Slurry Tanks • Fluid-Bed Tanks • Shell Handlers 	Class room / Workshop

	<p>mold and remove the casting as per SOP</p> <p>3. Separate the parts from the gating system by either sawing or cold breaking (using liquid nitrogen)</p> <p>4. Perform finishing operations such as grinding or sandblasting to smooth the part at the gates</p> <p>5. Clean up work area and equipment and dispose of waste according to environmental requirements</p>	<p>removing the casting</p> <ul style="list-style-type: none"> • Calculations for proportions/quantities of alloys • Data recording procedures • Consequences of poor work practices • Melting points of various metals/alloys • Furnace start-up and shut-down procedures • Housekeeping and equipment cleaning procedures • Safe work practices and procedures • Identifying metals and their alloys • Weighing metals and their alloys • Setting up, checking and operating equipment • Maintaining furnace temperatures 		<ul style="list-style-type: none"> • Casting Handlers • Barrel Sanders • Fluidized Bed Sanders • Grinders • Cut-Off Machines • Automated Casting Finishing Cells • Casting Positioner 	
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Heat Treatment Technician

Module 1: Perform stress relieving, austempering and martempering

Objective of the module: The aim of this module to get knowledge, skills and understanding to Perform stress relieving, austempering and martempering process.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform Stress Relieving	<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 heating 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 	<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 Consumable</p> <ul style="list-style-type: none"> • Heating furnaces • Long tonge • Insulating gloves 	Class room

	soaking time is achieved. 6. Remove the job from the furnace and cool into the air. 7. Clean the job and refer it to the next section.				
LU2: Perform Austempering Treatment on steel	The trainee will be able to: 1. Handle the job as per SOP. 2. Place the job in the heating furnace. 3. Adjust the temperature in the austenitic range and soaking time of the furnace according to the steel grade and size. 4. Turn off the furnace, once the required temperature and soaking time is achieved. 5. Let the workpiece to	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.	Total: 7hrs Theory: 5hrs Practical: 2 hrs	Consumable <ul style="list-style-type: none"> Quenching salt bath Non Consumable <ul style="list-style-type: none"> Heating furnaces Long tonge Insulating gloves 	Class room

	<p>quench in a salt bath maintained at a temperature above the martensitic start (MS) range.</p> <p>6. Hold the workpiece in a salt bath till the complete transformation of bainite.</p> <p>7. Remove the workpiece from the furnace, once the temperature drops to room temperature.</p> <p>8. Remove the workpiece from the salt bath and cool in the air.</p> <p>9. Clean the workpiece and referred it to the next section..</p>				
LU3: Perform Martempering treatment on steel.	<p>The trainee will be able to:</p> <p>1. Handle the job as per SOP</p>	<ol style="list-style-type: none"> Types of carbon steel. Explain the effect of carbon on hardness. 	<p>Total</p> <p>7 hrs</p> <p>Theory:</p>	<p>Consumable</p> <ul style="list-style-type: none"> Quenching salt bath <p>Non Consumable</p>	Class room

	<ol style="list-style-type: none"> 2. Place the job in the furnace 3. Adjust the temperature above the upper critical range and soaking time of the furnace according to steel grade and size 4. Turn off the furnace, once the required temperature and soaking time is achieved. 5. Remove the workpiece from the furnace and quenched in a salt bath, kept at a temperature of 150-300 °C. 6. Hold the workpiece in a bath, until the temperature becomes uniform throughout the cross section of 	<ol style="list-style-type: none"> 3. Explain Iron-Carbon diagram. 4. Explain the effect of heat treatment on the formation of different phases. 	<p>5hrs</p> <p>Practical:</p> <p>2hrs</p>	<ul style="list-style-type: none"> • Heating furnaces • Long tonge • Insulating gloves 	
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	workpiece.				
	7. Remove the workpiece from the salt bath and cooled in air to room temperature.				
	8. Clean the workpiece and referred it to the next section.				

Module 2: Perform Case Hardening Process

Objective of the module: The aim of this module to get knowledge, skills and understanding to Perform Case Hardening Processes (Flame hardening, Induction hardening treatment, Carburising and Nitriding treatment on carbon steels, Alloy steels and cast iron).

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform Flame hardening	The trainee will be able to: <ol style="list-style-type: none"> Place the workpiece in flame exposed area Wear the safety gloves and googles. 	<ol style="list-style-type: none"> Induction heating principle Explain oxyacetylene flame heating zones Explain cast iron, carbon steel and alloy steel Explain surface hardening 	Total: 7hrs Theory: 5 hrs Practical: 2hrs	Consumable <ul style="list-style-type: none"> Gas Cylenders Quenching bath Non Consumable <ul style="list-style-type: none"> Safety gloves , googles Flame torch 	Class room

	<p>3. Adjust the oxyacetylene flame torch.</p> <p>4. Heat the surface of workpiece as per standard time.</p> <p>5. Quench the workpiece in quenching media as per job requirement.</p> <p>6. Perform tempering of job as per requirement.</p> <p>7. Clean the workpiece and prepare report of all findings</p>	<p>5. Explain the preparation of salt bath</p>		<ul style="list-style-type: none"> Long tonge 	
LU2: Perform Induction hardening	The trainee will be able to: <ol style="list-style-type: none"> 1. Install induction coil as per job requirement 	<ol style="list-style-type: none"> 1. Induction heating principle 2. Explain oxyacetylene flame heating zones 	Total: 7hrs Theory: 5hrs	<div>Consumable</div> <ul style="list-style-type: none"> Quenching bath <div>Non Consumable</div> <ul style="list-style-type: none"> Induction Heating 	Class room

	<ol style="list-style-type: none"> 2. Supply water to induction coil and quenching medium. 3. Switch on the main power supply 4. Check the cooling system of electric panel. 5. Set the frequency of heating machine as per job requirement. 6. Place the specimen between the heating coil 7. Adjust the vertical movement of attachment as per job requirement 8. Adjust water flow of heating coil. 9. Energize the 	<ol style="list-style-type: none"> 3. Explain cast iron, carbon steel and alloy steel 4. Explain surface hardening 5. Explain the preparation of salt bath 	Practical: 2 hrs	furnaces <ul style="list-style-type: none"> • Long tonge • Insulating gloves 	
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	heating coil. 10. Control the heat-up time as per job requirement. 11. Quench the job in quenching media 12. Remove the job from attachments 13. Perform tempering of job as per requirement. 14. Clean the job and referred them to the next section.				
LU3: Perform pack carburizing	1. Handle the job as per standard 2. Pack the job in carbonaceous material in steel box and seal the boxes by suitable method. 3. Place the steel box in heating furnace. 4. Heat the job for suitable time and temperature.	1. Induction heating principle 2. Explain oxyacetylene flame heating zones 3. Explain cast iron, carbon steel and alloy steel 4. Explain surface hardening 5. Explain the preparation of salt bath		Consumable <ul style="list-style-type: none"> • Quenching bath • Carbonaceous material. Non Consumable <ul style="list-style-type: none"> • Heating furnaces • Long tonge • Insulating gloves 	

	<ol style="list-style-type: none"> 5. Turn off the furnace after standard heat treatment cycle 6. Remove the steel box from furnace, and recover the specimen. 7. Place the job in heat treatment furnace 8. Switch on the furnace 9. Carry out heat treatment cycle for hardening 10. Allow soaking time as per job requirement 11. Quench the job in quenching medium as per requirement 12. Perform tempering of job as per requirement 13. Clean the job and refer to the next section. 				
LU4: Perform Gas Nitriding	<ol style="list-style-type: none"> 1. Energize the furnace as per SOP 2. Set the pressure of 	<ol style="list-style-type: none"> 1. Induction heating principle 2. Explain oxyacetylene flame heating 		Consumable <ul style="list-style-type: none"> • Quenching bath • NH3 gas 	

	<p>feed gas(NH₃,N₂)</p> <ol style="list-style-type: none"> Place the sample in the furnace. Adjust the Ammonia (NH₃) environment in the furnace. Adjust the temperature and soaking time of the furnace. Turn off the furnace after completion of the process Remove the samples from furnace Clean the samples and referred them to the next section. 	<p>zones</p> <ol style="list-style-type: none"> Explain cast iron, carbon steel and alloy steel Explain surface hardening Explain the preparation of salt bath 		<p>cylinder</p> <p>Non Consumable</p> <ul style="list-style-type: none"> Heating furnaces Long tonge Insulating gloves 	
<p>LU5: Perform liquid Nitriding</p>	<ol style="list-style-type: none"> Energize the furnace as per SOP Prepare cyanide salt bath in a suitable container Dip the sample in salt bath with appropriate fixtures Adjust the required 	<ol style="list-style-type: none"> Induction heating principle Explain oxyacetylene flame heating zones Explain cast iron, carbon steel and alloy steel Explain surface hardening Explain the preparation of salt bath 		<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 	

	temperature of the salt bath 5. Allow soaking time as per job requirement 6. Remove the sample from furnace once the temperature reaches to the required range. 7. Immerse the sample in salt bath for a prescribed time. 8. Remove the sample from salt bath, clean it and referred it to the next section.				
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Destructive Testing Technician

Module 1: Perform Hardness Tests

Objective of the module: This module covers the skills and knowledge required to Measure hardness of the specimen by using Brinell Hardness Test, Measure hardness of the specimen by using Rockwell Hardness Test and Measure hardness of the specimen by using Vickers Hardness Test.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
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<p>LU1. Measure hardness of the specimen by using Brinell Hardness Test</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Prepare the surface of standard specimen as per requirement. 2. Inspect the working mode of the Brinell Hardness Testing Machine. 3. Select the indenter and Load as per standard. 4. Place the specimen on anvil with safety precautions. 5. Apply load on the specimen for standard time period. 6. Calculate the Brinell Hardness number with formula or directly 	<ul style="list-style-type: none"> • Define mechanical properties. • Define destructive test. • Define Hardness. • Describe Brinell hardness test procedure • Enlist different limitations of Brinell hardness test. • What is the formula of Brinell hardness number? • What is the standard method of writing Brinell hardness number? 	<p>Total:7hrs</p> <p>Theory:</p> <p>5 hrs</p> <p>Practical:</p> <p>2 hrs</p>	<ul style="list-style-type: none"> • Brinell Hardness Testing Machine • Measuring instruments • Accessories for surface cleaning 	<p>Class room / Workshop</p>
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	note from the gauge according to design of the machine				
LU2. Measure hardness of the specimen by using Rockwell Hardness Test	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Prepare the surface of standard specimen as per requirement. 2. Inspect the working mode of the Rockwell Hardness Testing Machine. 3. Select the Scale of the machine (A, B or C) depending upon the material. 4. Place the specimen on anvil with safety precautions and apply minor load. 5. Apply major load on the specimen 	<ul style="list-style-type: none"> • Enlist different advantages of Rockwell hardness test over Brinell hardness test. • Describe Rockwell hardness test procedure • What is the standard method of writing Rockwell hardness number? • Compare A, B and C Scales of Rockwell hardness test 	<p>Total: 7hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Rockwell Hardness Testing Machine • Measuring instruments • Accessories for surface cleaning 	Class room / Workshop

	<p>according to the scale of the machine.</p> <p>6. Note the Rockwell Hardness number from gauge</p>				
<p>LU3. Measure hardness of the specimen by using Vickers Hardness Test</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Prepare the surface of standard specimen as per requirement. 2. Inspect the working mode of the Vickers Hardness Testing Machine. 3. Select the Load as per standard depending upon the material. 4. Place the specimen on anvil with safety precautions. 	<ul style="list-style-type: none"> • Describe Vickers hardness test procedure. • What are different ways of writing Vickers Hardness number? 	<p>Total 7 hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2hrs</p>	<ul style="list-style-type: none"> • Vickers Hardness Testing Machine • Measuring instruments • Accessories for surface cleaning 	<p>Class room / Workshop</p>

	<p>5. Apply load on the specimen for standard time period.</p> <p>6. Note the Vickers Hardness number from the gauge.</p>				
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Module 2: Perform Impact Tests

Objective of the module: This module covers the skills and knowledge required to Measure toughness of the specimen by using Izod Impact Test and Measure Toughness of the specimen by using Charpy Impact Test.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Measure toughness of the specimen by using Izod Impact Test	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Check the dimensions of Izod specimen with the help of measuring instrument as per ASTM standard. 2. Inspect the working mode of the izod impact testing machine. 3. Adjust the initial position of the hammer. 4. Calculate the 	<ul style="list-style-type: none"> • Define impact load. • Define toughness. • Define potential Energy • Difference of ASTM standard and ISO Standards for Izod impact test specimen • Describe Izod impact test procedure. 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Izod impact testing machine • Measuring devices 	Class room / Workshop

	<p>initial potential energy of the hammer.</p> <p>5. Clamp the standard specimen in the anvil by keeping standard length out of the anvil.</p> <p>6. Drop the hammer to strike it with standard specimen.</p> <p>7. Calculate the final potential energy of the hammer.</p> <p>8. Calculate the toughness of the specimen material by calculating difference of initial and final energy of the hammer</p>				
LU2. Measure Toughness	The trainee will be able to:	<ul style="list-style-type: none"> Difference of ASTM standard and ISO Standards for charpy 	Total:7hrs Theory:	<ul style="list-style-type: none"> Charpy impact testing 	Class room / Workshop

<p>of the specimen by using Charpy Impact Test</p>	<ol style="list-style-type: none"> 1. Check the dimensions of Charpy specimen, received from workshop, with Vernier calliper as per ASTM standard. 2. Inspect the working mode of the charpy impact testing machine. 3. Adjust the initial position of the hammer. 4. Calculate the initial potential energy of the hammer. 5. Clamp the standard specimen in the anvil by keeping standard length out of the anvil. 6. Drop the hammer 	<p>impact test specimen.</p> <ul style="list-style-type: none"> • Describe Charpy impact test procedure 	<p>5 hrs Practical: 2 hrs</p>	<p>machine</p> <ul style="list-style-type: none"> • Measuring devices 	
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	<p>to strike it with standard specimen.</p> <p>7. Calculate the final potential energy of the hammer.</p> <p>8. Calculate the toughness of the specimen material by calculating difference of initial and final energy of the hammer</p>				
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Module 3: Perform Mechanical Testing on Universal Testing Machine

Objective of the module: This module covers the skills and knowledge required to Measure tensile properties of the specimen, Measure Compressive strength of the specimen, Measure the Bending strength of specimen and Measure Shear strength of the specimen.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Measure tensile properties of the specimen	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Inspect the dimensions of standard specimen with the help of measuring instruments. 2. Mark the gauge length points on the specimen. 3. Measure the initial cross sectional area of the specimen. 4. Select the gripping device as per standard specimen. 5. Inspect the functioning condition of the 	<ul style="list-style-type: none"> • Define stress. • Define strain. • Describe types of loads. • Describe the types of stress. • Describe the types of strain. • Describe difference of ferrous and non-ferrous materials. • Describe the yield strength of materials. • Describe Ultimate strength of materials 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Universal Testing Machine • Measuring Instruments 	Class room / Workshop

	<p>gripping device.</p> <p>6. Grip the specimen in gripping device according to standard.</p> <p>7. Attach the extensometer with the specimen if required.</p> <p>8. Apply the load on the specimen up to fracture.</p> <p>9. Note the values of applied load after specific intervals.</p> <p>10. Note the extension produced against the noted applied load.</p> <p>11. Calculate stress and strain from the values of load and extension.</p> <p>12. Sketch stress strain curve.</p> <p>13. Calculate the</p>				
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	required mechanical properties				
LU2: Measure Compressive strength of the specimen	The trainee will be able to: <ol style="list-style-type: none"> 1. Inspect the dimensions of standard specimen with the help of measuring instruments. 2. Calculate the initial cross sectional area of the specimen. 3. Prepare the end surfaces of the specimen. 4. Inspect the working condition of fixtures used for compression. 5. Fix the specimen, between fixtures, in the machine. 	<ul style="list-style-type: none"> • Describe breaking strength of Materials. • Describe the different parts of the UTM. • Describe working of UTM. 	Total:7hrs Theory: 5 hrs Practical: 2 hrs	<ul style="list-style-type: none"> • Universal Testing Machine • Measuring Instruments 	Class room / Workshop

	<ol style="list-style-type: none"> 6. Apply the load on the specimen up to surface failure. 7. Note the value of load at which surface get failure. 8. Calculate compressive stress. 9. Record the results 				
LU 3: Measure the Bending strength of specimen	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Inspect the dimensions of standard specimen with the help of measuring instruments. 2. Inspect the working condition of bend test fixture. 3. Fit the bend test fixture in the 	<ul style="list-style-type: none"> • Describe bending strength. 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<ul style="list-style-type: none"> • Universal Testing Machine • Measuring Instruments 	Class room / Workshop

	<p>machine.</p> <ol style="list-style-type: none"> 4. Adjust the span between two rollers of the fixture according to the length of the specimen. 5. Fit the mandrel in the machine. 6. Place the specimen on the rollers of the fixture. 7. Apply the load on the specimen up to maximum selected bend. 8. Note the bending force. 9. Measure bending strength by using formula. 10. Record the results. 				
LU 4: Measure Shear strength of the specimen	The Trainee will be able to:	<ul style="list-style-type: none"> • Describe shear strength. 		<ul style="list-style-type: none"> • Universal Testing Machine 	

	<ol style="list-style-type: none"> 1. Inspect the dimensions of standard specimen with the help of measuring instruments. 2. Calculate the cross sectional area of the Specimen. 3. Prepare the machine for test. 4. Install the fixture of shear test. 5. Place the sample within the fixture. 6. Apply the load for single shear or double shear test. 7. Set the machine speed according to sample. 8. Note the maximum/breaking force. 			<ul style="list-style-type: none"> • Measuring Instruments 	
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	<p>9. Calculate shear strength.</p> <p>10. Record the results.</p>				
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Module 4: Perform Torsion test and fatigue test

Objective of the module: This module covers the skills and knowledge required to identify and use tools required for cutting and grinding operations.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU 1: Measure torsion strength of specimen	The trainee will be able to: 1. Inspect the Prepared sample according to the requirements of machine and standard. 2. Check the working mode of the machine. 3. Fix the sample in the fixture. 4. Adjust speed, torque angle and time of machine as per material requirement. 5. Draw torque vs	<ul style="list-style-type: none">• Define torque.• Define moment of inertia.• Write torsion equation.• Describe procedure of torsion test.	Total: 7hrs Theory: 5 hrs Practical: 2 hrs	<ul style="list-style-type: none">• Torsion test machine• Measuring Instruments	Class room / Workshop

	angle graph. 6. Calculate torsion strength. 7. Observe fractured surface of the specimen. 8. Record the results				
LU2: Measure fatigue strength of specimen	The trainee will be able to: <ol style="list-style-type: none"> 1. Inspect the Prepared specimen according to standard. 2. Check the working mode of the machine. 3. Grip the samples in fixture. 4. Apply load as per material requirement. 5. Re-zero rotation counter. 6. Turn on the machine and start 	<ul style="list-style-type: none"> • Define Fatigue load. • Define Fatigue Strength. • Describe the procedure of fatigue test 	Total: 7hrs Theory: 5 hrs Practical: 2 hrs	<ul style="list-style-type: none"> • Fatigue test machine • Measuring Instruments 	Class room / Workshop

	<p>the test.</p> <p>7. Observe number of rotation once the material breaks.</p> <p>8. Calculate fatigue strength by using formula.</p>				
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Junior Metallography technician

Module 1: Perform Sectioning, Cutting and Rough Grinding

Objective of the module: The aim of this module to get knowledge, skills and understanding to Perform Sectioning, Cutting and basic Grinding operations for Metallography of Metallic materials. Also, determine Sectioning, Cutting and basic grinding requirements, Check the operations of equipment, Perform visual inspection to finish operations.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform labeling, and marking	<p>The trainee will be able to:</p> <p>8. Label the identification</p>	<p>1. Define purpose of labeling and documentation.</p> <p>2. Record keeping of samples.</p> <p>3. ID marking of samples.</p>	<p>Total:7hrs</p> <p>Theory: 5 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> Permanent Marker Packing 	Class room

	<p>number to recognize specimen identity.</p> <p>9. Perform proper documentation with date & time in logbook.</p> <p>10. Record the initial conditions of Specimen.</p> <p>11. Use the measuring tool for marking.</p> <p>12. Mark the cutting area with permanent marker, to be sectioned or cut.</p>	<p>4. Tracking of samples.</p>	<p>Practical:</p> <p>2 hrs</p>	<p>Tapes</p> <ul style="list-style-type: none"> • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • White board • Multimedia • Internet • Computer system • Marking Tools • Measuring Tools • Marking punch 	
<p>LU2: Perform Sectioning & Cutting Operation</p>	<p>The trainee will be able to:</p> <p>10. Adopt standard safety practice and procedure for handling sectioning operation.</p>	<ol style="list-style-type: none"> 1. Explain sectioning techniques 2. Define fine and rough grinding. 3. Define cutting materials 4. The sectioning operation can be obtained by abrasive cutting (metals and metal matrix composites), diamond wafer 	<p>Total:</p> <p>7hrs</p> <p>Theory:</p> <p>5hrs</p> <p>Practical:</p> <p>2 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Cutting materials. • Notebooks • Pencils • Erasers 	

	<p>11. Grip the specimen area of interest, which will be easier in handling during grinding and polishing.</p> <p>12. Select of the abrasive blade depend upon material type.</p> <p>13. Identify proper cutting requirement and the correct selection of abrasive type, bonding, and size; as well as proper cutting speed, load and coolant.</p>	cutting (ceramics, electronics, biomaterials, minerals), or thin sectioning with a microtome (plastics).		<ul style="list-style-type: none"> Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> Cutting machine Cutting tools White board PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
LU3:Perform Rough Grinding Operation	<p>The trainee will be able to:</p> <p>9. Adopt standard safety practice and procedure for handling rough</p>	<ol style="list-style-type: none"> Explain sectioning techniques Define fine and rough grinding. Define grinding materials The grinding operation can 	<p>Total 7 hrs</p> <p>Theory: 5hrs</p> <p>Practical:</p>	<p>Consumable</p> <ul style="list-style-type: none"> Grinding papers and cloths. Notebooks Pencils 	

	<p>grinding operation.</p> <p>10. Select of the abrasive blade depend upon material type.</p> <p>11. Grip the specimen in hands then place on abrasive wheel.</p> <p>12. Remove the sharp edges and corner of specimen.</p>	<p>be obtained by abrasive (metals and metal matrix composites), diamond wafer cutting (ceramics, electronics, biomaterials, minerals), or thin sectioning with a microtome (plastics).</p>	2hrs	<ul style="list-style-type: none"> • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • White board • Safety manuals • Mounting Cups • Wooden Sticks • Mixing jars • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
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Module 2: Perform Mounting Operation

Objective of the module: The aim of this module to get knowledge, skills and understanding to Perform Mounting operations for Metallography of Metallic materials. Also determine Mounting requirements, Check the operations of equipment.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU2:Determining of Mounting Operation	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Identify the mounting method as per requirement of metallographic standards. <ul style="list-style-type: none"> • Cold Mounting. • Hot Mounting. 2. Adopt standard safety practice and procedure for handling 	<ol style="list-style-type: none"> 1. Define purpose of Mounting. 2. Define types of mounting materials 3. Identification and selection of mounting method as per sample size and type. 	<p>Total: 7hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Mounting raw materials. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Mounting machine • Mounting tools • White board • PPEs (Safety glasses, Ear muffs/ear 	

				plugs, Protective Gloves, Cap, Safety shoes etc.)	
LU3: Perform Cold Mounting Operation	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Select the specimen side or face, which will be study. 2. Place that side toward bottom of the mounting cup. 3. Prepare the castable mounting material by mixing material A and B. 4. Make past of mounting material by proper mixing. 5. Lubricate the 	<ol style="list-style-type: none"> 1. Define purpose of Mounting. 2. Define types of mounting materials 3. Identification and selection of mounting method as per sample size and type. 4. Explain cold mounting techniques 	<p>Total 7 hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Epoxy Resin • Hardener • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • White board • Safety manuals • Mounting Cups • Wooden Sticks • Mixing jars • PPEs (Safety glasses, Ear muffs/ear 	

	<p>mounting cup by oil.</p> <p>6. Pour the mixture in mounting cup and leave it for settling.</p> <p>7. Remove the mounted specimen and ready for next step of metallography.</p>			<p>plugs,</p> <p>Protective Gloves, Cap, Safety shoes etc.)</p>	
LU4: Perform Hot Mounting Operation	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Switch on the hot mounting machine. 2. Select the area or side of specimen to be mounted. 3. Place that side toward bottom of the mounting die. 4. Measure the mounting material 	<ol style="list-style-type: none"> 1. Define purpose of Mounting. 2. Define types of mounting materials 3. Identification and selection of mounting method as per sample size and type. 4. Explain Hot mounting techniques 	<p>Total:</p> <p>9hrs</p> <p>Theory:</p> <p>5 hrs</p> <p>Practical:</p> <p>4 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Mounting raw Materials • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Hot mounting machine 	

	<p>according to standard requirement.</p> <p>5. Transfer the mounting material into the mounting die.</p> <p>6. Select the mounting load according to standard and apply.</p> <p>7. Adjust the mounting temperature as per standard.</p> <p>8. Select the time for mounting.</p> <p>9. Remove the specimen from die and ready for next step.</p>		<ul style="list-style-type: none"> • White board • Mounting Cups • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
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Modules

Module 3: Perform Fine Grinding Operation

Objective of the module: The aim of this module to get knowledge, skills and understanding to Perform Fine Grinding Operation operations for Metallography of Metallic materials. Also determine Fine Grinding Operation requirements, Check the operations of equipment.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform Fine Grinding on Handy Met	<p>The trainee will be able to:</p> <p>13. Adopt standard safety practice and procedure for handling.</p> <p>14. Select the set of emery or abrasive paper according to their grit size.</p> <p>15. Start grinding on paper from 60 to 1200 grit size.</p>	<ol style="list-style-type: none"> 1. Explain Fine grinding techniques. 2. Define fine grinding. 3. Define fine grinding materials. 4. Explain lubrication in fine grinding. 5. Define General grit size ranges. 6. The grinding operation can be obtained by abrasive (metals and metal matrix composites), diamond wafer 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Grit papers. • Emery papers. • Lubricating oils. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p>	Class room

	<p>16. Use water during grinding operation.</p> <p>17. Rotate the specimen at 90 degree after short intervals in manual operation and continuously ground until the scratches from previous grinding direction are removed.</p> <p>18. Replace paper on requirement.</p>	cutting (ceramics, electronics, biomaterials, minerals), or thin sectioning with a microtome (plastics).		<ul style="list-style-type: none"> • Handy Met • Grinding wheel. • White board • Multimedia • Marking Tools • Measuring Tools • Marking punch • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
LU2: Perform Grinding on semi/ fully automatic machine	<p>The trainee will be able to:</p> <p>1. Identify grinding material specifications</p>	<ol style="list-style-type: none"> 1. Explain Fine grinding techniques. 2. Define fine grinding. 3. Define fine grinding materials. 4. Explain lubrication in fine 	<p>Total: 7hrs</p> <p>Theory: 5hrs</p> <p>Practical:</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Grinding papers. • Lubricating oils. • Notebooks 	

	<p>(Grit number) according to metallographic standard and type of specimen.</p> <p>2. Adopt standard safety practice and procedure for handling.</p> <p>3. Attach or past the abrasive paper on grinding wheel of grinding machine. Grinding step is accomplished by decreasing the abrasive grit size (60 to 1200).</p> <p>4. Open tape water to lubricating the grinding</p>	<p>grinding.</p> <p>5. Define General grit size ranges.</p> <p>6. The grinding operation can be obtained by abrasive (metals and metal matrix composites), diamond wafer cutting (ceramics, electronics, biomaterials, minerals), or thin sectioning with a microtome (plastics).</p>	2 hrs	<ul style="list-style-type: none"> • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • grinding machine • Cutting tools • White board • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
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	<p>operation.</p> <p>5. Rotate the specimen at 90 degree after short intervals in manual operation and continuously ground until the scratches from previous grinding direction are removed.</p> <p>6. Thoroughly clean the specimen between each abrasive grit size in automated operation.</p> <p>7. Change the abrasive paper if necessary.</p>				
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Modules

Module 4: Perform Fine Polishing Operation

Objective of the module: The aim of this module to get knowledge, skills and understanding to Perform Fine Polishing operations for Metallography of Metallic materials. Also determine Fine Grinding Operation requirements, Check the operations of equipment.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform Polishing Operation Manually	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Identify polishing material specifications (micron number) according to metallographic standard and type of specimen. 2. Adopt standard safety practice and procedure for handling. 	<ol style="list-style-type: none"> 1. Explain Fine polishing techniques. 2. Define fine polishing. 3. Define fine polishing materials. 4. Explain lubrication in fine polishing. 5. Define General grit size ranges. 6. The polishing operation can be obtained by using (different grit size numbers) abrasive diamond pastes 	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Diamond pates. • Polishing cloths. • Lubricating oils. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Polishing 	Class room

	<p>3. Attach napped polishing cloth on wheel of machine.</p> <p>4. Carry out polishing by decreasing down the abrasive micron number (09 to 01).</p> <p>5. Lubricate the grinding operation with special oil.</p> <p>6. Rotate the specimen at 90 degree after short intervals in manual operation and continuously ground until the scratches from previous polishing direction are removed.</p> <p>7. Change the abrasive cloth if required.</p>			<p>machine</p> <ul style="list-style-type: none"> • Polishing wheel. • White board • Multimedia • Marking Tools • Measuring Tools • Marking punch • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
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LU2: Perform Grinding on semi/ fully automatic machine	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Identify grinding material specifications (Grit number) according to metallographic standard and type of specimen. 2. Adopt standard safety practice and procedure for handling. 3. Attach or past the abrasive paper on grinding wheel of grinding machine. Grinding step is accomplished by decreasing the abrasive grit size (60 to 	<ol style="list-style-type: none"> 1. Explain Fine grinding techniques. 2. Define fine grinding. 3. Define fine grinding materials. 4. Explain lubrication in fine grinding. 5. Define General grit size ranges. 6. The grinding operation can be obtained by abrasive (metals and metal matrix composites), diamond wafer cutting (ceramics, electronics, biomaterials, minerals), or thin sectioning with a microtome (plastics). 	<p>Total: 7hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Diamond pates. • Polishing cloths. • Lubricating oils. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Polishing machine • Polishing wheel. • White board • Multimedia • Marking Tools • Measuring Tools • Marking punch • PPEs 	
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	<p>1200).</p> <p>4. Open tape water to lubricating the grinding operation.</p> <p>5. Rotate the specimen at 90 degree after short intervals in manual operation and continuously ground until the scratches from previous grinding direction are removed.</p> <p>6. Thoroughly clean the specimen between each abrasive grit size in automated</p>			<p>(Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.)</p>	
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	operation.				
	7. Change the abrasive paper if necessary.				

Junior Surface Coating Technician

Module 1: Perform Galvanizing Coating

Objective of the module: The aim of this module to get knowledge, skills and understanding to perform galvanizing of steel materials and observing operational sequence and parameters.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform Cataloging	<p>The trainee will be able to:</p> <p>19. Perform documentation of the initial conditions of Specimen and recognize its identity.</p> <p>20. Adopt standard safety practice and procedure for</p>	<p>Define purpose of labeling and documentation.</p> <p>Record keeping of samples.</p> <p>ID marking of samples.</p> <p>Tracking of samples.</p> <p>Why drying and quenching techniques does performed.</p> <p>Define coating thickness ranges</p> <p>Define cleaning types.</p> <p>Explain galvanizing time and temperatures.</p> <p>Define galvanizing of metals specimen.</p>	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Marker • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • White board • Multimedia 	Class room

	<p>handling.</p> <p>21. Prepare job layout according to process requirements</p>	Explain cleaning steps.			
LU2: Perform Cleaning Operation	<p>The trainee will be able to:</p> <p>14. Carry out cleaning process as per standard requirement.</p> <p>15. Adopt standard safety practice and procedure for chemical handling.</p> <p>16. Select the specimen side/face for coating</p> <p>17. Prepare caustic cleaning solution for treatment with a hot alkali solution to remove dirt and oil.</p> <p>18. Place specimen in</p>	<p>1. Define cleaning types.</p> <p>2. Explain cleaning steps.</p> <p>3. Types of Chemical for cleaning of dirt.</p>	<p>Total:</p> <p>7hrs</p> <p>Theory:</p> <p>5hrs</p> <p>Practical:</p> <p>2 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Cleaning Chemical. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Glass wares. • Cleaning baths. • Cleaning Tools. • Measuring tools. • White board • PPEs (Safety glasses, Ear muffs/ear plugs, 	

	<p>the solution for standard time then remove and rinsing with water.</p> <p>19. Prepare pickling cleaning solution where the surface rust and scales are removed by using a hydrochloric acid solution.</p> <p>20. Place specimen in the solution for specific time then remove and rinsing with water.</p> <p>21. Prepare flux solution where the surface oxides are removed and protected from further oxidation risks.</p> <p>22. Place specimen in the solution for specific time.</p>			<p>Protective Gloves, Cap, Safety shoes etc.)</p>	
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	23. Remove the specimen from bath and ready for next step.				
LU3: Perform Drying Operation	<p>The trainee will be able to:</p> <p>13. Place the specimen on the drying holders or fixtures.</p> <p>14. Arrange specimen in sequence with all safety factors</p> <p>15. Use hot air blower for drying the specimen.</p>	1. Why drying techniques does performed.	<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"> • Dry/Hot Air • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Hot air system • White board • Multimedia • Safety manuals • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	

LU4: Perform Galvanize coating Operation	<p>The trainee will be able to:</p> <p>10. Identify galvanizing material specifications (Zn or Al %) according to standard and type of galvanizing coating on specimen.</p> <p>11. Adopt standard safety practice and procedure for handling process.</p> <p>12. Prepare molten metal bath to react specimen surface with molten material.</p> <p>13. Place specimen in the bath for given time</p> <p>14. Remove specimen from bath and detract the excess coating material</p>	<ol style="list-style-type: none"> 1. Define purpose of galvanizing. 2. Describe safety symbols for acid chemical. 3. Define General coating thickness ranges 4. Define galvanizing materials. 5. Define galvanizing of metals specimen. 	<p>Total: 9hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 4 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Galvanizing raw materials • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Galvanizing bath. • Thermocouple • Air system • White board • Holders 	
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	through pressurized air.				
LU6: Perform Quenching Operation	The trainee will be able to: <ol style="list-style-type: none"> 1. Identify quenching material specifications according to standard and type of galvanizing coating on specimen. 2. Adopt standard safety practice and procedure for handling process. 3. Prepare mild sodium dichromate solution in the 	<ol style="list-style-type: none"> 1. Explain quenching techniques 2. Explain quenching steps. 		Consumable <ul style="list-style-type: none"> • Raw quenching materials • Notebooks • Pencils • Erasers • Sharpeners Non Consumable <ul style="list-style-type: none"> • Quenching bath. • Thermocouple • Air system • White board • Holders 	

	<p>bath to prevent the onset of wet storage staining during the early life of galvanizing.</p> <p>4. Place specimen in the bath for given time then remove.</p>				
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Module 2: Perform Conversion Coating (Anodizing)

Objective of the module: The aim of this module to get knowledge, skills and understanding to perform Conversion Coatings of Metallic materials and observing operational sequence and parameters.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform Cataloging	<p>The trainee will be able to:</p> <p>22. Perform documentation of the initial conditions of Specimen and recognize its identity.</p> <p>23. Adopt standard safety practice and procedure for handling.</p> <p>24. Prepare job layout according to process requirements</p>	<p>Define purpose of labeling and documentation.</p> <p>Record keeping of samples.</p> <p>ID marking of samples.</p> <p>Tracking of samples.</p> <p>Why drying and quenching techniques does performed.</p> <p>Define coating thickness ranges</p> <p>Define cleaning types.</p> <p>Explain Anodizing time and temperatures.</p> <p>Define Anodizing of metals specimen.</p> <p>Explain cleaning steps.</p>	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Marker • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • White board • Multimedia 	Class room
LU2: Perform Cleaning Operation	<p>The trainee will be able to:</p> <p>1. Identify the</p>	<p>4. Define cleaning types.</p> <p>5. Explain cleaning steps.</p>	<p>Total: 7hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Cleaning 	

	<p>cleaning process as per requirement of standards.</p> <ol style="list-style-type: none"> 2. Adopt standard safety practice and procedure for chemical handling. 3. Select the specimen side or face, which will be coating. 4. Prepare degreasing cleaning solution where steel is treated with spirit solution which removes common dirt and oils. 5. Place specimen in the solution for 	<p>6. Types of Chemical for cleaning of dirt.</p>	<p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>	<p>Chemical.</p> <ul style="list-style-type: none"> • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Glass wares. • Cleaning baths. • Cleaning Tools. • Measuring tools. • White board • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
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	<p>specific time then remove and rinsing with water.</p> <p>6. Prepare chemical cleaning solution where the surface rust and scales are removed by using alkaline solution.</p> <p>7. Place specimen in the solution for specific time then remove and rinsing with water.</p> <p>8. Prepare nitric acid solution where the surface oxides are removed.</p> <p>9. Place</p>				
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	specimen in the solution for specific time. 10. Remove the specimen from bath and ready for next step.				
LU3: Set up Coating bath	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Add prepared solution in the bath. 2. Adopt standard safety practice and procedure for handling process. 3. Place the lead sheets or plates on the opposite sides of bath. (Act as cathodes) 4. Connect the both lead plates to electric supply. 5. Place Ti rod or wood coiled with Al 	<ol style="list-style-type: none"> 1. Describe safety symbols for acid chemical. 2. Define General coating thickness ranges 3. Define anodizing materials. 	<p>Total 7 hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Raw Chemicals. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Hot air system • Holders • Current system • White board • Safety manuals • PPEs (Safety glasses, Ear muffs/ear plugs, 	

	<p>wire in the middle of bath. (Act as Anode)</p> <p>6. Connect the bar to electric supply.</p> <p>7. Arrange them in sequence and order don't touch each other.</p> <p>8. Hang the specimen with wire to anode.</p>			Protective Gloves, Cap, Safety shoes etc.)	
LU4: Perform Coating Operation	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Identify anodizing specifications. 2. Adopt standard safety practice and procedure for handling process. 3. Switch on rectifier and adjust required current density. 	<ol style="list-style-type: none"> 6. Define purpose of Anodizing. 7. Describe safety symbols for acid chemical. 8. Define General coating thickness ranges 9. Define Anodizing materials. 10. Define Anodizing of metals specimen. 	<p>Total: 9hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 4 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Galvanizing raw materials • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Galvanizing bath. • Thermocouple • Air system • White board • Holders 	

	<ol style="list-style-type: none"> 4. Allow coating deposition for specific time. 5. Agitate the bath with air bubbles system. 6. Bath temperature should be maintain from 20-25C. 7. Switch off rectifier and remove specimen. 				
LU6: Perform Drying Operation	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Place specimen in the drying oven. 2. Set temperature the switch on oven. 	<ol style="list-style-type: none"> 1. Explain Drying techniques 2. Explain Drying steps. 		<p>Consumable</p> <ul style="list-style-type: none"> • Elements • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Heating Furnace • Thermocouple 	

	3. Remove specimen after specific time for drying.			<ul style="list-style-type: none"> • Air system • White board • Holders 	
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Module 3: Perform Electrochemical Coating (Electroplating)

Objective of the module: The aim of this module to get knowledge, skills and understanding to perform Electrochemical Coatings of steel materials and observing operational sequence and parameters.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform Cataloging	<p>The trainee will be able to:</p> <p>25. Perform documentation of the initial conditions of Specimen and recognize its identity.</p> <p>26. Adopt standard safety practice and procedure for handling.</p> <p>27. Prepare job layout according to process requirements</p>	<p>Define purpose of labeling and documentation.</p> <p>Record keeping of samples.</p> <p>ID marking of samples.</p> <p>Tracking of samples.</p> <p>Why drying and quenching techniques does performed.</p> <p>Define coating thickness ranges</p> <p>Define cleaning types.</p> <p>Explain Anodizing time and temperatures.</p> <p>Define Anodizing of metals specimen.</p> <p>Explain cleaning steps.</p>	<p>Total:7hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 2 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Marker • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • White board • Multimedia 	Class room
LU2: Perform Polishing Operation	<p>The trainee will be able to:</p> <p>1. Adopt standard safety practice and procedure</p>	<p>7. Define Polishing types.</p> <p>8. Explain Polishing steps.</p> <p>9. Types of grits for Polishing.</p>	<p>Total: 7hrs</p> <p>Theory: 5hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Abrasives. • water • Notebooks 	

	<p>for handling.</p> <ol style="list-style-type: none"> 2. Select of the abrasive blade depend upon material type. 3. Gripe the specimen in hands then place on abrasive wheel. 4. Remove the sharp edges and corner of specimen. 5. Select the set of emery or abrasive paper according to their grit size. 6. Start grinding on paper from 60 to 1200 grit size. 7. Use water during grinding operation. 		<p>Practical:</p> <p>2 hrs</p>	<ul style="list-style-type: none"> • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Grinding and polishing machines and Tools. • Cleaning Tools. • Measuring tools. • White board • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
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	<p>8. Rotate the specimen at 90 degree after short intervals in manual operation and continuously ground until the scratches from previous grinding direction are removed.</p> <p>9. Replace paper on requirement.</p>				
LU3: Perform Cleaning Operation	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Identify the Cleaning process as per requirement of standards. 2. Adopt standard safety practice and procedure for chemical 	<ol style="list-style-type: none"> 1. Define cleaning types. 2. Explain cleaning steps. 3. Types of Chemical for cleaning of dirt. 	<p>Total 7 hrs</p> <p>Theory: 5hrs</p> <p>Practical: 2hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Raw Chemicals. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Hot air system • Holders • Current 	

	<p>handling.</p> <p>3. Select the specimen side or face, which will be coating.</p> <p>4. Prepare degreasing cleaning solution where steel is treated with solution which removes common dirt and oils.</p> <p>5. Place specimen in the solution for specific time then remove and rinsing with water.</p> <p>6. Prepare pickling solution where the surface rust and scales are removed by</p>			<p>system</p> <ul style="list-style-type: none"> • White board • Safety manuals • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
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	<p>using alkaline or acidic solution.</p> <p>7. Place specimen in the solution for specific time then remove and rinsing with water.</p> <p>8. Remove the specimen from bath and ready for next step.</p>				
LU4: Perform Solution Preparation	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Take glass beaker or polythene tank. 2. Adopt standard safety practice and procedure for handling chemical process. 3. Filled half with distil or 	<ol style="list-style-type: none"> 1. Define electrolyte materials. 2. Explain electroplating time and temperatures. 	<p>Total: 9hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 4 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Cleaning Chemical. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Glass wares. • Coating baths. • Cleaning Tools. 	

	<p>deionized water.</p> <p>4. Add acid and metal salts into solution then mix it slowly and stir it.</p>			<ul style="list-style-type: none"> • Measuring tools. • White board • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
LU5: Set up Coating bath	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Add prepared solution in the bath of S.S. 2. Adopt standard safety practice and procedure for handling process. 3. Alternatively Arrange the Cu rods for anode and cathode system setup 	<ol style="list-style-type: none"> 1. Define purpose of Electroplating. 2. Describe safety symbols for acid chemical. 3. Define electrolyte materials. 4. Explain electroplating time and temperatures. 		<p>Consumable</p> <ul style="list-style-type: none"> • Raw Chemicals. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Hot air system • Holders • Current system • White board • Safety manuals 	

	<p>and insulate it.</p> <ol style="list-style-type: none"> 4. Hang the anode sheets or plates with hooks on anode bar of bath. (Act as Anodes) 5. Connect the plates to electric supply. 6. Hang the cathode specimen with hooks on cathode bar of bath. (Act as cathode) 7. Connect the bar to electric supply. 8. Arrange them in sequence and order don't touch each other. 			<ul style="list-style-type: none"> • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
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LU6: Perform Coating Operation	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Identify electroplating specifications. 2. Adopt standard safety practice and procedure for handling process. 3. Switch on rectifier and adjust required current density. 4. Allow coating deposition for specific time. 5. Bath temperature should be maintain from 20-25C. 6. Switch off rectifier and remove specimen. 	<ol style="list-style-type: none"> 1. Define purpose of Electroplating. 2. Define General coating thickness ranges 3. Define electrolyte materials. 4. Explain electroplating time and temperatures. 		<p>Consumable</p> <ul style="list-style-type: none"> • Raw Chemicals. • PH papers. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Hot air system • Holders • Current system • PH Meter. • White board • Safety manuals • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
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	7. Maintain the PH value of electrolyte as per requirement				
LU6:Perform Drying Operation	The trainee will be able to: <ol style="list-style-type: none"> 1. Place specimen in the drying oven. 2. Set temperature the switch on oven. 3. Remove specimen after specific time for drying. 	<ol style="list-style-type: none"> 1. Explain Drying techniques 2. Explain Drying steps. 		Consumable <ul style="list-style-type: none"> • Elements • Notebooks • Pencils • Erasers • Sharpeners Non Consumable <ul style="list-style-type: none"> • Heating Furnace • Thermocouple • Air system • White board • Holders 	

Module 4: Perform Electrochemical Coating (Electrolysis Electroplating)

Objective of the module: The aim of this module to get knowledge, skills and understanding to perform electrolysis electroplating of steel materials and observing operational sequence and parameters.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform Cataloging	The trainee will be able to: 1. Perform documentation of the initial conditions of	Define purpose of labeling and documentation. Record keeping of samples. ID marking of samples. Tracking of samples. Why drying and quenching techniques	Total: 7hrs Theory: 5 hrs Practical: 2 hrs	Consumable <ul style="list-style-type: none">• Marker• Notebooks• Pencils• Erasers• Sharpeners	Class room

	<p>Specimen and recognize its identity.</p> <p>2. Adopt standard safety practice and procedure for handling.</p> <p>3. Prepare job layout according to process requirements</p>	<p>does performed.</p> <p>Define coating thickness ranges</p> <p>Define cleaning types.</p> <p>Explain Anodizing time and temperatures.</p> <p>Define Anodizing of metals specimen.</p> <p>Explain cleaning steps.</p>		<p>Non Consumable</p> <ul style="list-style-type: none"> • White board • Multimedia 	
LU2: Perform Polishing Operation	<p>The trainee will be able to:</p> <p>1. Adopt standard safety practice and procedure for handling.</p> <p>2. Select abrasive blade depend upon material type.</p> <p>3. Gripe the specimen in hands then place on abrasive wheel.</p>	<p>1. Define Polishing types.</p> <p>2. Explain Polishing steps.</p> <p>3. Types of grits for Polishing.</p>	<p>Total:</p> <p>7hrs</p> <p>Theory:</p> <p>5hrs</p> <p>Practical:</p> <p>2 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Abrasives. • water • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Grinding and polishing machines and Tools. • Cleaning Tools. • Measuring 	

	<ol style="list-style-type: none"> 4. Remove the sharp edges and corner of specimen. 5. Select the set of emery or abrasive paper according to their grit size. 6. Start grinding on paper from 60 to 1200 grit size. 7. Use water during grinding operation. 8. Rotate the specimen at 90 degree after short intervals in manual operation and continuously ground until the scratches from previous 			<p>tools.</p> <ul style="list-style-type: none"> • White board • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
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	<p>grinding direction are removed.</p> <p>9. Replace paper on requirement.</p>				
LU3: Perform Cleaning Operation	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Identify the Cleaning process as per requirement of standards. 2. Adopt standard safety practice and procedure for chemical handling. 3. Select the specimen side or face, which will be coating. 4. Prepare degreasing cleaning solution where 	<ol style="list-style-type: none"> 4. Define cleaning types. 5. Explain cleaning steps. 6. Types of Chemical for cleaning of dirt. 	<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"> • Cleaning Chemicals. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Hot air system • Holders • Current system • White board • Safety manuals • PPEs (Safety glasses, Ear muffs/ear plugs, Protective 	

	<p>steel is treated with solution which removes common dirt and oils.</p> <p>5. Place specimen in the solution for specific time then remove and rinsing with water.</p> <p>6. Prepare pickling solution where the surface rust and scales are removed by using alkaline or acidic solution.</p> <p>7. Place specimen in the solution for specific time then remove</p>			<p>Gloves, Cap, Safety shoes etc.)</p>	
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	<p>and rinsing with water.</p> <p>8. Remove the specimen from bath and ready for next step.</p>				
LU4: Perform Solution Preparation	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Take glass beaker or polythene tank. 2. Adopt standard safety practice and procedure for handling chemical process. 3. Filled half with distil or deionized water. 4. Add reducing agent and metal salts into solution then mix it slowly 	<ol style="list-style-type: none"> 3. Define electrolyte materials. 4. Explain electroplating time and temperatures. 	<p>Total: 9hrs</p> <p>Theory: 5 hrs</p> <p>Practical: 4 hrs</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Chemical. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Glass wares. • Coating baths. • Cleaning Tools. • Measuring tools. • White board • PPEs (Safety glasses, Ear muffs/ear plugs, Protective 	

	<p>and stir it.</p> <p>5. Component act as catalyst.</p> <p>6. Add prepared solution in the bath of S.S or glass beaker.</p>			Gloves, Cap, Safety shoes etc.)	
LU5: Perform Coating Operation	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Identify Electroless electroplating specifications. 2. Adopt standard safety practice and procedure for handling process. 3. Hang specimen with Cu/Al wire then immerse in the bath. 4. Use burner or hot plate for heat up 	<ol style="list-style-type: none"> 5. Define purpose of Electrolysis. 6. Describe safety symbols for acid chemical. 7. Define electrolyte materials. 8. Explain Electrolysis time and temperatures. 		<p>Consumable</p> <ul style="list-style-type: none"> • Raw Chemicals. • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Bath system • Holders • Current system • White board • Safety manuals • PPEs (Safety glasses, Ear muffs/ear plugs, 	

	<p>solution.</p> <p>5. Bath temperature should be maintain from 80-85C.</p> <p>6. Allow coating deposition for specific time.</p> <p>7. Maintain the PH value of electrolyte as per requirement.</p>			Protective Gloves, Cap, Safety shoes etc.)	
LU6:Perform Drying Operation	<p>The trainee will be able to:</p> <p>4. Place specimen in the drying oven.</p> <p>5. Set temperature the switch on oven.</p> <p>6. Remove specimen after</p>	<p>3. Explain Drying techniques</p> <p>4. Explain Drying steps.</p>		<p>Consumable</p> <ul style="list-style-type: none"> • Elements • Notebooks • Pencils • Erasers • Sharpeners <p>Non Consumable</p> <ul style="list-style-type: none"> • Heating Furnace • Thermocouple • Air system • White board 	

	specific time for drying.			<ul style="list-style-type: none"> • Holders 	
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Metal Forming Technician

Module 01: Perform rolling process

Objective of the module: The aim of this module to covers the the the skills and knowledge required to Perform Cold and Hot rolling process as per given requirement.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Perform Cold rolling process as per given requirement	The trainee will be able to: <ol style="list-style-type: none"> 1. Ensure occupation health safety and environment standards as per requirement 2. Prepare the metal stock. 	<ol style="list-style-type: none"> 1. Define metal forming process 2. Describe types of metal forming processes (bulk deformation and sheet metalworking) 3. Explain types of sheet metalworking (bending, deep or cup drawing, shearing processes and miscellaneous processes) 4. Explain types of rolling process 5. Describe material behavior in 	Total: 7hrs Theory: 5 hrs Practical: 2 hrs	<ol style="list-style-type: none"> 1. Raw Material 2. Measuring Tools 3. Two-High Rolling Mills 4. Three-High Rolling Mills 5. Reheating Furnaces 	Class room Manufacturing Lab

	<ol style="list-style-type: none"> 3. Check the Property of stock. 4. Check the Property of Materials 5. Measure the stock dimensions. 6. Select the Open dies according to requirement. 7. Preheat the stock for hot forging operation. 8. Apply the forced multiple times to get desired shape 9. Perform Finishing operations 	<p>metal forming processes</p> <ol style="list-style-type: none"> 6. Explain temperature in metal forming 7. Explain strain rate sensitivity 8. Explain friction and lubrication in metal forming 9. Describe Basic safety practices regarding rolling process 10. Cold Rolling and Hot rolling process <p>Practical Activities:</p> <p>Perform cold rolling with two rolling mill.</p>			
LU2. Perform Hot rolling process as per given requirement	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Ensure occupation health safety and environment 	<ol style="list-style-type: none"> 1. Define metal forming process 2. Describe types of metal forming processes (bulk deformation and sheet metalworking) 3. Explain types of sheet metalworking (bending, deep or 	<p>Total:</p> <p>7hrs</p> <p>Theory:</p> <p>5hrs</p> <p>Practical:</p>	<p>Consumable</p> <ul style="list-style-type: none"> • Notebooks • Pencils • Erasers • Sharpeners <p>Non</p>	<p>Class room</p> <p>Manufacturing Lab</p>

	<p>standards as per requirement</p> <ol style="list-style-type: none"> 2. Check the Property of Materials 3. Measured the stock dimensions. 4. Select the open and closed dies according to Shape requirement. 5. Preheat the stock for hot forging operation. 6. Apply force through moveable die to get desired shape 7. Perform Finishing operations. 	<p>cup drawing, shearing processes and miscellaneous processes)</p> <ol style="list-style-type: none"> 4. Explain types of rolling process 5. Describe material behavior in metal forming processes 6. Explain temperature in metal forming 7. Explain strain rate sensitivity 8. Explain friction and lubrication in metal forming 9. Describe Basic safety practices regarding rolling process 10. Cold Rolling and Hot rolling process <p>Practical Activities:</p> <p>Perform hot rolling with two rolling mill.</p>	2 hrs	<p>Consumable</p> <ul style="list-style-type: none"> • White board • Multimedia • Internet • Computer system • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
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Module 02: Perform forging process

Objective of the module: The aim of this module to covers the the the skills and knowledge required to Perform Cold and Hot rolling process as per given requirement.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Perform Open Die Forging (Cold, Hot)	The trainee will be able to: <ol style="list-style-type: none"> 1. Ensure occupation health safety and environment standards as per requirement 2. Prepare the metal stock. 3. Check the Property of stock. 4. Check the Property of Materials 5. Measure the stock dimensions. 	<ol style="list-style-type: none"> 1. Define metal forming process 2. Hot Forging and Cold Forging 3. Types of open dies and closed dies 4. Types of dies 5. Types of Molds 6. Difference between Molds and dies 7. Preheating Furnaces 8. Tpes of presses <p>Practical Activities:</p> <p>Perform Open Die Forging (Cold, Hot)</p>	Total: 7hrs Theory: 5 hrs Practical: 2 hrs	<ol style="list-style-type: none"> 1. Raw Materials/slabs/ ingot 2. Measuring Tools 3. Open Dies 4. Closed Dies 5. Presses 6. Reheating Furnaces 	Class room Manufacturing Lab

	<ol style="list-style-type: none"> 6. Select the Open dies according to requirement. 7. Preheat the stock for hot forging operation. 8. Apply the forced multiple times to get desired shape 9. Perform Finishing operations. 				
LU2. Perform closed/impression die Forging(Cold, Hot)	The trainee will be able to: <ol style="list-style-type: none"> 1. Ensure occupation health safety and environment standards as per requirement 2. Prepare the metal stock. 3. Check the Property of stock. 4. Check the Property of Materials 	<ol style="list-style-type: none"> 1. Define metal forming process 2. Hot Forging and Cold Forging 3. Types of open dies and closed dies 4. Types of dies 5. Types of Molds 6. Difference between Molds and dies 7. Effects on materials due to open and close die forging. <p>Practical Activities:</p> <p>Perform closed/impression die Forging(Cold, Hot)</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"> • Raw Materials/slabs/ ingot • Measuring Tools • Open Dies • Closed Dies • Presses • Reheating Furnaces • shoes etc.) 	<p>Class room</p> <p>Manufacturing Lab</p>

	<ol style="list-style-type: none"> 5. Measure the stock dimensions. 6. Select the Open dies according to requirement. 7. Preheat the stock for hot forging operation. 8. Apply the forced multiple times to get desired shape 9. Perform Finishing operations. 				
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Module 03: Perform extrusion process

Objective of the module: The aim of this module to covers the the the **skills and knowledge required to Perform Hot and cold extrusion.**

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Perform Cold Extrusion	The trainee will be able to: <ol style="list-style-type: none"> 1. Ensure 	<ol style="list-style-type: none"> 1. Define metal forming process 2. Describe types of metal forming processes (bulk deformation 	Total: 7hrs Theory:	<ol style="list-style-type: none"> 1. Measuring Tools 2. Raw 	Class room Manufacturing Lab

	<p>occupation health safety and environment standards as per requirement</p> <ol style="list-style-type: none"> 2. Prepare the metal blanks. 3. Check the property of Blank. 4. Select the suitable die according to your Requirements. 5. Select the suitable Punch according to your Requirement. 6. Perform forward extrusion 7. Perform backward extrusion 8. Perform hydrostatic extrusion. 9. Compare The 	<p>and sheet metalworking)</p> <ol style="list-style-type: none"> 3. Describe types of bulk deformation (rolling, forging, extrusion and wire and bar drawing) 4. Explain types of sheet metalworking (bending, deep or cup drawing, shearing processes and miscellaneous processes) 5. Explain types of types of extrusion 6. Describe material behavior in metal extrusion processes 7. Explain temperature in extrusion process 8. Explain strain rate sensitivity 9. Explain friction and lubrication in extrusion. <p>Practical Activities:</p> <p>Perform cold Extrusion</p>	<p>5 hrs</p> <p>Practical:</p> <p>2 hrs</p>	<p>Materials/slabs/ ingot.</p> <ol style="list-style-type: none"> 3. Dies 4. Punches 5. Reheating Furnaces 	
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	output with your Requirements. 10. Perform Finishing operation				
LU2. Perform Hot Extrusion	The trainee will be able to: <ol style="list-style-type: none"> 1. Ensure occupation health safety and environment standards as per requirement 2. Prepare the metal blanks. 3. Check the Property of Blank. 4. Preheat the stock for hot forging operation. 5. Select the suitable die according to your Requirements. 6. Select the suitable Punch according to your 	<ol style="list-style-type: none"> 1. Define metal forming process 2. Describe types of metal forming processes (bulk deformation and sheet metalworking) 3. Describe types of bulk deformation (rolling, forging, extrusion and wire and bar drawing) 4. Explain types of sheet metalworking (bending, deep or cup drawing, shearing processes and miscellaneous processes) 5. Explain types of types of extrusion 6. Describe material behavior in metal extrusion processes 7. Explain temperature in extrusion process 8. Explain strain rate sensitivity 9. Explain friction and lubrication in extrusion. 	Total: 7hrs Theory: 5hrs Practical: 2 hrs	<ul style="list-style-type: none"> • Measuring Tools • Raw Materials/slabs/ ingot. • Dies • Punches • Reheating Furnaces • PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	Class room Manufacturing Lab

	Requirement. 7. Perform forward extrusion 8. Perform backward extrusion 9. Perform hydrostatic extrusion 10. Compare the output with your Requirements. 11. Perform Finishing operation	Practical Activities: Perform Hot Extrusion			
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Module 04: Perform wire drawing and deep drawing process

Objective of the module: The aim of this module to covers the the the **skills and knowledge required to Perform Wire Drawing operation and perform deep drawing operation.**

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Perform Wire Drawing operation	The trainee will be able to: 1. Ensure	1. Define metal forming process 2. Describe types of metal forming processes (bulk deformation	Total: 7hrs Theory: 5 hrs	<ul style="list-style-type: none"> Raw Materials/slabs/ ingot 	Class room Manufacturing Lab

	<p>occupation health safety and environment standards as per requirement</p> <ol style="list-style-type: none"> 2. Prepare the metal blanks. 3. Check the Property of Blank. 4. Set No of Dies according to requirement. 5. Perform wire drawing operation. 6. Measure the diameter of wire and match it with requirements. 	<p>and sheet metal working)</p> <ol style="list-style-type: none"> 3. Describe types of bulk deformation (rolling, forging, extrusion and wire and bar drawing) 4. Explain Bending, Straightening, Friction, Compression and Tension. 5. What is difference Between wire drawing and Extrusion 6. Difference between Wire Drawing and Deep drawing. 7. Types Of punches 8. Types Of dies. 9. Explain types of sheet metal working (bending, deep or cup drawing, shearing processes and miscellaneous processes) 10. Explain types of rolling process 11. Explain types of forging process 12. Explain types of extrusion process 13. Describe material behavior in metal forming processes 14. Explain temperature in metal forming 	<p>Practical:</p> <p>2 hrs</p>	<ul style="list-style-type: none"> • Punches • Dies • Blank Holder PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	
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		15. Explain strain rate sensitivity 16. Explain friction and lubrication in metal forming Practical Activities: Perform Wire Drawing operation			
LU2. Perform Deep Drawing operation	The trainee will be able to: 1. Ensure occupation health safety and environment standards as per requirement 2. Prepare the metal blanks. 3. Check the Property of Blank. 4. Chose the die according to your requirement. 5. Set the Blank Holder 6. Select the punch and set the	1. Define metal forming process 2. Describe types of metal forming processes (bulk deformation and sheet metal working) 3. Describe types of bulk deformation (rolling, forging, extrusion and wire and bar drawing) 4. Explain Bending, Straightening, Friction, Compression and Tension. 5. What is difference Between wire drawing and Extrusion 6. Difference between Wire Drawing and Deep drawing. 7. Types Of punches 8. Types Of dies. 9. Explain types of sheet metal working (bending, deep or cup	Total: 7hrs Theory: 5hrs Practical: 2 hrs	<ul style="list-style-type: none"> Raw Materials/slabs/ ingot. Punches Dies Blank Holder PPEs (Safety glasses, Ear muffs/ear plugs, Protective Gloves, Cap, Safety shoes etc.) 	Class room Manufacturing Lab

	<p>punch Travel distance.</p> <p>7. Apply the require force through punch and get the final output.</p> <p>8. Perform Measuring and finishing operation.</p>	<p>drawing, shearing processes and miscellaneous processes)</p> <p>10. Explain types of rolling process</p> <p>11. Explain types of forging process</p> <p>12. Explain types of extrusion process</p> <p>13. Describe material behavior in metal forming processes</p> <p>14. Explain temperature in metal forming</p> <p>15. Explain strain rate sensitivity</p> <p>16. Explain friction and lubrication in metal forming</p> <p>17. Annealing, Drawing, Lubrication</p> <p>Practical Activities:</p> <p>Perform Wire Drawing operation</p>			
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Assistant QC Inspector

Module 1: Perform inspection

Objective of the module: The aim of this module to get knowledge, skills and understanding of products and process inspection, record keeping and feedback provision.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Inspect products and process	<p>The trainee will be able to:</p> <p>28. Test casting defects for conformance to specifications in accordance with standard operating procedures.</p> <p>29. Test forging defects for conformance to specifications in accordance with standard operating procedures.</p> <p>30. Test molding process for conformance to specifications in accordance with</p>	<ul style="list-style-type: none"> Identify casting defects Identify forging defects describe safe working conditions while analyzing casting defects <p>Practical Activity:</p> <p>Inspect casting and forging defects from a given specimen with using HSE protocols.</p>	<p>Total:7hrs</p> <p>Theory: 2 hrs</p> <p>Practical: 3 hrs</p>	<ul style="list-style-type: none"> Material handling equipment Check sheet Log book 	Work Shop

	<p>standard operating procedures.</p> <p>31. Test Heat treatment process for conformance to specifications in accordance with standard operating procedures.</p>				
LU2. Keep records	<p>The trainee will be able to:</p> <p>24. Ensure identification of conforming products</p> <p>25. Ensure identification of non-conforming products</p> <p>26. Ensure identification of conforming process</p> <p>27. Ensure identification of non-conforming process</p> <p>28. Maintain records</p>	<ul style="list-style-type: none"> • Explain conformance reports • Explain non-conformance reports • Describe the importance of record keeping <p>Practical Activity: Develop non-conforming reports for non-conformed products</p>	<p>Total: 7hrs</p> <p>Theory: 2 hrs</p> <p>Practical: 3 hrs</p>	<ul style="list-style-type: none"> • Material handling equipment • Check sheet • Log book 	Work Shop

	accurately using standard operating procedures				
LU3. Provide feedback	<p>The trainee will be able to:</p> <p>16. Test products after rework or repair</p> <p>17. Inspect products after rework or repair</p> <p>18. Measure products after rework or repair</p> <p>19. Report Deficiencies or deviations according to standard operating procedures.</p>	<ul style="list-style-type: none"> • Explain the difference between repair and rework • Explain the difference between variation and standard deviation <p>Practical Activity:</p>	<p>Total 7 hrs</p> <p>Theory: 2 hrs</p> <p>Practical: 3 hrs</p>	<ul style="list-style-type: none"> • Material handling equipment • Check sheet • Log book 	Work Shop

Module 2: Select and control inspection process and procedures

Objective of the module: The aim of this module to get knowledge, skills and understanding the selection of inspection test and procedures along with their controls.

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Select inspection/test procedures	The trainee will be able to: <ol style="list-style-type: none"> 1. Understand incoming inspection 2. Understand in-process and in-product control inspection 3. Understand final inspection 4. Select appropriate methods of inspection 5. Implement appropriate methods of inspection 6. Ensure desired outcome by monitoring inspection process and procedures 	<ul style="list-style-type: none"> Describe a range of inspection methods and their application Define the appropriate inspection method for the process/product Explain procedures for implementing inspection methods Practical Activity:	Total: 7hrs Theory: 5 hrs Practical: 2 hrs	<ul style="list-style-type: none"> Check sheet 	Work Shop
LU2. Control inspection/test environment and	The trainee will be able to:	<ul style="list-style-type: none"> Define the desired/target outcomes of the 	Total: 7hrs	<ul style="list-style-type: none"> Check sheet 	Work Shop

equipment	<ol style="list-style-type: none"> 1. Monitor Environmental conditions to ensure reliability of tests and results 2. Check Equipment/instruments for correct calibration 3. Ensure calibration of equipment/instruments initiated or undertaken against appropriate standard as required 4. Maintain calibration record as per standard operating procedures 5. Check validity of previous results in case of finding out of calibration equipment 6. Report as per standard operating procedures. 	<p>inspection/test procedures</p> <ul style="list-style-type: none"> • Explain reasons for discrepancies/trends • Define procedures for monitoring inspection/test procedures <p>Practical Activity:</p>	<p>Theory: 5hrs</p> <p>Practical: 2 hrs</p>		
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Module 3: Ensure calibration

Objective of the module: The aim of this module to get knowledge, skills and understanding the calibration of mechanical equipment, instruments and tools, mechanical testing machines and mechanical machines

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

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Ensure calibration of mechanical equipment	The trainee will be able to: <ol style="list-style-type: none"> 1. Understand calibration. 2. Understand pressure calibration 3. Understand temperature calibration 4. Understand flow calibration 5. Understand electrical calibration 6. Understand mechanical calibration 7. Identify the standards required for calibration of each mechanical equipment 8. Ensure the calibration of each mechanical equipment 	Define calibration Types of calibration procedures Purpose of calibrations Define QA calibration Define Calibration uncertainty Describe how to calibrate Mechanical equipment Practical Activity:	Total: 7hrs Theory: 5 hrs Practical: 2 hrs	<ul style="list-style-type: none"> • Check sheet 	Work Shop

	9. Keep record of calibrated and non-calibrated equipment.				
LU2. Ensure calibration of mechanical machines	The trainee will be able to: <ol style="list-style-type: none"> 1. Understand calibration 2. Understand Transducer calibration 3. Understand Data system calibration 4. Understand Physical end-to-end calibration 5. Identify the standards required for calibration of each mechanical machines 6. Ensure the calibration of mechanical machines 7. Keep record of calibrated and non-calibrated machines 	<ul style="list-style-type: none"> • Define force gauge calibration • Define pressure gauge calibration • Define strain gauge calibration • Define vacuum gauge calibration 	Total: 7hrs Theory: 5hrs Practical: 2 hrs	<ul style="list-style-type: none"> • Check sheet 	Work Shop
LU3. Ensure calibration of mechanical instruments and tools	The trainee will be able to: <ol style="list-style-type: none"> 1. Understand calibration. 2. Identify the standards required 	<ul style="list-style-type: none"> • Define temperature calibration • Define flow calibration • Define electrical calibration 		<ul style="list-style-type: none"> • 	

	<p>for calibration of each mechanical instruments and tools</p> <ol style="list-style-type: none"> 3. Ensure the calibration of mechanical instruments and tools 4. Keep record of calibrated and non-calibrated instruments and tools 				
<p>LU4. Ensure calibration of mechanical testing machines</p>	<p>The trainee will be able to:</p> <ol style="list-style-type: none"> 1. Understand calibration. 2. Identify the standards required for calibration of each mechanical testing machines 3. Ensure the calibration of mechanical testing machines 4. Keep record of calibrated and non-calibrated mechanical testing machines 	<ul style="list-style-type: none"> • Define calibration for tensile testing machine. 		<ul style="list-style-type: none"> • 	

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.		
B.		
C.		
D.		
E.		
F.		