



Curriculum
"Metal Forming & Processing Senior Technician" Level 04



**National Vocational Certificate for
"Metal Forming & Processing Senior Technician"
Level 04**



Competency Based Curriculum

**National Vocational and Technical Training Commission (NAVTTTC),
Government of Pakistan**



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



Table of Contents

1. Introduction	4
a. “Metal Forming & Processing Senior Technician” Level 04	4
b. Purpose of the Training Program.....	5
c. Overall Objectives of Training Program	5
d. Competencies to be gained after completion of course	5
e. Possible available Job opportunities available immediately and later in the future	6
f. Trainee Entry level	6
g. Minimum Qualification of Trainer	6
h. Recommended Trainer: Trainee Ratio.....	6
i. Medium of Instruction i.e. Language of Instruction	7
j. Duration of the Course	7
k. Sequence of the Modules	7
2. Summary – Overview of the Curriculum.....	8
3. Modules	12
0715-MF&P 01 Module: Manage the meetings.....	12
0715-MF&P 02 Module: Manage workforce planning.....	15
0715-MF&P 03 Module: Undertake project work	19
0715-MF&P 04 Module: Identify and communicate trends in career development	22
0715-MF&P 05 Module: Apply interpersonal skills.....	25
0715-MF&P 06 Module: Work safely in an office environment	27
0715-MF&P 07 Module: Maintain professionalism in workplace.....	30
0715-MF&P 08 Module: Perform Lathe Machine and Shaper Operations.....	33
0715-MF&P 09 Module: Perform Milling and Hobbing Operations.....	42
0715-MF&P 10 Module: Perform Shielded Metal Arc Welding (SMAW)	49
0715-MF&P 11 Module: Perform Submerged Arc Welding (SAW)	58
0715-MF&P 12 Module: Perform Metal Die Casting Operations	63
0715-MF&P 13 Module: Perform Centrifugal Casting Process	69
0715-MF&P 14 Module: Perform Shell Mold Casting	72
0715-MF&P 15 Module: Perform Investment Casting	75
0715-MF&P 16 Module: Perform Die Forging Process.....	79
0715-MF&P 17 Module: Perform Hydrostatic Extrusion Process	84
0715-MF&P 18 Module: Perform wire drawing process.....	87
0715-MF&P 19 Module: Perform Heat treatment of Ferrous Materials.....	91
0715-MF&P 20 Module: Perform Heat treatment of Non- Ferrous Materials	96
0715-MF&P 21 Module: Carryout hardness testing	98
0715-MF&P 22 Module: Carryout Impact testing.....	101
0715-MF&P 23 Module: Perform mechanical testing on universal testing machine.....	104



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 24	Module: Perform Torsion test and Fatigue test.....	110
4.	Supportive Notes.....	112
5.	List of Tools, Machinery and Equipment	112
6.	List of Consumable Supplies	112
7.	Members of the Curriculum Development Committee.....	112



1. Introduction

a. *“Metal Forming & Processing Senior Technician” Level 04*

The Metal Forming & Processing industries are an essential part of our society that processes metals in order to manufacture machine components, machinery, instruments and tools needed by industries as well as by other sectors of the economy.

The products and components created by the different metal shaping techniques are used in creating everything from scaffolding and heavy machinery, to designing and creating microprocessors and artificial intelligence.

When it comes to metal forming, there are several processes to choose from, with each offering its own list of benefits and detriments, each suited to certain applications and for different types of metals.

That includes:

- Knowing the principles of common forming processes and their typical applications
- Identifying the key factors in the product to be made which will guide the forming process selection
- Applying basic metallurgy to the situation so as to make an appropriate recommendation.

Keeping in view of the above, the competency based national vocational qualifications have been developed by NAVTTC to train the unskilled human resource on the technical and entrepreneurial skills.

Training Course is based on competency standards which are defined by the industry and the traditional role of a trainer changes and shifts towards the facilitation of training. A trainer encourages and assists trainees to learn for themselves. Trainees are likely to work in groups (pairs) and all doing something different. Some are doing practical tasks in the workshop, some writing, some not even in the classroom or workshop but in another part of the building using special equipment. As trainees learn at different pace they might be at different stages in their learning, thus learning must be tailored to suit individual needs.



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



b. Purpose of the Training Program

The purpose of this training program is to set the highly professional standards for **Metal Forming & Processing Level 02 - 05** in order to compete local and international job market requirements. The specific objectives of developing these qualifications are as under:

- Empower the youth with locally and globally required employable skills
- Produce competitive **Metal Forming & Processing Skilled Personnel**
- Improve the quality and effectiveness of the training and assessment for **Metal Forming & Processing Industry**

c. Overall Objectives of Training Program

The main objectives of the National Vocational Certificate for **“Metal Forming & Processing Senior Technician” Level 04** are as follows:

- Improve the professional competence of the personnel
- Capacitate the local community and trainers in modern CBT training, methodologies and processes as envisaged under NVQF
- Provide flexible pathways and progressions in the Metal sector
- Enable the trainees to perform their duties in efficient manner
- Establish a standardized and sustainable system of training for Metal Forming & Processing work across globe

d. Competencies to be gained after completion of course

- | |
|--|
| 1. Manage the meetings |
| 2. Manage workforce planning |
| 3. Undertake project work |
| 4. Identify and communicate trends in career development |
| 5. Apply interpersonal skills |
| 6. Work safely in an office environment |
| 7. Maintain professionalism in workplace |
| 8. Perform Lathe Machine and Shaper Operations |
| 9. Perform Milling and Hobbing Operations |
| 10. Perform Shielded Metal Arc Welding (SMAW) |
| 11. Perform Submerged Arc Welding (SAW) |
| 12. Perform Metal Die Casting Operations |
| 13. Perform Centrifugal Casting Process |
| 14. Perform Shell Mold Casting |



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



15. Perform Investment Casting
16. Perform Die Forging Process
17. Perform Hydrostatic Extrusion Process
18. Perform Wire Drawing Process
19. Perform Heat Treatment of Ferrous Materials
20. Perform Heat Treatment of Non-Ferrous Materials
21. Carryout Hardness Testing
22. Carryout Impact Testing
23. Perform Mechanical Testing on Universal Testing Machine
24. Perform Torsion Test and Fatigue test

e. Possible available Job opportunities available immediately and later in the future

01 Machining Senior Technician
02 Welding Senior Technician
03 Metal Casting Senior Technician
04 Metal Forming Senior Technician
05. Heat Treatment Technician
06 Destructive Testing Technician

f. Trainee Entry level

The entry for National Vocational Certificate for “Metal Forming & Processing Senior Technician” Level 04 would be Middle Certificate (8th Class) or “Metal Forming & Processing Technician” Level 03

g. Minimum Qualification of Trainer

Must be a holder of DAE in Metallurgy / Mechanical Technology with at least 2 years relevant experience

OR

BSc Engineering Technology (Metallurgy/Mechanical), B.E
Metallurgy/Mechanical, BSc Metallurgy/Mechanical Engineering

h. Recommended Trainer: Trainee Ratio

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



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



i. Medium of Instruction i.e. Language of Instruction

Instructions will be in Urdu/ English/ Local language.

j. Duration of the Course

The distribution of contact hours is given below:

Total	-	1200 hours
Theory	-	186 hours (15.5%)
Practical	-	1014 hours (84.5%)
Proposed Course Duration	-	12 Months

k. Sequence of the Modules

1. Manage the meetings
2. Manage workforce planning
3. Undertake project work
4. Identify and communicate trends in career development
5. Apply interpersonal skills
6. Work safely in an office environment
7. Maintain professionalism in workplace
8. Perform Lathe Machine and Shaper Operations
9. Perform Milling and Hobbing Operations
10. Perform Shielded Metal Arc Welding (SMAW)
11. Perform Submerged Arc Welding (SAW)
12. Perform Metal Die Casting Operations
13. Perform Centrifugal Casting Process
14. Perform Shell Mold Casting
15. Perform Investment Casting
16. Perform Die Forging Process
17. Perform Hydrostatic Extrusion Process
18. Perform Wire Drawing Process
19. Perform Heat Treatment of Ferrous Materials
20. Perform Heat Treatment of Non-Ferrous Materials
21. Carryout Hardness Testing
22. Carryout Impact Testing
23. Perform Mechanical Testing on Universal Testing Machine
24. Perform Torsion Test and Fatigue test



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



2. Summary – Overview of the Curriculum

Module Title	Learning Units	Th.	Pr.	T.	Cr. Hrs
1. Manage the meetings	LU.1 Prepare for meetings LU.2 Conduct meetings LU.3 Follow up meetings	6	12	18	1.8
2. Manage workforce planning	LU.1 Identify workforce LU.2 Develop workforce objectives and strategies LU.3 Implement initiatives to support workforce planning objectives LU.4 Monitor and evaluate workforce trends	6	12	18	1.8
3. Undertake project work	LU.1 Identify project LU.2 Develop project plan LU.3 Monitor project LU.4 Finalize the project	6	12	18	1.8
4. Identify and communicate trends in career development	LU.1 Research and explore career trends LU.2 Assess and confirm ongoing career development LU.3 Maintain quality of career development services and professional practice	3	12	15	1.5
5. Apply interpersonal skills	LU.1 Communicate effectively LU.2 Apply specialized counseling interviewing skills LU.3 Evaluate own communication	3	12	15	1.5
6. Work safely in an office environment	LU.1 Ensure safe work environment LU.2 Implement workplace safety requirements LU.3 Participate in OHS consultative processes LU.4 Follow safety procedures	3	12	15	1.5
7. Maintain professionalism in workplace	LU.1 Respect work timeframes LU.2 Maintain personal appearance and hygiene LU.3 Maintain adequate distance with colleagues and clients LU.4 Work in an ethical manner	3	12	15	1.5
8. Perform Lathe Machine and Shaper Operations	LU.1 Perform centering operations on lathe machine LU.2 Perform facing Operations LU.3 Perform turning Operations LU.4 Perform drilling and boring operations	9	48	57	5.7



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	LU.5 Perform step turning operations LU.6 Perform knurling Operations LU.7 Perform Internal and External threading Operation LU.8 Perform Squaring of workpiece on shaper machine. LU.9 Perform Slotting on Shaper machine				
9. Perform Milling and Hobbing Operations	LU.1 Arrange Tools, Equipment and material for Milling Operation LU.2 Prepare work piece for milling operation LU.3 Perform setting of milling machine LU.4 Carryout Milling operations. LU.5 Arrange Tools, Equipment and material for hobbing to make the gear LU.6 Set Hobbing Machine for operations LU.7 Carry out Hobbing operations to make gear	12	51	63	6.3
10. Perform Shielded Metal Arc Welding (SMAW)	LU.1 Prepare Welding Machine and Accessories for SMAW LU.2 Make Welds on Carbon Steel Plate Flat (1F) and Flat (1G) LU.3 Make Welds on Carbon Steel Plate Horizontal (2F) and Horizontal (2G) LU.4 Make Welds on Carbon Steel Plate Vertical (3F) and Vertical (3G) LU.5 Make Welds on Carbon Steel Plate Overhead (4F) and Overhead (4G) LU.6 Perform Post Welding Operations	10	66	76	7.6
11. Perform Submerged Arc Welding (SAW)	LU.1 Prepare Welding Machine and Accessories for SAW LU.2 Make Fillet Weld on Carbon Steel Plate LU.3 Make Groove Weld on Carbon Steel Plate LU.4 Perform Post Welding Operations	10	48	58	5.8
12. Perform Metal Die Casting Operations	LU.1 Arrange material for die (Cold Chambered High pressure) casting LU.2 Conduct pre-operational checks on machine LU.3 Prepare the high pressure die casting molds LU.4 Operate die casting machine (Cold chambered high pressure) LU.5 Inspect final product	6	96	102	10.2



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	LU.6	Perform Workplace cleaning				
13. Perform Centrifugal Casting Process	LU.1	Prepare mold for casting	6	45	51	5.1
	LU.2	Cast the molten metal				
	LU.3	Remove the Casting from molds				
	LU.4	Perform post casting operations				
14. Perform Shell Mold Casting	LU.1	Arrange pattern for casting	6	51	57	5.7
	LU.2	Arrange mold for casting				
	LU.3	Assemble mold for casting				
	LU.4	Cast molten metal in mold				
	LU.5	Remove the casting from mold				
15. Perform Investment Casting	LU.1	Arrange pattern for Casting	8	60	68	6.8
	LU.2	Prepare mold for casting				
	LU.3	Perform casting				
	LU.4	Perform post-casting operations				
16. Perform Die Forging Process	LU.1	Perform Open Die Forging (Cold/Hot)	6	51	57	5.7
	LU.2	Perform Impression Die Forging (Cold/Hot)				
	LU.3	Perform precision / flash less forging operation				
	LU.4	Perform forging machine maintenance				
17. Perform Hydrostatic Extrusion Process	LU.1	Perform cold hydrostatic extrusion	12	96	108	10.8
	LU.2	Perform hot hydrostatic extrusion				
	LU.3	Carryout inspection of finished production				
18. Perform Wire Drawing Process	LU.1	Arrange tools and equipment for wire drawing through draw plate	12	51	63	6.3
	LU.2	Perform Annealing of the given wire to be drawn				
	LU.3	Carryout pulling of wire through drawplate				
	LU.4	Perform wire drawing operation on metal blank				
19. Perform Heat Treatment of Ferrous Materials	LU.1	Perform hardening on carbon steel	10	48	58	5.8
	LU.2	Perform tempering of hardened carbon steel				
	LU.3	Perform annealing on steel				
	LU.4	Perform normalizing of steel				
	LU.5	Perform carburizing of steel				
	LU.6	Perform stress relieving of Metal				
20. Perform Heat Treatment of Non-Ferrous Materials	LU.1	Perform Solution Treatment	10	36	46	4.6
	LU.2	Perform Aging				
21. Carryout Hardness Testing	LU.1	Measure hardness of the specimen by Brinell Hardness Test	10	42	52	5.2
	LU.2	Measure hardness of the specimen by Rockwell Hardness Test				



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	LU.3	Measure hardness of the specimen by Vickers Hardness Test				
22. Carryout Impact Testing	LU.1	Measure toughness of the specimen by Izod Impact Test	10	36	46	4.6
	LU.2	Measure Toughness of the specimen by Charpy Impact Test				
23. Perform Mechanical Testing on Universal Testing Machine	LU.1	Measure tensile properties of the specimen	10	60	70	7
	LU.2	Measure Compressive strength of the specimen				
	LU.3	Measure the Bending strength of specimen				
	LU.4	Measure Shear strength of the specimen				
24. Perform Torsion Test and Fatigue test	LU.1	Measure torsion strength of specimen	9	45	54	5.4
	LU.2	Measure fatigue strength of specimen				
	Total		186	1014	1200	120



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



3. Modules

0715-MF&P 01 Module: Manage the meetings

Objective: This module covers the knowledge and skills required to manage a range of meetings including overseeing the meeting preparation processes, chairing meetings, organizing the minutes and reporting meeting outcomes.

Duration: 18

Hours

Theory: 6

Hours

Practice:

12 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Prepare for meetings	Trainee will be able to: <ul style="list-style-type: none"> Develop an agenda in line with the stated meeting purpose Ensure the style and structure of the meeting are appropriate to its purpose Identify meeting participants and notify them in accordance with organizational procedures Confirm meeting arrangements in accordance with the requirements of meeting Dispatch meeting working papers to participants 	<ul style="list-style-type: none"> Knowledge about the objective and agenda of the meeting Description of meeting terminology, structure and arrangements Knowledge about the arrangement of meeting as per the requirements Dispatch procedure regarding minutes of the meeting to the participants. <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> Develop meeting agenda as per the requirement of 	<p>Theory-2 Hrs. Practical-3 Hrs. Total-5 Hrs.</p>	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	<p>Class Room and Lab</p>



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	within designated timelines	structure and notify other team members accordingly.			
LU2. Conduct meetings	Trainee will be able to: <ul style="list-style-type: none"> • Conduct meetings in accordance with organizational requirements, agreed conventions for type of meeting and legal and ethical requirements • Conduct meetings to ensure they are focused, time efficient and achieve the required outcomes • Ensure meeting facilitation enables participation, discussion, problem-solving and resolution of issues • Record minutes of meeting in accordance with organizational requirements. • Brief other minute-taker on method for recording meeting minutes in accordance with organizational requirements and 	<ul style="list-style-type: none"> • Description of the legal and ethical requirement of meetings • Importance of MOM (minutes of meeting) recording • Describe the mediums for meetings including In-person/physical, teleconferencing, web-conferencing and using webcams • Explain the relevant organizational procedures and policies regarding meetings <p><u>Practical Activity</u> Conduct a practice meeting and record MOM</p>	Theory-2 Hrs. Practical-3 Hrs. Total-5 Hrs.	<ul style="list-style-type: none"> • Stationary • Information communication technology (ICT) resources 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	conventions for type of meeting				
LU3. Follow up meetings	<ul style="list-style-type: none"> • Check transcribed meeting notes to ensure they reflect a true and accurate record of the meeting and are formatted in accordance with organizational procedures and meeting conventions • Distribute and store minutes and other follow-up documentation within designated timelines, and according to organizational requirements • Report outcomes of meetings as required, within designated timelines 	<ul style="list-style-type: none"> • Explain the actions required for follow up of meetings • Importance of follow up of meeting regarding the tasks assigned • Understanding about reporting the outcome of meeting <p><u>Practical Activity</u> Prepare a report containing outcome of a practice meeting</p>	Theory-2 Hrs. Practical-6 Hrs. Total-8 Hrs	<ul style="list-style-type: none"> • Stationary • Information communication technology (ICT) resources 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 02 Module: Manage workforce planning

Objective: This module covers the knowledge and skills required to manage planning in relation to an organization’s workforce including researching requirements, developing objectives and strategies, implementing initiatives and monitoring and evaluating trends.

Duration: 18 Hours Theory: 6 Hours Practice: 12 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Identify workforce	Trainee will be able to: <ul style="list-style-type: none"> Review current data on staff turnover and demographics Assess factors that may affect workforce supply Develop organization’s requirement for skilled workforce 	<ul style="list-style-type: none"> Explain the factors affecting workforce supply Knowledge about the organizational requirement related to the skilled workforce Description of labor force analysis and forecasting skills <p><u>Practical Activity</u></p> <p>Prepare a report containing information related to the staff turnover in the organization</p>	Theory-1 Hrs. Practical-3 Hrs. Total-4 Hrs.	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



LU2. Develop workforce objectives and strategies	Trainee will be able to: <ul style="list-style-type: none"> • Review organizational strategy and establish aligned objectives for modification • Prepare strategies to address unacceptable staff turnover, if required • Develop objectives to retain required skilled labor • develop objectives for workforce diversity and cross-cultural management • Set targets as per organizational requirement <ul style="list-style-type: none"> • Develop contingency plans to cope with extreme situations 	<ul style="list-style-type: none"> • Explain organizational objectives and strategy related to the workforce • Description about the objectives of staff retention • Understanding of cross-cultural management • Knowledge about the contingency plans related to the extreme situations <p><u>Practical Activity</u></p> <p>Prepare a report containing objectives related to the workforce retention and discuss with the management</p>	<p>Theory-2 Hrs. Practical-3. Total- 5 Hrs.</p>	<ul style="list-style-type: none"> • Stationary • Information communication technology (ICT) resources 	<p>Class Room and Lab</p>
LU3. Implement initiatives to support workforce planning	Trainee will be able to: <ul style="list-style-type: none"> • Implement action to support agreed objectives for recruitment, training, 	<ul style="list-style-type: none"> • Explain the process of recruitment and training of the workforce 	<p>Theory-2 Hrs. Practical-3 Hrs. Total-5 Hrs</p>	<ul style="list-style-type: none"> • Stationary • Information communication technology (ICT) resources 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



objectives	<p>redeployment and redundancy</p> <ul style="list-style-type: none"> Develop and implement strategies to assist workforce to deal with organizational dynamics Implement succession planning model to ensure desirable workers are developed and retained Implement programs to ensure workplace is an employer of choice 	<ul style="list-style-type: none"> description about the strategies and planning to assist and deal the workforce <p><u>Practical Activity</u> Practice to implement the objectives at the organization suggested by the management related to the workforce.</p>			
LU4. Monitor and evaluate workforce trends	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Evaluate workforce plan against patterns in exiting employee and workforce changes Monitor labor supply trends for areas of high turnover in external environment Monitor effects of labor trends on demand for labor Survey organizational 	<ul style="list-style-type: none"> Understanding about the evaluation plans related to the workforce Importance of monitoring and evaluation Knowledge about the monitoring process Understanding about the government 	<p>Theory-1 Hrs. Practical-3 Hrs. Total-4 Hrs</p>	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>climate to gauge worker satisfaction</p> <ul style="list-style-type: none"> • Refine objectives and strategies in response to national and international changes and make recommendations in response to global trends. • Regularly review government policy on labor jobs according to labor rights. • Evaluate effectiveness of change processes against agreed objectives 	<p>policies related to the workforce</p> <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> • Practice to prepare a report that contains effectiveness related to the implementation of organizational objectives 			
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 03 Module: Undertake project work

Objective: This module covers the knowledge and skills required to undertake a straightforward project or a section of a larger project. It covers developing a project plan, administering and monitoring the project, finalizing the project and reviewing the project to identify lessons learned for application to future projects. This unit applies to individuals who play a significant role in ensuring a project meets timelines, quality standards, budgetary limits and other requirements set for the project.

Duration: 18 Hours Theory: 6 Hours Practice: 12 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Identity project	Trainee will be able to: <ul style="list-style-type: none"> Assess project scope and other relevant documentation Identify project stakeholders Seek clarification of discrepancies from delegating authority related to project and project parameters Determine and access available resources to undertake project 	<ul style="list-style-type: none"> Understanding about the scope of the project and all the required documentation Knowledge of available resources relate to the project Description of sources of information commonly used in defining the parameters of a project Explain project management tools 	Theory-2 Hrs. Practical-3 Hrs. Total-5 Hrs .	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



		<p style="text-align: center;"><u>Practical Activity</u></p> <ul style="list-style-type: none"> Practice to prepare a report on available resources that can be utilized in the project. 			
<p>LU2. Develop project plan</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Develop project feasibility report Develop project plan in line with the project parameters Develop and approve project budget Formulate risk management plan for project, including Workplace Health and Safety (WHS) 	<ul style="list-style-type: none"> Understanding about the project plans, parameters and feasibility reports Explain the risk management plan for the project Understanding about the Workplace health and safety requirements <p style="text-align: center;"><u>Practical Activity</u></p> <p>Practice to prepare project feasibility report</p>	<p>Theory-2 Hrs. Practical-3 Hrs. Total-5 Hrs .</p>	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	<p>Class Room and Lab</p>
<p>LU3. Control and monitor project</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Ensure project team members are clear about their responsibilities and 	<ul style="list-style-type: none"> recordkeeping Procedure Importance of recordkeeping 	<p>Theory-1 Hrs. Practical-3 Hrs. Total-4 Hrs</p>	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) 	<p>Class Room and Lab</p>



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> the project requirements • Ensure outcomes and documented time lines of the project are met • Maintain required recordkeeping systems throughout the project • Implement and monitor plans of project finances and resources • Prepare project progress reports as required to stakeholders • Monitor risk management as required to ensure project outcomes are met 	<ul style="list-style-type: none"> • identification of the stakeholders <p>Identification of risk which may affect outcomes</p> <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> • Practice to prepare project progress reports as required by the stakeholders 		resources	
LU4. Finalize the project	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Assess project scope and other relevant documentation • Identify project stakeholders • Seek clarification of discrepancies from delegating authority related to project and project parameters • Determine and access available resources to undertake project 	<ul style="list-style-type: none"> • Knowledge of the documents required for finalization of project • Knowledge about the Quality assurance <p><u>Practical Activity</u></p> <p>Practice to prepare a report addressing issues in the project and their appropriate solutions</p>	<p>Theory-1 Hrs. Practical-3 Hrs. Total-4 Hrs</p>	<ul style="list-style-type: none"> • Stationary • Information communication technology (ICT) resources 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 04 Module: Identify and communicate trends in career development

Objective: This module covers the knowledge and skills required to conduct research to identify and communicate career trends.

Duration: 15

Hours

Theory: 3

Hours

Practice:

12 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Research and explore career trends	Trainee will be able to: <ul style="list-style-type: none"> Apply knowledge of changing organizational structures, lifespan of careers and methods of conducting work search, recruitment and selection processes Analyze changing worker and employer issues, rights and responsibilities in context of changing work practices Examine importance of quality careers development services Maintain all research, documentation, sources and 	<ul style="list-style-type: none"> Description about the organizational structures Knowledge about the recruitment and selection methods Understanding about the Diversity and its potential effects on career choices <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> Practice to prepare a document for the recruitment and selection process of the organization 	<p>Theory-1 Hrs. Practical-3 Hrs. Total-4 Hrs.</p>	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>references (digital or physical).</p> <ul style="list-style-type: none"> Analyze implications of relevant policy, legislation, professional codes of practice and national standards relating to worker and employer issues Confirm cluster employability skills and preferences that may open employment options in other career pathways 				
LU2. Assess and confirm ongoing career development	Trainee will be able to: <ul style="list-style-type: none"> Assess success of previous career development services Maintain privacy and security of all data, research and personal records according to relevant policy Establish existing work-life balance and friendly environment 	<ul style="list-style-type: none"> Description of the relevant policy, legislation, codes of practice and standards relevant to career development Understanding about the privacy and security policies of the organization <p><u>Practical Activity</u></p>	<p>Theory-1 Hrs. Practical-3 Hrs. Total-4 Hrs.</p>	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	<p>Class Room and Lab</p>



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



		<ul style="list-style-type: none"> Practice to prepare a report to maintain a suitable work environment 			
LU3. Maintain quality of career development series and professional practice	Trainee will be able to: <ul style="list-style-type: none"> Analyze and review relevance of career theories, models, frameworks and SOPs Incorporate into career development services and professional practice Comply with all relevant policies 	<ul style="list-style-type: none"> Explain the human psychological development and needs in relation to career development Description of framework and SOP's of the organization related to the career development <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> Practice to write a report on the importance of quality careers 	Theory-1 Hrs. Practical-6 Hrs. Total-7 Hrs	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 05 Module: Apply interpersonal skills

Objective: This module covers the knowledge and skills required to use advanced and specialized communication skills in the client-counselor relationship.

Duration: 15

Hours

Theory: 3

Hours

Practice:

12 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1. Commu nicate effectively	Trainee will be able to: <ul style="list-style-type: none"> Identify communication barriers and use strategies to overcome these barriers in the client-counselor relationship Facilitate the client-counselor relationship through selection and use of micro skills Observe and respond to non-verbal communication cues Integrate case note taking with minimum distraction 	<ul style="list-style-type: none"> Importance of communication Explain the types of communications and micro-skills Description of communication barriers <p style="text-align: center;"><u>Practical Activity</u></p> <ul style="list-style-type: none"> Practice to perform a meeting with team members using verbal communication methods 	<p>Theory-1 Hrs. Practical-3 Hrs. Total-4 Hrs .</p>	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	Class Room and Lab
LU2. Apply specialized	Trainee will be able to: <ul style="list-style-type: none"> Select and use 	<ul style="list-style-type: none"> Knowledge about impact of trauma and stress on the 	<p>Theory-1 Hrs. Practical-3 Hrs. Total-4 Hrs</p>	<ul style="list-style-type: none"> Personal Protective Stationary 	Class Room and



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



counseling interviewing skills	<p>communication skills according to the sequence of a counseling interview</p> <ul style="list-style-type: none"> Identify points at which specialized counseling interviewing skills are appropriate for inclusion Use specialized counseling communication techniques based on their impacts and potential to enhance client development and growth Identify and respond appropriately to strong client emotional reactions 	<p>communication process</p> <ul style="list-style-type: none"> Description of specialized counseling interviewing skills Knowledge about the challenges in the counseling sessions <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> Practice to performed the counseling session using verbal mode of communication 		<ul style="list-style-type: none"> Information communication technology (ICT) resources 	Lab
LU3. Evaluate own communication	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Reflect on and evaluate own communication with clients Recognize the effect of own values and beliefs on communication with clients Identify and respond to the need for development of own skills and knowledge 	<ul style="list-style-type: none"> Explain self-evaluation process Importance of self-evaluation <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> Write a report on self-evaluation and record the improvement areas. 	<p>Theory-1 Hrs. Practical-6 Hrs. Total-7 Hrs</p>	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 06 Module: Work safely in an office environment

Objective: This module covers the knowledge and skills required to prepare for test equipment , apply check and test methods and Check the Accessories

Duration: 15

Hours

Theory: 3

Hours

Practice:

12 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Ensure safe work environment	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Follow established safety procedures when conducting work Carry out pre-start systems and equipment checks in accordance with workplace procedures 	<ul style="list-style-type: none"> Explain the standard working procedure related to Safety and symbols Understanding about the equipment, tools and Its safety procedures <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> Practice to perform the inspection of the required equipment before usage 	<p>Theory-0.5 Hrs. Practical-3 Hrs. Total- 3.5 Hrs</p>	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



LU2: Implement workplace safety requirements	Trainee will be able to: <ul style="list-style-type: none"> Identify designated persons for reporting queries and concerns about safety in the workplace Identify existing and potential hazards in the workplace, report them to designated persons and record them in accordance with workplace procedures Follow organizational SOP's Report emergency incidents and injuries to designated persons Maintain emergency contact list 	<ul style="list-style-type: none"> Explain the reporting procedures Knowledge about the hazard identification and risk assessment describe the risk control methods Understanding about the emergency response procedure <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> Perform the activity of risk assessment at workplace 	<p>Theory-0.5 Hrs. Practical-3 Hrs. Total- 3.5 Hrs</p>	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	<p>Class Room and Lab</p>
LU3. Participate in OHS consultative processes	Trainee will be able to: <ul style="list-style-type: none"> Contribute to workplace meetings, inspections or other consultative activities Raise OHS issues with designated persons in 	<ul style="list-style-type: none"> Understanding about safety related contribution at the workplace Reporting procedure Understanding about the hazard 	<p>Theory-1 Hrs. Practical-3 Hrs. Total- 4Hrs</p>	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>accordance with organizational procedures</p> <ul style="list-style-type: none"> • Take actions to eliminate workplace hazards or to reduce risks 	<p>and risk elimination/reduction techniques at workplace</p> <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> • Perform the activity of hazard elimination at the workplace 			
<p>LU4. Follow safety procedures</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Identify and report emergency incidents • Follow organizational procedures for responding to emergency incidents • Check safety tools 	<ul style="list-style-type: none"> • Describe the incident/accident reporting system • Understanding about SOP.s of emergency incidents response • Inspection techniques of equipment and tools <p><u>Practical Activity</u></p> <p>Perform mock activity related to inspection of equipment before usage for a given task</p>	<p>Theory-1 Hrs. Practical-3 Hrs. Total- 4Hrs</p>	<ul style="list-style-type: none"> • Stationary • Information communication technology (ICT) resources 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 07 Module: Maintain professionalism in workplace

Objective: This module covers the knowledge and skills required to use advanced and specialized communication skills in the client-counselor relationship.

Duration: 15

Hours

Theory: 3

Hours

Practice:

12 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Respect work timeframes	Trainee will be able to: <ul style="list-style-type: none"> Demonstrate punctuality in meeting, set working hours and times. Utilize working hours only for working and follow company regulations. Complete work tasks within deadlines according to order of priority Perform extra ordinary during working hours 	<ul style="list-style-type: none"> understanding about workplace timeframe/working schedules and deadlines importance of adhering to the deadline 	Theory-1 Hrs. Practical-3 Hrs. Total- 4Hrs	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	Class Room and Lab
LU2: Maintain personal appearance and hygiene	Trainee will be able to: <ul style="list-style-type: none"> Clean hair, body and nails regularly. 	<ul style="list-style-type: none"> Understanding about the Personal hygiene 	Theory-1 Hrs. Practical-3 Hrs. Total- 4Hrs	<ul style="list-style-type: none"> Stationary Information communication 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> Wear suitable cloths for the workplace, and respect local and cultural contexts Meet specific company dress code requirements Keep smiling and have positive body language during working hours 	<ul style="list-style-type: none"> Importance of personal hygiene Description of suitable and mandatory cloths at workplace 		technology (ICT) resources	
LU3. Maintain adequate distance with colleagues and clients	Trainee will be able to: <ul style="list-style-type: none"> Respect personal space of colleagues and clients with reference to local customs and cultural contexts. Avoid cross transmission of infections (especially through respiration). 	<ul style="list-style-type: none"> understanding of the adequate distance of colleagues and clients Importance of the personal space at the workplace <p>Practical activity: Demonstrate to avoid transmission of infections especially through respiration</p>	Theory-0.5 Hrs. Practical-3 Hrs. Total- 3.5Hrs	<ul style="list-style-type: none"> Stationary Information communication technology (ICT) resources 	
LU4. Work in an ethical manner	Trainee will be able to: <ul style="list-style-type: none"> Follow company 	<ul style="list-style-type: none"> Understanding of SOPs of organization related 	Theory-0.5 Hrs. Practical-3 Hrs. Total- 3.5Hrs	<ul style="list-style-type: none"> Stationary Information communication 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>values/ethics codes of ethics and/or conduct, policies and guidelines.</p> <ul style="list-style-type: none"> • Use company resources in accordance with company ethical standards. • Undertake work practices in compliance with company ethical standards, organizational policy and guidelines. • Instruct co-workers on ethical, lawful and reasonable directives. • Share Company values/practices with co-workers using appropriate behavior and language. • Report work incidents/situations and/or resolved in accordance with company protocol/guidelines. 	<p>to the ethical manners and values</p> <ul style="list-style-type: none"> • Importance of organizational values • Importance of reporting unwanted activities at the workplace <p><u>Practical Activity</u></p> <p>Perform Tool box talk related to ethical responsibilities with your co-worker</p>		<p>technology (ICT) resources</p>	
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 08 Module: Perform Lathe Machine and Shaper Operations

Objective: This module covers the knowledge and skills required to to Perform centering operations, Perform facing Operations, Perform turning Operations, Perform drilling and boring operations, Perform step turning operations, Perform knurling Operations, Perform Internal and External threading Operations and make a Rack Gear on shaper machine

Duration: 57 Hours

Theory: 09 Hours

Practice: 48 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform centering operations on lathe machine	Trainee will be able to: <ul style="list-style-type: none"> Mount and set the required work-holding devices Mount and set the required work piece Mount and set the required cutting tools. Select safe procedures and tools to accomplish the work. Adjust the operating parameters (e.g. speed and feed) of machine tool for centering the job. Follow all safety rules required for the machine. 	<ul style="list-style-type: none"> Describe the calculation of speed and feed Description of the operating parameters of centering operations Knowledge about the safety precautions involved in the work <p><u>Practical Activity</u></p> <p>Perform activity of centering operation on given job</p>	<p>Theory-1 Hrs. Practical-3 Hrs. Total- 4Hrs</p>	<ul style="list-style-type: none"> Lathe Machine and accessories Measuring Tools Cutting Tool Inspection Tools Personal Protective Equipment 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



LU2: Perform facing operations	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Mount and set the required work-holding devices • Mount and set the required work piece. • Select facing tools according to job requirement. • Select safe procedures and tools to accomplish the work. • Adjust the operating parameters (e.g. speed and feed) of machine tool to achieve the work specification. • Follow all safety rules required for the machine. 	<ul style="list-style-type: none"> • Explain the methods and techniques of mounting and setting of workpiece • Description of the adjustment of feed and speed • Understanding about the techniques to adjust operating parameters of machine tool. <p><u>Practical Activity</u> Perform activity of facing operation on given job</p>	<p>Theory-1 Hrs. Practical-6 Hrs. Total- 7Hrs</p>	<ul style="list-style-type: none"> • Lathe Machine and accessories • Measuring Tools • Cutting Tool • Inspection tools • Personal Protective Equipment 	<p>Class Room and Lab</p>
LU3. Perform turning operations	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Follow work specifications, drawings or sketches to accomplish the turning operation. • Set up and adjust the machine as per work 	<ul style="list-style-type: none"> • Knowledge about Reading and interpreting work specifications, drawings and sketches. • Describe the 	<p>Theory-1 Hrs. Practical-6 Hrs. Total- 7Hrs</p>	<ul style="list-style-type: none"> • Lathe Machine and accessories • Measuring Tools • Cutting Tool • Inspection tools • Personal Protective 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>specifications and procedures.</p> <ul style="list-style-type: none"> Inspect the components produced have the required quality and within the specified dimensional accuracy by turning operation. Shut down the machine and equipment on conclusion of the machining activities. 	<p>cutting speed and RPM calculations</p> <ul style="list-style-type: none"> Explain the Method and technique of adjusting RPM of lathe machine. <p><u>Practical Activity</u></p> <p>Perform activity of turning operation on given job</p>		Equipment	
LU4. Perform drilling and boring operations	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Maintain safe working condition at workplace. Follow work specifications, drawings or sketches to accomplish the turning operation. Mount and set the required work-holding devices Mount and set the required work piece Adjust the drill bit in the tail stock. 	<ul style="list-style-type: none"> Explain the types of drilling and boring tools and their functionality Describe the safe boring procedures Understanding about the Safety precautions and procedures need to be observed during work. Understanding about the techniques to check the quality of 	<p>Theory-1 Hrs. Practical-6 Hrs. Total- 7Hrs</p>	<ul style="list-style-type: none"> Lathe Machine and accessories Measuring Tools Cutting Tool Inspection tools Personal Protective Equipment 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> Adjust the RPM of machine according to the cutting speed. Make the hole according to given drawing. Perform the boring operation according to the drawing. Check quality of the component produced at different intervals. 	<p>component produced</p> <p><u>Practical Activity</u></p> <p>Perform activity of drilling on given job</p>			
LU5. Perform step turning operations	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Follow work specifications, drawings or sketches to accomplish the turning operation. Set up and adjust the machine as per work specifications and procedures. Inspect the components produced have the required quality and within the specified dimensional accuracy by turning operation 	<ul style="list-style-type: none"> Understanding about the selection of left hand and right hand turning tool as per job requirement Knowledge about checking accuracy and quality of the component in the step Turing operations Knowledge about the health and safety rules for the required task. <p><u>Practical Activity</u></p> <p>Perform activity of step</p>	<p>Theory-1 Hrs. Practical-6 Hrs. Total- 7Hrs</p>	<ul style="list-style-type: none"> Lathe Machine and accessories Measuring Tools Cutting Tool Inspection tools Personal Protective Equipment 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> • Check quality of the component produced at different intervals. • Follow safety precautions to ensure safe work and to avoid any injury. 	turning operation on given job			
LU6. Perform knurling operations	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Maintain safe working condition at workplace. • Select the knurling tool according to requirement. • Set the tool and work piece in the machine according to procedure. • Use right methods and techniques to produce proper knurling on work piece. • Select and adjust appropriate speeds and feeds of lathe machine. • Use coolants during knurling to achieve smooth impression on 	<ul style="list-style-type: none"> • Understanding about the knurling methods • Explain the types of knurling tools • Importance of using coolant during the knurling operations <p><u>Practical Activity</u></p> <p>Perform activity of knurling operation on given job</p>	<p>Theory-1 Hrs. Practical-3 Hrs. Total- 4Hrs</p>	<ul style="list-style-type: none"> • Lathe Machine and accessories • Measuring Tools • Cutting Tool • Knurling Tool • Inspection tools • Personal Protective Equipment 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	work piece.				
LU7. Perform internal and external threading operations	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Mount and set the required work-holding devices • Mount and set the required work piece • Use Proper cutting tool to cut the threads with required dimensions. • Select and adjust appropriate speeds and feeds of turning machine. • Produce a component which matches the work specifications using appropriate methods and techniques. • Check quality of the component produced at different intervals. • Follow safety precautions to ensure safe work and to avoid any injury 	<ul style="list-style-type: none"> • Describe the types of threading tools • Understanding about the types and methods of threading • Description of the procedure of setting tools and work piece in the machine <p><u>Practical Activity</u> Perform activity of external threading operation on given job</p>	<p>Theory-1 Hrs. Practical-6 Hrs. Total- 7Hrs</p>	<ul style="list-style-type: none"> • Lathe Machine and accessories • Measuring Tools • Cutting Tool • Knurling Tool • Inspection tools • Threading Tools • Personal Protective Equipment 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



<p>LU8. Perform squaring of workpiece on shaper machine</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. • Interpret the drawings as per job requirement • Install the machine vice according to job requirement. • Set cutting tool and set machine as per requirements.(feed, speed, depth of cut and length of stroke) • Mount cutting tool and work piece in the machine. • Perform Squaring operation • Check quality of the component at suitable intervals. • Shut down the machine at safe position after finishing the work. 	<ul style="list-style-type: none"> • Describe the methods of mounting and cutting tools • Knowledge about checking the right angle with the tri-square • Describe the rack and pinion gears • Explain the types of shaper machines <p><u>Practical Activity</u></p> <p>Perform squaring of the job on shaper machine</p>	<p>Theory-1 Hrs. Practical-6 Hrs. Total- 7Hrs</p>	<ul style="list-style-type: none"> • Measuring Tools • Cutting Tool • Inspection tools • Personal Protective Equipment • Shaper Machine and accessories 	
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> Shut down the machine at safe position after finishing the work. 				
LU9. Perform slotting on shaper machine	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Identify safety hazards related with shaping operations and take appropriate steps to avoid any injury or accident. Interpret the drawings as per job requirement Install the machine vice according to job requirement. Set cutting tool and set machine as per requirements.(feed, speed, depth of cut and length of stroke) Mount cutting tool and work piece on the machine. Cut a slot on the work piece as per given drawing. Check quality of the 	<ul style="list-style-type: none"> Description of hazard related to the shaping operations Knowledge about the hazard elimination methods Explain standard operating procedures of shaper machine <p><u>Practical Activity</u></p> <p>Perform the activity of slotting on the shaper machine</p>	<p>Theory-1 Hrs. Practical-6 Hrs. Total- 7Hrs</p>	<ul style="list-style-type: none"> Measuring Tools Cutting Tool Inspection tools Personal Protective Equipment Shaper Machine and accessories 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>component at suitable intervals.</p> <ul style="list-style-type: none">• Shut down the machine at safe position after finishing the work.				
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 09 Module: Perform Milling and Hobbing Operations

Objective: This module covers the knowledge and skills required to arrange Tools, Equipment and material for milling operation, prepare work piece for milling operation, perform setting of milling machine, carryout milling operations, arrange tools, equipment and material for Hobbing to make the gear, set Hobbing Machine for operations, and carry out Hobbing operations to make gear.

Duration: 63 Hours

Theory: 12 Hours

Practice: 51 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Arrange tools, equipment and material for milling operation	Trainee will be able to: <ul style="list-style-type: none">Identify tools, equipment and material for milling operationSelect the tool, equipment, material (type, shape and size of cutter) according to the job requirementsArrange the measuring instruments and holding devices	<ul style="list-style-type: none">Explain milling operations and its typesKnowledge about the equipment & tools used for milling operations	Theory-2 Hrs. Practical-6 Hrs. Total- 8 Hrs	<ul style="list-style-type: none">Universal milling machine with standard accessoriesMeasuring toolsMarking toolsWork holding devicesPedestal grinderFilesCoolants and lubrications oilsPersonal protective equipmentFirst aid boxMaintenance tool kitHands tool kit	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



LU2: Prepare work piece for milling operation	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Interpret drawing as per job requirement • Prepare the work-piece by required machining (sawing and filing etc.) • Check and verify the dimensions of blank for making gear as per drawing. 	<ul style="list-style-type: none"> • Describe the application of milling operations • description about the interpretation of drawing • Knowledge about the sawing and filing <p><u>Practical Activity</u> Perform the activity to prepare work piece for milling operation</p>	<p>Theory-2 Hrs. Practical-6 Hrs. Total- 8 Hrs</p>	<ul style="list-style-type: none"> • Work piece Material • Measuring tools • Marking tools • Work holding devices • Pedestal grinder • Files • Coolants and lubrications oils • Personal protective equipment • First aid box • Maintenance tool kit • General repairing tool kit • Hands tool kit • Power hacksaw machine with blade 	<p>Class Room and Lab</p>
LU3. Perform setting of milling machine	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Clamp the blank work-piece and tool into its holding devices as per SOPs • Maintain the safe distance between work-piece and cutter 	<ul style="list-style-type: none"> • Describe the procedure of safe clamping the workpiece • Understanding of milling machine and its accessories 	<p>Theory-2 Hrs. Practical-6 Hrs. Total- 8 Hrs</p>	<ul style="list-style-type: none"> • Universal milling machine with standard accessories • Measuring tools • Marking tools • Coolants and lubrications oils 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>as per prescribed method</p> <ul style="list-style-type: none"> Adjust the revolution per minute(rpm) of spindle according to the specifications of work piece Adjust parameters of speed and feed from control unit as per prescribed methods 	<ul style="list-style-type: none"> Explain the speed and feed of milling machine Understanding about the adjustment of RPM <p><u>Practical Activity</u> Perform activity of setting RPM, speed and feed for the given job</p>		<ul style="list-style-type: none"> Personal protective equipment <ul style="list-style-type: none"> First aid box Maintenance tool kit General repairing tool kit Hands tool kit 	
LU4. Carryout milling operations	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Check the alignment of work piece Locate the cutter at work piece as per standard practice Start the milling operation as per drawing and job specifications Verify the dimensions of work piece as per drawing 	<ul style="list-style-type: none"> Explain the preparation of workpiece for milling operation Knowledge about alignment process <p><u>Practical Activity</u> Perform the activity of</p>	<p>Theory-3 Hrs. Practical-6 Hrs. Total- 9 Hrs</p>	<ul style="list-style-type: none"> Universal milling machine with standard accessories Measuring tools Marking tools Coolants and lubrications oils Personal protective equipment First aid box 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



		milling operation for given job		<ul style="list-style-type: none"> • Maintenance tool kit • General repairing tool kit 	
LU5. Arrange tools, equipment and material for hobbing to make the gear	<ul style="list-style-type: none"> • Identify tools, equipment and material for hobbing operation • Select the tool, equipment, material (type, shape and size of cutter) according to the job requirements • Arrange the measuring instruments and holding devices 	<ul style="list-style-type: none"> • Explain the hobbing operation • Understanding about the equipment and tools used in hobbing operation • Description of the measuring and marking tools 	Theory-2 Hrs. Practical-09 Hrs. Total- 11 Hrs	<ul style="list-style-type: none"> • Hobbing machine and its accessories • Power hacksaw machine with blade • Measuring and marking tools • Hob cutter sets • Lathe machine along with standard accessories • Work holding devices • Pedestal grinder with tools cutting angle support • Files • Coolants and lubrications oils • Personal protective equipment • First aid box 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



				<ul style="list-style-type: none"> • Maintenance tool kit • General repairing tool kit • Hands tool kit 	
LU6. Set hobbing machine for operations	<ul style="list-style-type: none"> • Clamp the gear blank in their holding devices as per the standard practice • Attach the Hob cutter as per the standard practice • Maintain safe distance between gear blank and hob cutter as per prescribed method • Adjust the Revolution Per Minute (RPM) of hob cutter • Adjust feed from control unit as per prescribed method • Adjust the table according to the specifications of work piece 	<ul style="list-style-type: none"> • Describe the procedure of safe clamping the blank • Understanding of hobbing machine and its accessories • Knowledge about the speed and feed of hobbing machine • Description of the adjustment of RPM for hobbing machine 	<p>Theory-3 Hrs. Practical-6 Hrs. Total- 9 Hrs</p>	<ul style="list-style-type: none"> • Hobbing machine and its accessories • Power hacksaw machine with blade • Measuring and marking tools • Hob cutter sets • Lathe machine along with standard accessories • Work holding devices • Pedestal grinder with tools cutting angle support • Files • Coolants and lubrications oils • Personal protective 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



		<u>Practical Activity</u> Perform setting of hobbing machine for making gear		equipment <ul style="list-style-type: none"> • First aid box • Maintenance tool kit • General repairing tool kit • Hands tool kit 	
LU7. Carryout hobbing operations to make gear	<ul style="list-style-type: none"> • Produce simple/ angled/differential indexing and divide the gear into required number of divisions • Check the position of hob cutter and the gear blank and adjust them, if required • Operate Hobbing machine according to given specifications • Ensure the parameters of the gear as per requirement • Check and confirm the measurements with given specifications and finalize the gear 	<ul style="list-style-type: none"> • Knowledge about the structure and functions of hobbing machine • Understanding about the material type for the preparation of gears • Description of the calculation of machine speed • Knowledge about the method of positioning hob cutter 	Theory-1 Hrs. Practical-9 Hrs. Total- 10 Hrs	<ul style="list-style-type: none"> • Hobbing machine and its accessories • Power hacksaw machine with blade • Measuring and marking tools • Hob cutter sets • Lathe machine along with standard accessories • Work holding devices • Pedestal grinder with tools cutting angle support • Files • Coolants and lubrications oils 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



		<p>and work piece in the hobbing machine</p> <p><u>Practical Activity</u> Operate hobbing machine to make gear as per instructions</p>		<ul style="list-style-type: none"> • Personal protective equipment • First aid box • Maintenance tool kit • General repairing tool kit • Hands tool kit 	
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 10 Module: Perform Shielded Metal Arc Welding (SMAW)

Objective: This module covers the knowledge and skills required to Prepare Welding Machine and Accessories for SMAW, Make Welds on Carbon Steel Plate [Flat (1F) and Flat (1G)], Make Welds on Carbon Steel Plate [Horizontal (2F) and Horizontal (2G)], Make Welds on Carbon Steel Plate [Vertical (3F) and Vertical (3G)], Make Welds on Carbon Steel Plate [Overhead (4F) and Overhead (4G)], and perform Post Welding Operations.

Duration: 76 Hours

Theory: 10 Hours

Practice: 66 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Prepare welding machine and accessories for SMAW	Trainee will be able to: <ul style="list-style-type: none"> Identify welding requirements of the job, Welding Procedure Specifications (WPS) and/or technical drawings Carry out the pre-cleaning of base metal as per requirement. Prepare SMAW welding machine in accordance with WPS/ manufacturer instructions Set-up welding 	<ul style="list-style-type: none"> Explain the SMAW process Understanding about the parameters of SMAW Describe the accessories required for the process of SMAW Knowledge about the applications of SMAW 	Theory-2 Hrs. Practical-12 Hrs. Total- 14 Hrs	<ul style="list-style-type: none"> Shielded Metal Arc Welding plant Welding plant accessories PPEs Welding Electrodes Electrode baking Oven Measuring tools Inspection tools 	Class Room and Lab



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	<p>machine accessories and consumables as per job requirements, WPS and/or manufacturer's instructions</p> <ul style="list-style-type: none"> • Connect welding machine to an independent power supply • Perform baking of electrode in an Oven as per standard. • Set polarity indicated in the WPS 	<p><u>Practical Activity</u></p> <p>Perform activity to prepare welding machine for SMAW</p>			
<p>LU2: Make Welds on Carbon Steel Plate Flat (1F) and Flat (1G)</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Adjust welding parameters (current, voltage etc.) as per WPS/job requirements to produce acceptable weld by maintaining gap between electrode and base metal as per standard practices 	<ul style="list-style-type: none"> • Knowledge about the different types of joints • Describe the various position of welding • Understanding about the difference of flat and groove 	<p>Theory-2 Hrs. Practical-12 Hrs. Total- 14 Hrs</p>	<ul style="list-style-type: none"> • Shielded Metal Arc Welding plant • Welding plant accessories • PPEs • Welding Electrodes • Electrode 	<p>Class Room and Lab</p>



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“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> • Carry out pre-heating of the given job, if needed. • Carry out welding in Flat (1F) and Flat (1G) positions following standard procedures. • Carry out the cleaning of root pass as per requirement • Maintain distance between electrode and base metal as per standard practices. • Deposit root pass as per WPS/job requirements • Deposit filling passes as per WPS/job requirements • Deposit capping pass as per WPS/job requirements • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects 	<p>welds</p> <ul style="list-style-type: none"> • Explain the pre-heating of workpiece for welding • Description of the root pass, filing pass and capping pass. • Knowledge welding codes and standards <p><u>Practical Activity</u></p> <p>Perform weld on carbon steel plate, Flat (1G)</p>		<p>baking Oven</p> <ul style="list-style-type: none"> • Measuring tools • Inspection tools 	
LU3. Make	Trainee will be able to:	<ul style="list-style-type: none"> • Knowledge 	Theory-1 Hrs. Practical-09	<ul style="list-style-type: none"> • Shielded Metal 	



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“Metal Forming & Processing Senior Technician” Level 04



Welds on Carbon Steel Plate Horizontal (2F) and Horizontal (2G)	<ul style="list-style-type: none"> Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirements to produce acceptable weld. Carry out pre-heating of the given job, if needed. Maintain distance between electrode and base metal as per standard practices. Carry out welding in Horizontal (2F) and Horizontal (2G) positions following standard procedures Deposit root pass as per welding procedure specifications/job requirements Deposit filling passes as per welding procedure specifications/job requirements Deposit capping pass as per welding 	<p>about horizontal (2F) and (2G) welding positions</p> <p><u>Practical Activity</u></p> <p>Perform weld on carbon steel plate, Horizontal (2F)</p>	<p>Hrs. Total- 10 Hrs</p>	<p>Arc Welding plant</p> <ul style="list-style-type: none"> Welding plant accessories PPEs Welding Electrodes Electrode baking Oven Measuring tools Inspection tools 	
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“Metal Forming & Processing Senior Technician” Level 04



	<p>procedure specifications/job requirements</p> <ul style="list-style-type: none"> • Carry out the cleaning of passes as per requirement • Check root, filling and capping passes for any visual discontinuities as per acceptance standards • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects 				
LU4. Make Welds on Carbon Steel Plate Vertical (3F) and Vertical (3G)	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Adjust welding parameters (current, voltage etc.) as per welding procedure specifications/job requirement to produce acceptable weld • Carry out pre-heating of the given job, if needed. • Maintain distance between electrode and base metal as per 	<ul style="list-style-type: none"> • Knowledge about the vertical 3F and vertical 3G welding positions <p><u>Practical Activity</u></p> <p>Perform weld on carbon steel plate, Vertical (3G)</p>	<p>Theory-1 Hrs. Practical-12 Hrs. Total- 13 Hrs</p>	<ul style="list-style-type: none"> • Shielded Metal Arc Welding plant • Welding plant accessories • PPEs • Welding Electrodes • Electrode baking Oven • Measuring tools • Inspection tools 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>standard practices</p> <ul style="list-style-type: none"> • Carry out welding in Vertical (3F) and Vertical (3G) positions following standard procedures • Deposit root pass as per welding procedure specifications/job requirements • Deposit filling passes as per welding procedure specifications/job requirements • Deposit capping pass as per welding procedure specifications/job requirements • Carry out the cleaning of passes as per requirement • Check root, filling and capping passes for any visual discontinuities as per acceptance standards • Follow applicable manufacturing codes and standards for 				
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	acceptance criteria of visual welding defects				
LU5. Make Welds on Carbon Steel Plate Overhead (4F) and Overhead (4G)	Trainee will be able to: <ul style="list-style-type: none"> Adjust welding parameters (current, voltage etc.) as per WPS/job requirements to produce acceptable weld Carry out pre-heating of the given job, if needed. Maintain distance between electrode and base metal as per standard practices Carry out welding in Overhead (4F) and Overhead (4G) positions following standard procedures Deposit root pass as per WPS/job requirements Deposit filling passes as per WPS/job requirements Deposit capping pass as per WPS/job 	<ul style="list-style-type: none"> Knowledge about the overhead 4F and overhead 4G welding positions <p><u>Practical Activity</u> Perform weld on carbon steel plate, overhead (4F)</p>	<p>Theory-2 Hrs. Practical-09 Hrs. Total- 11 Hrs</p>	<ul style="list-style-type: none"> Shielded Metal Arc Welding plant Welding plant accessories PPEs Welding Electrodes Electrode baking Oven Measuring tools Inspection tools 	



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“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> requirements • Carry out the cleaning of passes as per requirement • Check root, filling and capping passes for any visual discontinuities as per acceptance standards • Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects 				
LU6. Perform Post Welding Operations	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Carry out finishing work of welds following standard procedures • Inspect weld visually and mark any defects, if any • Carry out repair work in accordance with approved procedures, if required • Perform post weld heat treatment operation as per requirement. 	<ul style="list-style-type: none"> • Explain the various tools and equipment used for post welding operating for SMAW • Description of the difference types of welding defects • Knowledge about the remedies of 	<p>Theory-2 Hrs. Practical-12 Hrs. Total- 14 Hrs</p>	<ul style="list-style-type: none"> • Shielded Metal Arc Welding plant • Welding plant accessories • PPEs • Welding Electrodes • Electrode baking Oven • Measuring tools • Inspection tools 	



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	<ul style="list-style-type: none"> • Clean work area in accordance with workplace safety practices • Maintain tools/equipment/consumable materials in accordance with organization guidelines • Store tools/equipment/consumable materials in accordance with organization guidelines 	<p>welding defects</p> <ul style="list-style-type: none"> • Explain the heat treatment of welded components <p><u>Practical Activity</u> Perform the activity of post weld heat treatment operation as per requirement</p>			
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0715-MF&P 11 Module: Perform Submerged Arc Welding (SAW)

Objective: This module covers the knowledge and skills required to Prepare Welding Machine and Accessories for SAW, Make Fillet Weld on Carbon Steel Plate, Make Groove Weld on Carbon Steel Plate and Perform Post Welding Operations.

Duration: 58 Hours

Theory: 10 Hours

Practice: 48 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Prepare welding machine and accessories for SAW	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Identify welding requirements from the job, Welding Procedure Specifications (WPS) and/or technical drawings Prepare Submerged Arc Welding (SAW) power supply unit in accordance with WPS/manufacturer instructions Set up welding machine accessories as per job requirements, WPS and/or manufacturer instructions Set up welding machine's wire feeding unit as per 	<ul style="list-style-type: none"> Describe the SAW process Description of the parameters of SAW Knowledge about the accessories required for the process of SAW explain the applications of SAW <p><u>Practical Activity</u></p> <p>Perform activity to prepare welding machine for SAW</p>	<p>Theory-3 Hrs. Practical-12 Hrs. Total- 15 Hrs</p>	<ul style="list-style-type: none"> SAW Welding plant Welding plant accessories PPEs Measuring tools Inspection tools 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>WPS</p> <ul style="list-style-type: none"> • Set Granular flux hopper as per requirement • Connect welding machine to an independent power supply • Set polarity indicated in the WPS 				
LU2: Make Fillet weld on Carbon Steel plate	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Adjust welding parameters (current, voltage, wire feed speed, welding speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld • Maintain gap between electrode and base metal as per standard practices • Carry out pre-heating of the given job, if needed. • Carry out welding in 1F, 2F, 3F positions following standard procedures • Carry out the cleaning of root pass as per requirement • Carryout the re-usage of 	<ul style="list-style-type: none"> • Describe the characteristics of ferrous material, carbon steel and stainless steel • Explain the components and features of the SAW equipment • Understanding about the characteristics of electric arc used for welding • Knowledge about the re-usage of flux in welding 	<p>Theory-3 Hrs. Practical-12 Hrs. Total- 15 Hrs</p>	<ul style="list-style-type: none"> • SAW Welding plant • Welding plant accessories • PPEs • Measuring tools • Inspection tools 	<p>Class Room and Lab</p>



Curriculum
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	<p>granular flux during welding</p> <ul style="list-style-type: none"> Follow applicable manufacturing codes and standards for acceptance criteria of visual welding defects 	<p><u>Practical Activity</u></p> <p>Perform activity of fillet weld on carbon steel plate</p>			
<p>LU3. Make Groove weld on carbon steel plate</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Adjust welding parameters (current, voltage, wire feed speed, welding speed etc.) as per welding procedure specifications/job requirements to produce acceptable weld Maintain gap between electrode and base metal as per standard practices Carry out pre-heating of the given job, if needed. Carry out welding in 1G position following standard procedures Deposit root pass as per WPS/job requirements Deposit filling passes as per welding procedure specifications/job requirements Deposit capping pass as 	<ul style="list-style-type: none"> Explain the difference between fillet and groove weld using SAW Description of welding codes and standards for SAW <p><u>Practical Activity</u></p> <p>Perform activity to make groove weld on given job</p>	<p>Theory-2 Hrs. Practical-12 Hrs. Total- 14 Hrs</p>	<ul style="list-style-type: none"> SAW Welding plant Welding plant accessories PPEs Measuring tools Inspection tools 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>per welding procedure specifications/job requirements</p> <ul style="list-style-type: none"> • Carry out the cleaning of passes as per requirement • Check root, filling and capping passes for any visual discontinuities as per acceptance standards • Follow applicable manufacturing codes and standards for visual welding defects 				
LU4. Perform post welding operations	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Carry out finishing work of welds following standard procedures • Inspect weld visually and mark any visual defects, as required • Perform Post Weld Heat Treatment of weld as per requirement • Carry out repair work in accordance with approved procedures, as required • Clean work area in accordance with workplace safety practices • Maintain 	<ul style="list-style-type: none"> • Describe the various tools and equipment used for post welding operating for SAW • Explain the common welding defects produced in SAW • Knowledge about the remedies of welding defects produced in SAW <p><u>Practical Activity</u></p> <p>Perform the activity of post</p>	<p>Theory-2 Hrs. Practical-12 Hrs. Total- 14 Hrs</p>	<ul style="list-style-type: none"> • SAW Welding plant • Welding plant accessories • PPEs • Measuring tools • Inspection tools 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>tools/equipment/consumable materials in accordance with organization guidelines</p> <ul style="list-style-type: none"> • Store tools/equipment/consumable materials in accordance with organization guidelines 	weld heat treatment operation as per requirement			
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0715-MF&P 12 Module: Perform Metal Die Casting Operations

Objective: This module covers the knowledge and skills required to arrange material for die casting, conduct pre-operational checks on machine, prepare the casting molds, operate die casting machine, inspect final product and perform workplace cleaning.

Duration: 102 Hours Theory: 6 Hours Practice: 96 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Arrange material for die (cold chambered high pressure) casting	Trainee will be able to: <ul style="list-style-type: none"> Interpret the drawing/process sheet for material requirement Select tools and equipment. Prepare the melting furnace as per SOPs (Crucible). Prepare Holding furnace as per SOPs (Crucible). Set die casting machine Parameters as per job specification. 	<ul style="list-style-type: none"> Describe the die casting and its types Description of various types of die casting materials Explain the application of die casting Knowledge about the difference between sand casting and die casting Understanding about the standard SOPs related to the 	Theory-1 Hrs. Practical-15 Hrs. Total- 16 Hrs.	<ul style="list-style-type: none"> Die Casting Machine Die Casting Mould Holding furnace Melting furnace (Crucible) Lifting chains Shackles Fork lifter Lifting Hoist Different sizes of plunger Measuring tools First aid box 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



		melting furnace		<ul style="list-style-type: none"> PPEs Pyrometer 	
LU2: Conduct pre-operational checks on machine	Trainee will be able to: <ul style="list-style-type: none"> Inspect all electrical connections. Check all mechanical fittings of mould (Bush water leakage nozzles, etc.) coolants 'lubricants, pasts, gate breaking Fixture etc. Check operation of emergency switches. Check plunger rod tip, moment, cooling system. Check cleaning, descaling of cooling lines of mould. Check and maintain proper lubrication of plunger rod, sleeve, and mould. Check air pressure of safety door, spray 	<ul style="list-style-type: none"> Description about the various parts of die casting machine Understanding about the different parts of die <p style="text-align: center;"><u>Practical Activity</u></p> <p>Prepare a list to conduct pre operational checks on machine</p>	<p>Theory-1 Hrs. Practical-15 Hrs. Total- 16 Hrs.</p>	<ul style="list-style-type: none"> Die Casting Machine Die Casting Mould Holding furnace Melting furnace (Crucible) Lifting chains Shackles Fork lifter Lifting Hoist Different sizes of plunger Measuring tools First aid box PPEs First aid box PPEs 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> head, • Check all water connections.. 				
LU3. Prepare the high pressure die casting molds	Trainee will be able to: <ul style="list-style-type: none"> • Lift mould with standard lifting equipment. • Place the mould between both side (fixed and movables) of mould platen. • Align mould in the center of platen. • Connect hydraulic and water connections. • Clamp mould with bolts/ hydraulic Couplings. • Check spray head nozzles position as per mould, core requirements. • Apply die releasing agent/ paste spray/beads. • Make a three to Shots on Intensification on off position for preheating of mould 	<ul style="list-style-type: none"> • Explain the types of molds • Understanding about the alignment process • Knowledge about various types of cores used in die casting • Knowledge about types of clamps used in die casting molds <p><u>Practical activity:</u></p> <p>Install the die casting mold on machine and perform required operational setting</p>	Theory-1 Hrs. Practical-18 Hrs. Total- 19 Hrs.	<ul style="list-style-type: none"> • Die Casting Machine • Die Casting Mould • Holding furnace • Melting furnace (Crucible) • Lifting chains • Shackles • Fork lifter • Lifting Hoist • Different sizes of plunger • Measuring tools • First aid box • PPEs 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



<p>LU4. Operate die casting machine (cold chambered high, HP pressure)</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Set all operating parameters of machine as per SOP • Adjust Quantity of molten metal from holding furnace in machine ladle as per mould size for auto Liddle. • Check all lubrication of mould, tip, and tie bars on auto. • Pour the casting material in the sleeve of plunger rod. • Preheat mould with burner. • Make de hydration of molten material in holding furnace. • Preheat mould sleeve by pouring molten metal in sleeve. • Proceed with die casting operation on auto run. • Brake risers, air vents flashes, gate of mould 	<ul style="list-style-type: none"> • Explain the different parameters in die casting • Advantages of die casting • Limitation of die casting • <p><u>Practical Activity</u></p> <p>Perform the activity to operate die casting machine and perform post casting operation on product</p>	<p>Theory-1 Hrs. Practical-15 Hrs. Total- 16 Hrs.</p>	<ul style="list-style-type: none"> • Die Casting Machine • Die Casting Mould • Holding furnace • Melting furnace (Crucible) • Lifting chains • Shackles • Fork lifter • Lifting Hoist • Different sizes of plunger and sleeves • Measuring tools • First aid box • PPEs 	
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Curriculum
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	breaking fixture of mould <ul style="list-style-type: none"> • Make air blow on mould face, Spray die release agent in mould with spray head/ manual spray gun, and dry with air as per mould requirement. • Monitor operations to ensure compliance with job requirements. 				
LU5. Inspect final product	Trainee will be able to: <ul style="list-style-type: none"> • Perform visual inspection for defects, if any. • Cut shot from different positions of casting to check blowholes, pinholes in casting • Check dimensions of the product as per drawing for first production only. • Check part on checking fixture if any. • Complete inspection report. 	<ul style="list-style-type: none"> • Explain the common defects produced in die casting • Describe the remedies of defects produced in die casting • Knowledge about the inspection of the final product 	Theory-1 Hrs. Practical-15 Hrs. Total- 16 Hrs.	<ul style="list-style-type: none"> • Die Casting product • Measuring tools • Inspection tools • First aid box • PPEs 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



<p>LU6. Perform workplace cleaning</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Maintain all check sheets and work instructions. • Perform cleaning, and descaling of mould cooling lines, machine and floor after job completion. • Perform Lubrication on slides, tie bar and mould. • Apply anti-rust spray/cleaning agent. • Store the tools and equipment. • Return excess material to store. • Transfer waste material into designated area. 	<ul style="list-style-type: none"> • Explain the standard cleaning procedure • Understanding about the lubrication <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> • Perform die machine cleaning activity 	<p>Theory-1 Hrs. Practical-18 Hrs. Total- 19 Hrs.</p>	<ul style="list-style-type: none"> • Cleaning equipment and Accessories 	
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0715-MF&P 13 Module: Perform Centrifugal Casting Process

Objective: This module covers the knowledge and skills required to prepare mold for casting, cast the molten metal, remove the Casting from molds and perform post casting operations.

Duration: 51Hours

Theory: 6 Hours

Practice: 45 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Prepare Mold for casting	Trainee will be able to: <ul style="list-style-type: none"> • Arrange material for centrifugal casting process • Apply refractory ceramic coating to cylindrical mold walls • Perform rotation of mold to spread coating properly • Perform drying of ceramic coat as per standard operating procedures • Rotate mold about its axis at required speeds 	<ul style="list-style-type: none"> • Describe centrifugal casting process • Knowledge about the material required for the centrifugal casting process • Explain the refractory ceramic coating of cylindrical mold walls • Explain the types of centrifugal casting 	Theory-1 Hrs. Practical-12 Hrs. Total- 13 Hrs.	<ul style="list-style-type: none"> • Centrifugal Casting Machine & accessories • Centrifugal Casting Mold • Moving and fixed platen • Measuring Devices 	Class Room and Lab



Curriculum
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LU2: Cast the molten metal	Trainee will be able to: <ul style="list-style-type: none">• Pour molten metal directly into the rotating mold without the use of runners or a gating system.• Pour the molten metal into the mold• Carryout pouring of molten metal as per standard• Follow safe handling practice during pouring of molten metal• Perform solidification of molten metal at room temperature• Trim the casting to the desired shape.	<ul style="list-style-type: none">• Explain the application of centrifugal casting• Describe the parameters of centrifugal casting• Knowledge about the safety precaution for the centrifugal casting <p style="text-align: center;"><u>Practical Activity</u></p> <p>Perform the activity to cast the molten metal</p>	Theory-1 Hrs. Practical-12 Hrs. Total- 13 Hrs.	<ul style="list-style-type: none">• Centrifugal Casting Machine & accessories• Centrifugal Casting Mold• Melting furnace (Crucible)• Plungers• Pot• Goose neck• Ladle• Moving and fixed platen• Lifting chains• Measuring devices• First aid box• PPEs	Class Room and Lab
LU3. Remove the casting from molds	Trainee will be able to: <ul style="list-style-type: none">• Take the metal out of the mold as per standard practice• Remove the solidified casting from mold• Inspect the molted part for defects, if any	<ul style="list-style-type: none">• Knowledge about the casting removal from the molds• Explain the inspection process in centrifugal casting	Theory-2 Hrs. Practical-12 Hrs. Total- 14 Hrs	<ul style="list-style-type: none">• Centrifugal Casting Machine & accessories• Centrifugal Casting Mold• Melting furnace (Crucible)• Plungers	



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	<ul style="list-style-type: none"> • Prepare the inspection report as per SOPs 	<p><u>Practical Activity</u></p> <ul style="list-style-type: none"> • Perform the activity of removing solidified casting from the mold • Prepare the inspection report as per the standard procedure 		<ul style="list-style-type: none"> • Pot • Goose neck • Ladle • Moving and fixed platen • Lifting chains • Measuring devices • First aid box • PPEs 	
LU4. Perform post casting operations	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Clean less dense impurities or bubbles at the inner surface of the casting. • Perform shot blasting to smooth the inner diameter of the part. • Execute proper shut down of the machine • Perform regular cleaning process as prescribed by manufacturer 	<ul style="list-style-type: none"> • Explain the process of post casting operations • Knowledge about the shot blasting • Understanding about the standard cleaning process <p><u>Practical Activity</u></p> <p>Perform the activity of shot blasting to smooth the inner diameter of the given part</p>	<p>Theory-2 Hrs. Practical-9 Hrs. Total- 11 Hrs</p>	<ul style="list-style-type: none"> • Centrifugal Casting product • Measuring tools • Inspection tools • Shot blasting Plant • First aid box • PPEs 	



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0715-MF&P 14 Module: Perform Shell Mold Casting

Objective: This module covers the knowledge and skills required to arrange pattern for casting, prepare the mold for casting, assemble mold for casting, cast molten metal in mold and remove the casting from mold.

Duration: 57 Hours:

Theory: 6 Hours

Practice: 51 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Arrange pattern for casting	Trainee will be able to: <ul style="list-style-type: none"> Handle two-piece metal pattern as per job requirement Use Aluminum pattern for mass production of patterns Use Graphite pattern for casting of reactive materials. 	<ul style="list-style-type: none"> Describe shell mold casting process Knowledge about the material required for the shell mold casting process Knowledge about graphite pattern for casting reactive material 	Theory-1 Hrs. Practical-12 Hrs. Total- 13 Hrs	<ul style="list-style-type: none"> Shell Mold PPEs 	Class Room and Lab
LU2: Prepare the mold for casting	Trainee will be able to: <ul style="list-style-type: none"> Heat up the pattern as per job requirements Coat the pattern with a lubricant to facilitate removal. Clamp the heated 	<ul style="list-style-type: none"> Explain the mold creating techniques Knowledge to prepare the mold for casting 	Theory-1 Hrs. Practical-12 Hrs. Total- 13 Hrs	<ul style="list-style-type: none"> Squeezing and jolting Machine Steam Plant Adhesive Materials 	Class Room and Lab



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	<p>pattern to a dump box (containing a mixture of molding material).</p> <ul style="list-style-type: none"> • Invert the dump box allowing molding material (Sand-resin mixture) to coat the pattern. • Make a shell around the heated pattern • Eject the shell from the pattern 	<p><u>Practical Activity</u></p> <p>Prepare mold for shell casting</p>		<ul style="list-style-type: none"> • Dump box • Shell Mold • Crucible • Dies • Die coats • Metal holding pot • Clamping device • PPEs 	
<p>LU3. Assemble mold for casting</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Join the two shell together as per job requirement • Insert core in the mold, if required. • Clamp mold parts to form the complete shell mold. • Place the shell mold into a flask supported by a backing material. 	<ul style="list-style-type: none"> • Knowledge about the assembly of molding <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> • Perform the activity to assemble molds for casting 	<p>Theory-1 Hrs. Practical-09 Hrs. Total- 10 Hrs</p>	<ul style="list-style-type: none"> • Dump box • Shell Mold • Tongs • Crucible • Dies • Die coats • Metal holding pot • Clamping device • PPEs • Ultrasonic machine for binding both halves of mold 	



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“Metal Forming & Processing Senior Technician” Level 04



LU4. Cast molten metal in mold	Trainee will be able to: <ul style="list-style-type: none"> • Pour molten metal from ladle through gating system • Fill the mold cavity completely with the molten metal • Perform cooling of molten metal as per SOPs • Carryout solidification of molten metal into final casting 	<ul style="list-style-type: none"> • Knowledge of pouring techniques • Explain the standard procedure to safely cool the molten metal <p><u>Practical Activity</u></p> <p>Pour molten metal into the mold</p>	<p>Theory-1 Hrs. Practical-12 Hrs. Total- 13 Hrs</p>	<ul style="list-style-type: none"> • Melting Furnace and accessories • Dump box • Shell Mold • Transfer Ladles • Tongs • Crucible • Mold coats • Metal holding pot • Clamping device • Transfer ladles • PPEs 	
LU5. Remove the casting from mold	Trainee will be able to: <ul style="list-style-type: none"> • Break the mold after the metal is cool down • Trim excess metal from the feed system, if any • Remove any sand from the mold, if any • Perform post casting inspection for any defect, if any • Prepare the inspection report as per SOPs 	<ul style="list-style-type: none"> • Describe the types of process of removing casting from the molds • Explain the inspection process in shell casting <p><u>Practical Activity</u></p> <p>Remove casted metal from the mold</p>	<p>Theory-2 Hrs. Practical-6 Hrs. Total- 8 Hrs</p>	<ul style="list-style-type: none"> • Inspection tools • Shell Mold • Tongs • Metal holding pot • Clamping device • PPEs 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 15 Module: Perform Investment Casting

Objective: This module covers the knowledge and skills required to arrange pattern for Casting, prepare mold for casting, perform casting and perform post-casting operations.

Duration: 68 Hours:

Theory: 8 Hours

Practice: 60 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Arrange pattern for casting	Trainee will be able to: <ul style="list-style-type: none"> • Arrange wax patterns as per requirement • Use cores to form internal features within the pattern, if required • Attach patterns to a central wax gating system (sprue, runners, and risers) to form a tree-like assembly 	<ul style="list-style-type: none"> • Describe the investment casting • Knowledge about the steps involved in investment casting • limitation of investment casting • Knowledge of material used in investment casting <p style="text-align: center;"><u>Practical Activity</u> Prepare pattern for investment Casting</p>	<p>Theory-2 Hrs. Practical-15 Hrs. Total- 17 Hrs</p>	<ul style="list-style-type: none"> • Melting Furnace and Accessories • Wax Injector • Flask • Ladle • Wax patterns • Shell Coater • Slurry Tanks • Shell Handlers • Casting Handlers • Barrel Sanders • Grinders • Casting Positioner 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



LU2: Prepare mold for casting	Trainee will be able to: <ul style="list-style-type: none"> Place wax tree-like assembly into mold flask Prepare slurry by mixing ceramic powder with water and stir it homogenously Perform degassing of slurry in vacuum chamber Pour slurry into the flask to coat the wax pattern tree Bake the shell as per standard to form a ceramic shell around the patterns and gating system Remove the wax leaving a hollow ceramic shell that acts as a one-piece mold Apply protective coating to mold as per standard 	<ul style="list-style-type: none"> Explain the mold creating techniques in investment casting Knowledge of preparation the mold for investment casting Understanding about the protective coating for the mold <p style="text-align: center;"><u>Practical Activity</u> Prepare mold for investment casting</p>	<p style="text-align: center;">Theory-2 Hrs. Practical-15 Hrs. Total- 17 Hrs.</p>	<ul style="list-style-type: none"> Melting Furnace and Accessories Wax Injector Flask Ladle Wax patterns Shell Coater Slurry Tanks Shell Handlers Casting Handlers Barrel Sanders Grinders Casting Positioner 	<p style="text-align: center;">Class Room and Lab</p>
LU3. Perform casting	Trainee will be able to: <ul style="list-style-type: none"> Pre-heat mold in a 	<ul style="list-style-type: none"> Knowledge to perform the 	<p style="text-align: center;">Theory-2 Hrs. Practical-15 Hrs.</p>	<ul style="list-style-type: none"> Melting Furnace and 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>furnace as per SOP</p> <ul style="list-style-type: none"> • Pour molten metal from a ladle into the gating system of the mold • Carry out complete filling of the mold cavity with liquid melt as per standard operating procedure 	<p>investment casting and steps involved</p> <ul style="list-style-type: none"> • Describe the gating system <p><u>Practical Activity</u> Perform investment casting</p>	Total- 17 Hrs	<p>Accessories</p> <ul style="list-style-type: none"> • Wax Injector • Flask • Ladle • Wax patterns • Shell Coater • Slurry Tanks • Shell Handlers • Casting Handlers • Barrel Sanders • Grinders • Casting Positioner 	
LU4. Perform post-casting operations	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Perform cooling of molten metal as per SOPs • Carryout solidification of molten metal into final casting • Remove casting flask as per standard procedure 	<ul style="list-style-type: none"> • Explain the process of post casting operations • Understanding about the standard cleaning process • Describe the standard procedure to dispose-off the waste material 	<p>Theory-2 Hrs. Practical-15 Hrs. Total- 17 Hrs</p>	<ul style="list-style-type: none"> • Melting Furnace and Accessories • Wax Injector • Flask • Ladle • Wax patterns • Shell Coater • Slurry Tanks • Shell 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> • Separate the casted parts from gating system either by sawing or cold breaking (using liquid nitrogen) • Perform post casting inspection for any defect, if any • Prepare the inspection report as per SOPs • Clean up work area and equipment • Dispose-off waste at designated place 	<p><u>Practical Activity</u> Perform post- investment casting operations</p>		Handlers <ul style="list-style-type: none"> • Casting Handlers • Barrel Sanders • Grinders • Casting Positioner 	
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 16 Module: Perform Die Forging Process

Objective: This module covers the knowledge and skills required to perform Open Die Forging (Cold, Hot), perform Closed/Impression Die Forging (Cold, Hot), perform precision/flash less forging operation, and Perform forging machine maintenance.

Duration: 57 Hours:

Theory: 6 Hours

Practice: 51 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform open die forging (cold/hot)	Trainee will be able to: <ul style="list-style-type: none"> Identify the tools and equipment required for the task. Calculate the material volume based on task requirements. Select open die as per requirement of forging Setup the Forging machine in accordance with the Standard Operating Procedure and specifications. Heat up the charge / billet to the specified temperature in case of 	<ul style="list-style-type: none"> Explain different types of forging dies Understanding about the accessories of forging hammers and presses Knowledge about the usage of various forging dies Calculations of the forging loads for open die Describe different parameters of forging operations Understanding about the difference between forging 	Theory-2 Hrs. Practical-12 Hrs. Total- 14 Hrs.	<ul style="list-style-type: none"> Forging machine and accessories Forging hammer Forging dies Anvil Heating furnaces PPEs Clamping devices Tongs Punch Fuller Flatter Swage 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>hot die forging</p> <ul style="list-style-type: none"> • Carryout pre-forming / Edging operation • Carryout forging operation as per requirement • Perform trimming operation as per requirement • Carryout inspection of the finish product. 	<p>hammers and forging press</p> <ul style="list-style-type: none"> • Knowledge about the tools and equipment required for the forging process <p><u>Practical Activity</u> Perform open die forging (cold/hot) as per instruction</p>		<ul style="list-style-type: none"> • Swage block • Measuring tools 	
LU2: Perform Impression Die Forging (Cold/Hot)	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Identify the tools and equipment required for the task. • Calculate the material volume based on task requirements. • Select close/impression die as per the requirement of forging • Setup the Forging machine in accordance with the Standard 	<ul style="list-style-type: none"> • Knowledge about the close die forging (cold/hot) • Identification of Tools and equipment required in close die forging • Calculations of the forging loads for close die • Understanding about the formation of flash • Knowledge about the advantages and 	<p>Theory-2 Hrs. Practical-12 Hrs. Total- 14 Hrs .</p>	<ul style="list-style-type: none"> • Forging machine and accessories • Forging hammer • Forging dies • Anvil • Forging hardies • Heating furnaces • PPEs • Clamping 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>Operating Procedure and specifications.</p> <ul style="list-style-type: none"> Heat up the charge / billet to the specified temperature in case of hot die forging Carryout pre-forming / Edging operation Carryout forging operation as per requirement Perform trimming operation as per requirement Carryout inspection of the finish product. 	<p>disadvantages of flash</p> <p><u>Practical Activity</u> Perform impression die forging (cold/hot)</p>		<p>devices</p> <ul style="list-style-type: none"> Tongs Punches Fullers Flatters Swages Swage block Measuring tools 	
<p>LU3. Perform precision / flash less forging operation</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Select the tools and Equipment required for the given task. Calculate the material volume based on task requirements. Use tools and formers according to the standard operating procedure. Setup the forging machine in accordance 	<ul style="list-style-type: none"> Understanding about the process of precision/ flash less forging operation Explain the process of inspection related to the final product Describe the advantages of precision forging 	<p>Theory-1 Hrs. Practical-15 Hrs. Total- 16 Hrs</p>	<ul style="list-style-type: none"> Forging machine and accessories Forging hammer Forging dies Anvil Heating furnaces PPEs Clamping devices 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>with the Standard Operating Procedure and specifications.</p> <ul style="list-style-type: none"> • Operate the forging machine in accordance with the Standard Operating Procedure • Carryout inspection of the finish produce. 	<ul style="list-style-type: none"> • Knowledge about the tools and equipment required for precision/flash less forging operation • Understanding about the special types of precision forging <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> • Perform the activity of precision / flash less forging operation as per instructions 		<ul style="list-style-type: none"> • Tongs • Punch • Fuller • Flatter • Swage • Swage block • Measuring tools 	
LU4. Perform forging machine maintenance	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Carryout Preventive maintenance of the machine. • Check the moving parts of the machine for excessive play. • Calibrate forging load of the machine as per 	<ul style="list-style-type: none"> • Knowledge about the maintenance of forging machine • Understanding about the personal protection equipment required for the forging operations 	<p>Theory-1 Hrs. Practical-12 Hrs. Total- 13 Hrs</p>	<ul style="list-style-type: none"> • Forging machine and accessories • Inspection tools • Measuring tools • Forging presses 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>SOPs</p> <ul style="list-style-type: none">• Clean, align and lubricate die load of the machine• Use required PPEs during maintenance of machine	<p><u>Practical Activity</u></p> <p>Perform the activity of forging machine preventive maintenance as per the given instructions</p>			
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 17 Module: Perform Hydrostatic Extrusion Process

Objective: This module covers the knowledge and skills required to perform cold hydrostatic extrusion, perform hot hydrostatic extrusion and carryout inspection of finished product

Duration: 108 Hours:

Theory: 12 Hours

Practice: 96 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform cold hydrostatic extrusion	Trainee will be able to: <ul style="list-style-type: none"> • Arrange metal-forming dies as per standard • Select the suitable raw material for cold Hydrostatic Extrusion process • Inspect tools for correct installation • Carryout the cold hydrostatic extrusion process as per SOPs • Store the extruded product as per SOPs • Turn off the cold hydrostatic extrusion machine as per SOPs 	<ul style="list-style-type: none"> • Explain the extrusion process • Knowledge about the types of extrusion • Understanding about the hydrostatic extrusion • Describe the cold hydrostatic extrusion • Knowledge about the cold hydrostatic machine and its accessories • Understanding about the application of cold hydrostatic extrusion 	<p>Theory-4 Hrs. Practical-33 Hrs. Total- 37 Hrs.</p>	<ul style="list-style-type: none"> • Hydrostatic Extrusion Machine with accessories • Dies • Hand tools • Lubricants • Measuring tools 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	Carryout inspection of the finish product.	<p style="text-align: center;"><u>Practical Activity</u></p> <p>Perform the activity of Cold hydrostatic extrusion as per the instructions</p>			
LU2: Perform hot hydrostatic extrusion	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Arrange metal-forming dies as per standard • Select the suitable raw material for Hot Hydrostatic extrusion process • Inspect tools for standard installation • Pre-heat the Die prior to the hot Hydrostatic Extrusion process • Adjust the temperature of the Die, if required. • Carryout the hot extrusion process • Store the extruded product as per SOPs • Turn off the Hot hydrostatic extrusion machine as per SOPs 	<ul style="list-style-type: none"> • Describe the hot hydrostatic extrusion • Knowledge about the hot hydrostatic machine and its accessories • Understanding about the application of hot hydrostatic extrusion <p style="text-align: center;"><u>Practical Activity</u></p> <ul style="list-style-type: none"> • Perform the activity of Hot hydrostatic extrusion as per given instructions 	<p>Theory-4 Hrs. Practical-33 Hrs. Total- 37 Hrs.</p>	<ul style="list-style-type: none"> • Hydrostatic Extrusion Machine with accessories • Dies • Hand tools • Lubricants • Measuring tools 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



<p>LU3. Carryout inspection of finished product</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Select samples to check conformance as per the requirement • Verify the dimensions of the finished products as per the given drawing • Carry out inspection of the finished extruded product as per Quality Standards. • Record the deviations, if any, with the given specifications • Report the deviations for corrective measures. 	<ul style="list-style-type: none"> • Understanding about the inspection of extruded product • Knowledge about the extrusion defects • Knowledge about the remedies of extrusion defects <p><u>Practical Activity</u></p> <p>Prepare inspection report for extruded job</p>	<p>Theory-4 Hrs. Practical-30 Hrs. Total- 34 Hrs</p>	<ul style="list-style-type: none"> • Inspection tools • Measuring tools 	
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 18 Module: Perform wire drawing process

Objective: This module covers the knowledge and skills required to arrange tools and equipment for wire drawing through draw plate, Perform annealing of the given wire to be drawn, carryout pull through drawplate and perform wire drawing operation on metal blank.

Duration: 63 Hours:

Theory: 12 Hours

Practice: 51 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Arrange tools and equipment for wire drawing through draw plate	Trainee will be able to: <ul style="list-style-type: none"> Arrange the required tools and equipment required for the process Arrange raw material wire for wire drawing process as per requirement Select the required tools and equipment for wire drawing process Inspect the working condition of tools and 	<ul style="list-style-type: none"> Describe the process of wire drawing Knowledge about the difference of wire drawing and deep drawing Knowledge about the tools and equipment required for wire drawing process <p style="text-align: center;"><u>Practical Activity</u></p> <p>Perform the activity of arranging tools for the</p>	<p>Theory-3 Hrs. Practical-12 Hrs. Total- 15 Hrs</p>	<ul style="list-style-type: none"> Drawplate & Dies Bench vise Draw tongs Wire rolling mill Blank holders Heating furnace and accessories 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	equipment	process of wire drawing			
LU2: Perform Annealing of the given wire to be drawn	Trainee will be able to: <ul style="list-style-type: none"> Heat the wire in the heating furnace up to required temperature Set standard soaking time of the heat treatment furnace as per requirements Stop the heating once the required temperature and soaking time is achieved. Perform the cooling of raw material wire in furnace 	<ul style="list-style-type: none"> Describe the annealing process Understanding about the Importance of annealing of the wire to be drawing <p style="text-align: center;"><u>Practical Activity</u></p> <ul style="list-style-type: none"> Perform the activity to set the furnace for annealing of the wire 	Theory-3 Hrs. Practical-12 Hrs. Total- 15 Hrs.	<ul style="list-style-type: none"> Heating furnace and accessories Long tongs PPEs 	Class Room and Lab
LU3. Carryout pulling of wire through drawplate	Trainee will be able to: <ul style="list-style-type: none"> Install the draw plate as per standard Fix the draw plate in the vise Taper the proper 	<ul style="list-style-type: none"> Understanding about the draw plate Knowledge about the importance of lubrication of wire to be drawn 	Theory-3 Hrs. Practical-15 Hrs. Total- 18 Hrs	<ul style="list-style-type: none"> Drawplate Bench vise Draw tongs Wire rolling mill 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>length of the wire to be drawn</p> <ul style="list-style-type: none"> • Lubricate the wire to be drawn • Select a hole in the draw plate slightly smaller than the diameter of raw material wire • Insert the taper end of wire in the back side of draw plate • Grasp the wire from the front of the plate with a draw tong or heavy duty pliers • Pull the wire through the plate • Maintain the constant speed to ensure the uniformity • Repeat the process with successively smaller holes until the desired diameter is achieved 	<ul style="list-style-type: none"> • Describe the process of wire tapering • Understanding about the importance of wire tapering • Calculation of draw load <p style="text-align: center;"><u>Practical Activity</u></p> <p>Perform activity of wire drawing through draw plate as per given instructions</p>		<ul style="list-style-type: none"> • Blank holders 	
<p>LU4.</p> <p>Perform wire drawing operation on</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Prepare the metal blanks as per 	<ul style="list-style-type: none"> • Knowledge about the preparation of metal blank • Understanding 	<p>Theory-3 Hrs. Practical-12 Hrs. Total- 15 Hrs</p>	<ul style="list-style-type: none"> • Metal Blanks • Dies • Bench vise 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



metal blank	<p>requirement</p> <ul style="list-style-type: none"> • Check the property of Blank as per standards • Set number of Dies according to requirement. • Set the drawing load as per requirement • Pull the wire through the metal blank • Carry out wire drawing as per standard • Measure the diameter of wire and confirm it with requirements. 	<p>about the process of wire drawing using metal blank</p> <ul style="list-style-type: none"> • Knowledge about the application of wire drawing • Knowledge about the inspection processes <p><u>Practical Activity</u></p> <p>Perform activity of wire drawing using metal blank as per given instructions</p>		<ul style="list-style-type: none"> • Draw tongs • Wire rolling mill • Blank holders 	
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 19 Module: Perform Heat treatment of Ferrous Materials

Objective: This module covers the knowledge and skills required perform hardening on Carbon Steel, perform tempering of hardened carbon steel, perform annealing on steel, perform normalizing of steel, perform Carburizing of Steel and perform stress relieving of Metal.

Duration: 58 Hours:

Theory: 10 Hours

Practice: 48 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform hardening on carbon steel	Trainee will be able to: <ul style="list-style-type: none"> Prepare the samples of required size. Place the sample in the furnace Adjust the temperature of furnace and soaking time of the furnace according to steel grade. Select a suitable quenching media. Quench the samples in quenching media. Interpret the results as per requirement 	<ul style="list-style-type: none"> Understand iron carbon diagram with respect to heat treatment process Describe heat treatment process Understanding about the types of heat treatment Explain the types of quenching media for steel Describe hardening of steel Understanding about the phases of steel Knowledge about formation of marten site 	Theory-2 Hrs. Practical-6 Hrs. Total- 08 Hrs	<ul style="list-style-type: none"> Heating furnace and accessories Hardness tester Long tongs Quenching media Carburizing media Quenching bath PPEs 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



		<u>Practical Activity</u> Perform the activity of hardening of carbon steel			
LU2: Perform Tempering of hardened carbon steel	Trainee will be able to: <ul style="list-style-type: none"> Take hardened sample (as prepared in above experiment). Place the sample in the furnace Adjust the tempering temperature of furnace and soaking time of the furnace according to require microstructure. Cool the specimen as per SOPs Interpret the results as per requirement 	<ul style="list-style-type: none"> Knowledge about the purpose of tempering Describe tempering of hardened steel Understanding about the types of tempering Knowledge about tempering bath <u>Practical Activity</u> <ul style="list-style-type: none"> Perform the activity of tempering of hardened carbon steel as per given instructions 	Theory-2 Hrs. Practical-9 Hrs. Total- 11 Hrs	<ul style="list-style-type: none"> Heating furnace and accessories Hardness tester Long tongs Quenching media Quenching bath PPEs 	Class Room and Lab
LU3. Perform annealing on steel	Trainee will be able to: <ul style="list-style-type: none"> Prepare the samples of required size. 	<ul style="list-style-type: none"> Describe the annealing process Understanding 	Theory-2 Hrs. Practical-6 Hrs. Total- 08 Hrs	<ul style="list-style-type: none"> Heating furnace and accessories 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> Place the sample in the furnace Adjust the temperature and soaking time of the furnace according to steel grade. Turn of the furnace and let the samples to cool in the furnace. Remove the samples from furnace once the temperature drops to near room temperature. Interpret the results as per requirement 	<p>about different types of annealing process</p> <ul style="list-style-type: none"> Explain the purpose of annealing Knowledge about the phase transformation of steel during annealing <p><u>Practical Activity</u></p> <p>Perform the activity of annealing on steel as per job requirements</p>		<ul style="list-style-type: none"> Hardness tester Long tongs PPEs 	
<p>LU4.</p> <p>Perform normalizing of steel</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Prepare the samples of required size. Place the sample in the furnace Adjust the temperature and soaking time of the furnace according to steel grade. Turn off the furnace Remove the samples from furnace and let 	<ul style="list-style-type: none"> Describe the process of normalizing Understanding about the phase transformation of steel during normalizing Knowledge about the purpose of normalizing 	<p>Theory-2 Hrs. Practical-9 Hrs. Total- 11 Hrs</p>	<ul style="list-style-type: none"> Heating furnace and accessories Hardness tester Long tongs PPEs 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> • them to cool in the air. • Interpret the results as per requirement 	<p style="text-align: center;"><u>Practical Activity</u></p> <p>Perform the activity of normalizing on steel as per job requirements</p>			
<p>LU5. Perform carburizing of steel</p>	<ul style="list-style-type: none"> • Cut and prepare the samples of required sizes. • Pack the samples in carbonaceous material in steel box and seal the boxes by suitable method. • Place the boxes in the furnace • Heat the samples for suitable time and temperature. • Turn off the furnace and remove the steel boxes from furnace and recover the specimen. • Check hardness of the sample's core and case. • Interpret the results of hardness and microstructure. 	<ul style="list-style-type: none"> • Explain the process of case hardening • Knowledge about the types of case hardening • Understanding of the carburizing process • Knowledge about the types of carburizing • Understanding of hardness test <p style="text-align: center;"><u>Practical Activity</u></p> <p>Perform the activity of carburizing of steel as per given instructions.</p>	<p>Theory-2 Hrs. Practical-9 Hrs. Total- 11 Hrs</p>	<ul style="list-style-type: none"> • Heating furnace and accessories • Hardness tester • Long tongs • Carburizing mediaPPEs 	
<p>LU6.</p>	<ul style="list-style-type: none"> • . Prepare the samples 	<ul style="list-style-type: none"> • Describe the 	<p>Theory-1 Hrs.</p>	<ul style="list-style-type: none"> • Heating 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



Perform stress relieving of metal	<p>of required size.</p> <ul style="list-style-type: none"> Place the sample in the furnace. Adjust the temperature and soaking time of the furnace as required Turn off the furnace and let the sample to cool in the furnace Remove the samples from furnace once the temperature reaches near room temperature. Check hardness of the sample Interpret the results as per standards 	<p>causes of residual stress</p> <ul style="list-style-type: none"> Understanding about the disadvantages of residual stress Knowledge about the residual stress removal process <p><u>Practical Activity</u></p> <p>Perform the activity of residual stress removal on given sample as per given instructions.</p>	<p>Practical-9 Hrs. Total- 10 Hrs</p>	<p>furnace and accessories</p> <ul style="list-style-type: none"> Hardness tester Long tongs PPEs 	
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 20 Module: Perform Heat treatment of Non- Ferrous Materials

Objective: This module covers the knowledge and skills required to Perform Solution Treatment and Aging of Non-Ferrous materials.

Duration: 46 Hours:

Theory: 10 Hours

Practice: 36 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Perform solution treatment	Trainee will be able to: <ul style="list-style-type: none">Handle the workpiece with appropriate carePlace the workpiece in the furnaceAdjust the temperature and soaking time of the furnace according to the material type/size.Turn of the furnace once the required temperature and soaking time is achieved.Remove the workpiece from the furnace and quench into the	<ul style="list-style-type: none">Describe properties of common non-ferrous metalsUnderstanding about the purpose of heat treatment of non-ferrous metalsExplain the solution treatment of non-ferrous metalKnowledge about the study of phase transformation of non-ferrous metalDescribe the anodizing of Aluminum and its types.	Theory-5 Hrs. Practical-18 Hrs. Total- 23 Hrs.	<ul style="list-style-type: none">Heating furnace and accessoriesSolution treatment bathHardness testerLong tongsQuenching bathPPEs	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>quenching media.</p> <ul style="list-style-type: none"> • Clean the workpiece and referred it to the next section. 	<p><u>Practical Activity</u></p> <p>Perform the activity of solution treatment on given non-ferrous metals as per given instructions.</p>			
LU2: Perform Aging	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> • Handle the workpiece with appropriate care • Place the workpiece in the furnace • Adjust the temperature and soaking time of the furnace according to the type and size of the material. • Turn of the furnace once the required temperature and soaking time is achieved • Let the workpiece to cool in the furnace. • Remove the workpiece from the furnace, once the temperature drops to room temperature. • Clean the workpiece and referred it to the next section. 	<ul style="list-style-type: none"> • Describe the process of aging • Understanding about aging of common non-ferrous metals • Explain the purpose of aging <p><u>Practical Activity</u></p> <ul style="list-style-type: none"> • Perform the activity of aging on given non-ferrous metal as per given instructions. 	<p>Theory-5 Hrs. Practical-18 Hrs. Total- 23 Hrs..</p>	<ul style="list-style-type: none"> • Heating furnace and accessories • Hardness tester • Long tongs • Quenching bath • PPEs 	<p>Class Room and Lab</p>



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 21 Module: Carryout hardness testing

Objective: This module covers the knowledge and skills 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: 52 Hours:

Theory: 10 Hours

Practice: 42 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Measure hardness of the specimen by Brinell hardness test	Trainee will be able to: <ul style="list-style-type: none">• Prepare the surface of standard specimen as per requirement.• Inspect the working mode of the Brinell Hardness Testing Machine.• Select the indenter and Load as per standard.• Place the specimen on anvil with safety precautions.• Apply load on the specimen for standard	<ul style="list-style-type: none">• Understanding about the hardness of materials• Knowledge about the destructive test• Describe the types of hardness test• Understanding about the different parts of Brinell hardness testing machine• Knowledge about the standard load and time of Brinell hardness test• Calculation of	Theory-3 Hrs. Practical-15 Hrs. Total- 18 Hrs..	<ul style="list-style-type: none">• Brinell Hardness Testing Machine• Measuring instruments• Accessories for surface cleaning	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>time period.</p> <ul style="list-style-type: none"> Calculate the Brinell hardness number with formula or directly note from the gauge according to design of the machine. 	<p>Brinell hardness number</p> <ul style="list-style-type: none"> Explain the limitation of Brinell hardness test <p><u>Practical Activity</u> Determine the Brinell hardness number for given sample</p>			
<p>LU2: Measure hardness of the specimen by Rockwell hardness test</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Prepare the surface of standard specimen as per requirement. Inspect the working mode of the Rockwell Hardness Testing Machine. Select the Scale of the machine (A, B or C) depending upon the material. Place the specimen on anvil with safety precautions and apply minor load. Apply major load on the specimen according to the scale of the machine. 	<ul style="list-style-type: none"> Describe the different scales of Rockwell hardness test Knowledge about the standard minor load, major load and different types of indenters of Rockwell hardness testing machine. Describe the comparison of Brinell and Rockwell hardness test Understanding about the different parts of Rockwell hardness testing machine 	<p>Theory-3 Hrs. Practical-15 Hrs. Total- 18 Hrs..</p>	<ul style="list-style-type: none"> Rockwell Hardness Testing Machine Measuring instruments Accessories for surface cleaning 	<p>Class Room and Lab</p>



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> Note the Rockwell Hardness number from gauge. 	<p style="text-align: center;"><u>Practical Activity</u></p> <p>Determine the Rockwell hardness number for the given sample</p>			
LU3: Measure hardness of the specimen by Vickers Hardness test	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Prepare the surface of standard specimen as per requirement. Inspect the working mode of the Vickers Hardness Testing Machine. Select the Load as per standard depending upon the material. Place the specimen on anvil with safety precautions. Apply load on the specimen for standard time period. Note the Vickers Hardness number from the gauge. 	<ul style="list-style-type: none"> Knowledge about the different parts of Vickers hardness testing machine Explain the shape and size of indenter Understanding about the standard load and time for different materials Describe the calculations of Vickers hardness numbers <p style="text-align: center;"><u>Practical Activity</u></p> <p>Determine the Vickers hardness numbers of given sample</p>	<p>Theory-4 Hrs. Practical-12 Hrs. Total- 16 Hrs.</p>	<ul style="list-style-type: none"> Vickers Hardness Testing Machine Measuring instruments Accessories for surface cleaning 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 22 Module: Carryout Impact testing

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

Duration: 46 Hours:

Theory: 10 Hours

Practice: 36 Hours

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Measure Toughness of the specimen by Izod impact test	Trainee will be able to: <ul style="list-style-type: none"> Check the dimensions of Izod specimen with the help of measuring instrument as per ASTM standard. Inspect the working mode of the izod impact testing machine. Adjust the initial position of the hammer. Calculate the initial potential energy of the hammer. Clamp the standard specimen in the anvil 	<ul style="list-style-type: none"> Understanding about toughness of materials Knowledge about the basic principle of impact test Describe the standard size of Izod impact test specimen Knowledge about the parts of Izod impact testing machine Describe the method of clamping and hammering of specimen 	Theory-5 Hrs. Practical-18 Hrs. Total- 23 Hrs...	<ul style="list-style-type: none"> Izod impact testing machine Measuring devices 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>by keeping standard length out of the anvil.</p> <ul style="list-style-type: none"> Drop the hammer to strike it with standard specimen. Calculate the final potential energy of the hammer. Calculate the toughness of the specimen material by calculating difference of initial and final energy of the hammer. 	<p style="text-align: center;"><u>Practical Activity</u></p> <p>Measure toughness of the specimen by Izod Impact Test</p>			
<p>LU2: Measure Toughness of the specimen by Charpy Impact Test</p>	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Check the dimensions of Charpy specimen, received from workshop, with Vernier calliper as per ASTM standard. Inspect the working mode of the charpy impact testing machine. 	<ul style="list-style-type: none"> Understanding about the difference of Izod and charpy impact test Knowledge about the basic principle of impact test Describe the standard size of Charpy impact test specimen 	<p>Theory-5 Hrs. Practical-18 Hrs. Total- 23 Hrs...</p>	<ul style="list-style-type: none"> Charpy impact testing machine Measuring devices 	<p>Class Room and Lab</p>



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> • Adjust the initial position of the hammer. • Calculate the initial potential energy of the hammer. • Clamp the standard specimen in the anvil by keeping standard length out of the anvil. • Drop the hammer to strike it with standard specimen. • Calculate the final potential energy of the hammer. • Calculate the toughness of the specimen material by calculating difference of initial and final energy of the hammer. 	<ul style="list-style-type: none"> • Knowledge about the parts of Charpy impact testing machine • Describe the method of clamping and hammering of specimen <p style="text-align: center;"><u>Practical Activity</u></p> <p>Measure Toughness of the specimen by Charpy Impact Test</p>			
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 23 Module: Perform mechanical testing on universal testing machine

Objective: This module covers the knowledge and skills 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: 70 Hours:

Theory: 10 Hours

Practice: 60 Hours



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Measure tensile properties of the specimen	Trainee will be able to: <ul style="list-style-type: none"> Inspect the dimensions of standard specimen with the help of measuring instruments. Mark the gauge length points on the specimen. Measure the initial cross sectional area of the specimen. Select the gripping device as per standard specimen. Inspect the functioning condition of the gripping device. Grip the specimen in gripping device according to standard. Attach the extensometer with the specimen if required. Apply the load on the specimen up to fracture. Note the values of applied load after specific intervals. 	<ul style="list-style-type: none"> Describe the hook's law Understanding about the yield stress, ultimate tensile stress and breaking stress Knowledge about the different parts of universal testing machine Describe the standard size of different shapes of tensile specimen Understanding about the stress and strain Knowledge about the sketching and labeling of stress strain curve Knowledge about gauge length Knowledge about the clamping of the specimen in machine for 	Theory-3 Hrs. Practical-15 Hrs. Total- 18 Hrs.	<ul style="list-style-type: none"> Universal Testing Machine & Accessories Measuring Instruments Specimens Computer with software Extensometer Gripping Jaws Holders 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> Note the extension produced against the noted applied load. Calculate stress and strain from the values of load and extension. Sketch stress strain curve. Calculate the required mechanical properties. 	<p>different types of loads</p> <p style="text-align: center;"><u>Practical Activity</u></p> <p>Perform the activity to determine the tensile strength of given specimen and plot the stress strain diagram.</p>			
LU2: Measure Compressive strength of the specimen	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Inspect the dimensions of standard specimen with the help of measuring instruments. Calculate the initial cross sectional area of the specimen. Prepare the end surfaces of the specimen. Inspect the working condition of fixtures used for compression. Fix the specimen, 	<ul style="list-style-type: none"> Describe compressive strength Knowledge about the compression test Understanding about the standard size of specimen for compression test <p style="text-align: center;"><u>Practical Activity</u></p> <p>Measure Compressive strength of the specimen</p>	<p>Theory-3 Hrs. Practical-15 Hrs. Total- 18 Hrs....</p>	<ul style="list-style-type: none"> Universal Testing Machine & Accessories Measuring Instruments Specimens Computer with software Extensometer Gripping Jaws Holders 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>between fixtures, in the machine.</p> <ul style="list-style-type: none"> • Apply the load on the specimen up to surface failure. • Note the value of load at which surface get failure. • Calculate compressive stress. • Record the results. 	and plot the stress strain diagram.			
LU3: Measure the Bending strength of specimen	<ul style="list-style-type: none"> • Inspect the dimensions of standard specimen with the help of measuring instruments. • Inspect the working condition of bend test fixture. • Fit the bend test fixture in the machine. • Adjust the span between two rollers of the fixture according to the length of the specimen. • Fit the mandrel in the 	<ul style="list-style-type: none"> • Knowledge about the bending strength of different materials • Knowledge of Bending equation • Describe different ways of applying bending loads <p style="text-align: center;"><u>Practical Activity</u></p> <p>Measure the Bending strength of given specimen</p>	<p>Theory-2 Hrs. Practical-15 Hrs. Total- 17 Hrs...</p>	<ul style="list-style-type: none"> • Universal Testing Machine & Accessories • Measuring Instruments • Specimens • Computer with software • Extensometer • Gripping Jaws • Holders 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<ul style="list-style-type: none"> machine. Place the specimen on the rollers of the fixture. Apply the load on the specimen up to maximum selected bend. Note the bending force. Measure bending strength by using formula. Record the results. 				
LU4: Measure Shear strength of the specimen	<ul style="list-style-type: none"> Inspect the dimensions of standard specimen with the help of measuring instruments. Calculate the cross sectional area of the Specimen. Prepare the machine for test. Install the fixture of shear test. Place the sample within the fixture. Apply the load for 	<ul style="list-style-type: none"> Knowledge about the shear load and shear stress Understanding about the shear modulus of different materials Describe the calculation of shear strength Specimen techniques for shearing test 	<p>Theory-2 Hrs. Practical-15 Hrs. Total- 17 Hrs...</p>	<ul style="list-style-type: none"> Universal Testing Machine & Accessories Measuring Instruments Specimens Computer with software Extensometer Gripping Jaws Holders 	



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>single shear or double shear test.</p> <ul style="list-style-type: none">• Set the machine speed according to sample.• Note the maximum/breaking force.• Calculate shear strength.• Record the results.	<p style="text-align: center;"><u>Practical Activity</u></p> <p>Measure Shear strength of the given specimen</p>			
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Curriculum
“Metal Forming & Processing Senior Technician” Level 04



0715-MF&P 24 Module: Perform Torsion test and Fatigue test

Objective: This module covers the knowledge and skills required to Measure torsion strength of specimen and Measure fatigue strength of specimen

Duration: 54 Hours:

Theory: 9 Hours

Practice: 45

Learning Unit	Learning Outcomes	Learning Elements	Duration	Materials Required	Learning Place
LU1: Measure torsion strength of specimen	Trainee will be able to: <ul style="list-style-type: none"> Inspect the Prepared sample according to the requirements of machine and standard. Check the working mode of the machine. Fix the sample in the fixture. Adjust speed, torque angle and time of machine as per material requirement. Draw torque vs angle graph. Calculate torsion strength. Observe fractured 	<ul style="list-style-type: none"> Knowledge about the torque Describe Moment of Inertia Knowledge about the torsion equation Understanding of torsion test process <p style="text-align: center;"><u>Practical Activity</u> Measure Torsion Strength of given material</p>	<p>. Theory-5 Hrs. Practical-21 Hrs. Total- 26 Hrs.</p>	<ul style="list-style-type: none"> Torsion test machine Measuring Instruments 	Class Room and Lab



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



	<p>surface of the specimen.</p> <ul style="list-style-type: none"> Record the results. 				
LU2: Measure fatigue strength of specimen	<p>Trainee will be able to:</p> <ul style="list-style-type: none"> Inspect the Prepared specimen according to standard. Check the working mode of the machine. Grip the samples in fixture. Apply load as per material requirement. Re-zero rotation counter. Turn on the machine and start the test. Observe number of rotation once the material breaks. Calculate fatigue strength by using formula. 	<ul style="list-style-type: none"> Knowledge about the phenomena of fatigue Understanding about the stages of fatigue Describe fatigue strength Knowledge about the procedure of fatigue test <p><u>Practical Activity</u> Measure Fatigue Strength of given material</p>	<p>Theory-4 Hrs. Practical-24 Hrs. Total- 28 Hrs.</p>	<ul style="list-style-type: none"> Fatigue test machine Measuring Instruments 	<p>Class Room and Lab</p>



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



4. Supportive Notes

Assessment Text, Critical Aspects, Assessment Conditions, Resources required for Assessments

5. List of Tools, Machinery and Equipment

Sr. No.	Name of Item / Equipment / Tools	Quantity

6. List of Consumable Supplies

Sr. No.	Name of Consumable Supplies	Quantity

7. Members of the Curriculum Development Committee

The following members participated in the curriculum development process of the **Metal Forming & Processing Level 02 - 05** at PITAC, Lahore.

Date: 29th November – 03rd December 2021

S#	Name	Designation	Organization
1.	Engr. Salman Khalid Chaudhary	Assistant Director (Technical) Metallurgy	PITAC, Lahore
2.	Engr. Sohail Naseer	Assistant Professor	GSPCT, Gujrat



Curriculum
“Metal Forming & Processing Senior Technician” Level 04



3.	Engr. Ahsan Shahbaz	Manager	PSS, Lahore
4.	Engr. Rashid Bashir	Senior Instructor	Pak Swiss Training Center, Lahore
5.	Engr. Farooq Iftikhar	Senior Engineer	PCSIR, Lahore
6.	Engr. Umer Farooq	Instructor Mechanical	GSPCT, Gujrat
7.	Engr. Adil Qadeer	Lecturer	UOL, Lahore
8.	Engr. Muhammad Arshad	Chief Instructor	PSTC, Lahore
9.	Engr. Nadeem Shahid	Vice Principal/Director	PCT, Lahore
10.	Engr. Fazal Rehman	Principal	GCT, Swabi
11.	Mr. Mushtaq Ahmed	Director M&E	P-TEVTA
12.	Engr. Liaqat Jamro	Director Academics	S-TEVTA
13.	Engr. Muhammad Umar	Project Engineer	OQE, Islamabad
14.	Engr. Abdul Maqsood	DACUM Facilitator, Principal	GPI Mardan
15.	Engr. Muhammad Yasir	Deputy Director	NAVTTC HQ, Islamabad