

REDESIGNED MODULES FOR THE SECTOR

OF

PRODUCTION & MANUFACTURING

UNDER

MODULAR EMPLOYABLE SKILLS (MES)

Revised in - 2014

By

**Ministry of Labour & Employment
Directorate General of Employment & Training**

GENERAL INFORMATION FOR MILLING

Name of Sector	PRODUCTION & MANUFACTURING
Name of Module	MILLING
MES Code	MAN703
Duration of Course	600 Hrs
Entry Qualification of Trainee	8 th Pass + 14 years of age
Unit size (No. Of trainees)	10
Power Norms	15KW
Space Norms	60 sq. mtrs. Minimum size of one side to be 04m.
Instructors Qualification	Degree in Mechanical Engineering with one year Experience OR Diploma in Mechanical Engineering with two years Experience OR NTC/ NAC in Machinist trade with three years of Experience
Desirable	Craft Instructor Certificate (CIC)

Course Contents for Module Milling

Practical Competencies	Underpinning Knowledge (Theory)
<p>OSH & Safety Practices: (10 hours)</p> <ul style="list-style-type: none"> ✓ Fire Fighting in workplace & Precautions ✓ General Safety of Tools & Equipments ✓ Awareness on OSH related to the job 	<ul style="list-style-type: none"> ✓ Fire Extinguishers & its Types ✓ Safely handling Tools & Equipments ✓ Use of proper Tools & Equipments & its maintenance ✓ OSH & practices to be observed as a precaution.
<p>Personnel & Material Safety: (10 hours)</p> <ul style="list-style-type: none"> ✓ Select, use, clean and store personal safety protective equipment. ✓ Use and store of materials in a safe manner. ✓ Use of safety devices and work holding devices on metal cutting machines. ✓ 5S concepts 	<ul style="list-style-type: none"> ✓ State the safety precaution specific to machining on the milling m/c. ✓ Safety related to handling of materials. ✓ Safety devices used for safe machining.
<p>Milling m/c & Tool specification: (40 hours)</p> <ul style="list-style-type: none"> ✓ Operation of milling machines ✓ Tools, general cleaning and maintenance and safe storage of tools applicable to workshop tasks. ✓ Identifying different types of cutter used in Horizontal milling machine. ✓ Identifying different types of cutter used in Vertical milling machine. ✓ Identifying different parts of Horizontal milling machine and importance of each part. ✓ Identifying different parts of Vertical milling machine and importance of each part 	<ul style="list-style-type: none"> ✓ Introduction to milling, description, types of milling m/c - constructional features and functions. ✓ Types of milling tools and their uses. ✓ Classification & properties of tool materials & selection criteria. ISO specification on carbide tools. ✓ Horizontal milling machine ✓ Vertical milling machine ✓ Horizontal milling operations- milling of flat surfaces, Gang and straddle milling, production of narrow slots, slotting and slitting of thin plates, key way cutting etc. ✓ Describe vertical milling operations- milling of sunk and recessed surfaces, woodruff cutters, use of shell end mills, face mills, face slot cutters, dovetail cutters etc.
<p>Job Holding & Centering: (40 hours)</p> <ul style="list-style-type: none"> ✓ Job holding devices on metal cutting machines & safety precautions. ✓ Study of process planning sheet ✓ Practice on leveling the job. ✓ Tool holding devices and setting the same. 	<ul style="list-style-type: none"> ✓ Different job holding devices in turning. ✓ Describe the basic method of Work holding devices - three jaw chuck, four jaw chuck, face plate, collect chuck etc. ✓ Describe the basic methods of supporting work – fixed steady, traveling steady.
<p>Measuring job: (40 hours)</p> <ul style="list-style-type: none"> ✓ Measurements using Calipers & standard scale. 	<ul style="list-style-type: none"> ✓ Describe the principle of the measuring instruments: its use and care for

<ul style="list-style-type: none"> ✓ Check measurements of components/machined parts, using micrometers and verniers. ✓ Check roundness of components using the dial test indicator and V-blocks. 	<p>measurement setting up and assembly operations-</p> <p>Micrometer: internal, external, depth.</p> <p>Vernier: Caliper, depth, height. bore dial gauge.</p> <p>Dial test indicator: its measurement.</p>
<p>Milling operation: (120 hours)</p> <ul style="list-style-type: none"> ✓ Marking practice. Use of hand tools. ✓ Plain milling, slab milling. ✓ Work alignment, cutting as per sample and parting off. ✓ Checking flatness with tri-square. ✓ Checking squareness with tri-square. ✓ Step milling using side and face milling cutter. ✓ Milling six faces of a cubical block to an accuracy of $\pm 0.1\text{mm}$. ✓ Measure using Vernier caliper ✓ Angular milling using angular milling cutter and checking with bevel protractor. ✓ Slot milling using slot milling cutter / slitting saw. 	<ul style="list-style-type: none"> ✓ Describe the geometry of the milling tool including tool angles and its effect on machining operation. ✓ Cutting fluid types, properties & applications. ✓ Selection of cutting speed, feed and depth of cut.
<p>Practical Competencies</p>	<p>Underpinning Knowledge (Theory)</p>
<p>Advance Milling: (120 hours)</p> <ul style="list-style-type: none"> ✓ Centering, pilot drilling, counter drilling, and chamfering. ✓ Slot milling using vertical milling machine. ✓ Milling a V-block, Dovetail & T-slot ✓ Use of dividing head. ✓ Milling a square, hexagon on a round rod using direct indexing. 	<ul style="list-style-type: none"> ✓ Describe Dividing head - types, parts, ✓ Calculation of spindle speeds, feeds & depth of cut for different material for relevant milling operations such as roughing and finishing etc. ✓ Calculation of direct indexing to mill a polygon.
<p>Gear cutting: (120 hours)</p> <ul style="list-style-type: none"> ✓ Identify different types of gear. ✓ Milling a rack, by linear indexing method. ✓ Cut Spur gear on horizontal milling machine by using indexing head. ✓ Gear tooth measurement using gear tooth vernier caliper. ✓ Measurement of gear tooth using flange micrometer 	<ul style="list-style-type: none"> ✓ Types of Gear and its use. ✓ Describe universal indexing head - parts and function. ✓ Describe methods of indexing and their Calculation. ✓ Describe Rack - types, nomenclature ✓ Nomenclature of spur gear ✓ Describe methods of producing rack on milling machine. ✓ Describe methods of producing Spur gear on milling machine. ✓ Identify and report milling machine faults

TERMINAL COMPETENCY: The successful candidate would be able to:

- Use safety devices.
- Familiar with the necessary safety precautions required to run a milling machine
Plan the sequence of operations.
- Identify and know the purpose of the work-holding and driving accessories.
- Identify and know the purpose of the cutting-tool-holding accessories and attachments.
- Know the various types of materials, milling cutters, measuring instruments and its application.
- Know the purpose of the main operational parts of horizontal and vertical milling machine.
- Determine spindle speed, feed and depth of cut for different materials as roughing, finishing milling operation.
- To operate the conventional Milling machine along with standard accessories.
- Produce components using plain milling, angular milling, slotting and key-way cutting.
- Milling six faces of a cubical block to an accuracy of $\pm 0.1\text{mm}$
- Calculate gear tooth dimensions, set up for milling a spur gear and helical gear.
- Calculate and milling a square hexogen by direct indexing.
- Set up and mill dovetails, V-block, & T- slot.
- Identify milling fault and correction.

TOOLS AND EQUIPMENTS FOR MILLING:

Sl.no	Item	Quantity
1.	Steel Rule 30 cm graduated both in English & Metric units	10
2.	Divider spring 150 mm	10
3.	Centre punch 100 mm	5
4.	Hammer B.P. 800 gms, with handle	5
5.	Combination plier 150 mm	2
6.	Safety glasses	10
7.	File flat assorted	10
8.	Surface plate 400 mm x 400 mm grade	1
9.	Table for surface plate 900x 900 x 1200 mm	1
10.	Marking off table 1200 x 1200 x 900 mm	1
11.	Scribing block universal 300 mm	3
12.	"V" block 100 mm	2
13.	Vernier gear tooth caliper	1
14.	Try square 300 mm	5
15.	Outside, inside spring caliper	10
16.	Oil stone 150 x 50 x 25 mm	1
17.	Hacksaw frame adjustable 250300 mm with blades	5
18.	Hand vice 50 mm jaw	4
19.	Universal table angle plate	2
20.	Micrometer outside /inside/depth	2 each
21.	vernier caliper 300 mm with least count 0.02 mm	2
22.	Solid parallels in pairs (different sizes)	4pairs

23.	Taper shank sleeves to suit drill machines	1 set
24.	Vernier height gauge 250 mm with least count of 0.01mm	1
25.	Vernier bevel protractor with 150 mm blade	1
26.	Bevel gauge 200 mm	1
27.	Spirit level 250mm 0.05 least count	1
28.	Spanner D.E.G.P. series 2 (7 pcs. Each)	2sets
29.	Screw driver, heavy duty assorted with handle	4
30.	Nylon/ soft Hammer 1 kg	4
31.	Allen hexagonal keys 2.5 to 12	4
32.	Set of Double ended spanner, set of box spanner with ratchet handle.	2
33.	Adjustable spanner 300 mm	2
34.	Parallel shank HSS twist drill 3mm to 12mm in a step of 1mm	3set
35.	Taper shank HSS twist drill 15mm,19mm,22mm & 25mm	1 each.
36.	Angle plate size 200x100x200 mm with strap clamp	2
37.	HSS Milling cutters of different sizes, shapes etc. including end mill, face mills, slot mills, "T"-slot mill, Dovetail mill, side & face mills, slab mills, angular mills drills and slot drills suitable to milling machine arbor.	2no. each
38.	Involutes milling cutter 2 module	1
39.	Carbide inserted face cutter(Dia. 200mm), Side & face cutter(dia. 200x12mm) to suit milling m/c arbor.	2 each
40.	Insert for above carbide cutters	10 set for each
41.	Compound dial gauge with stand (metric)	1
42.	Dial test indicator with magnetic gauge type 1 grade A with magnetic base -0.002mm, 0.010 mm	1
43.	Centre gauge 600	1
44.	Slip gauge set (normal set) Metric	1
45.	Limit plug gauges 5 mm to 25 mm by 2.5 mm range	1

46.	Pedestal grinder, double ended with 170mm wheels (one fine and one rough)	1										
47.	Horizontal and Vertical milling machine	2 each										
	<table> <tr> <td colspan="2">Table</td> </tr> <tr> <td>Length x width</td> <td>1350x310 mm</td> </tr> <tr> <td>Longitudinal traverse</td> <td>700 - 800 mm</td> </tr> <tr> <td>Cross traverse</td> <td>200 - 265 mm</td> </tr> <tr> <td>Vertical traverse</td> <td>300 - 400 mm</td> </tr> <tr> <td>Speed range rpm</td> <td>20 to 1800</td> </tr> </table>		Table		Length x width	1350x310 mm	Longitudinal traverse	700 - 800 mm	Cross traverse	200 - 265 mm	Vertical traverse	300 - 400 mm
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48.	Universal Milling Machine -	1 no.										
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GENERAL INFORMATION FOR CNC MILLING

Name of Sector	PRODUCTION & MANUFACTURING
Name of Module	CNC MILLING
MES Code	MAN704
Duration of Course	500 Hrs
Entry Qualification of Trainee	10 th Pass + 18 yrs of age
Unit size (No. Of trainees)	10
Power Norms	11KW
Space Norms	60 sq.m Minimum size of one side to be 04m.
Instructors Qualification	Degree in Mechanical Engineering with one year Experience OR Diploma in Mechanical Engineering with two year Experience OR NTC/ NAC in Machinist trade with three years of Experience
Desirable	Craft Instructor Certificate (CIC)

Course Contents for Module CNC Milling (MAN704)

Practical Competencies	Underpinning Knowledge (Theory)
<p>OSH & Safety Practices: (10 hours)</p> <ul style="list-style-type: none"> ✓ Fire Fighting in workplace & Precautions ✓ General Safety of Tools & Equipments ✓ Awareness on OSH related to the job 	<ul style="list-style-type: none"> ✓ Fire Extinguishers & its Types ✓ Safely handling Tools & Equipments ✓ Use of proper Tools & Equipments & its maintenance ✓ OSH & practices to be observed as a precaution.
<p>Personnel & Material Safety: (10 hours)</p> <ul style="list-style-type: none"> ✓ Select, use, clean and store personal safety protective equipment. ✓ Use and store of materials in a safe manner. ✓ Use of safety devices and work holding devices on metal cutting machines. ✓ 5S concepts 	<ul style="list-style-type: none"> ✓ State the safety precaution specific to machining on the milling m/c. ✓ Safety related to handling of materials. ✓ Safety devices used for safe machining.
<p>Milling m/c & Tool specification: (40 hours)</p> <ul style="list-style-type: none"> ✓ Operation of milling machines ✓ Tools, general cleaning and maintenance and safe storage of tools applicable to workshop tasks. ✓ Identifying different types of cutter used in Horizontal milling machine. ✓ Identifying different types of cutter used in Vertical milling machine. ✓ Identifying different parts of Horizontal milling machine and importance of each part. ✓ Identifying different parts of Vertical milling machine and importance of each part 	<ul style="list-style-type: none"> ✓ Introduction to milling, description, types of milling m/c - constructional features and functions. ✓ Types of milling tools and their uses. ✓ Classification & properties of tool materials & selection criteria. ISO specification on carbide tools. ✓ Horizontal milling machine ✓ Vertical milling machine ✓ Horizontal milling operations- milling of flat surfaces, Gang and straddle milling, production of narrow slots, slotting and slitting of thin plates, key way cutting etc. ✓ Describe vertical milling operations- milling of sunk and recessed surfaces, woodruff cutters, use of shell end mills, face mills, face slot cutters, dovetail cutters etc.
<p>Job Holding & Centering: (40 hours)</p>	

<ul style="list-style-type: none"> ✓ Job holding devices on metal cutting machines & safety precautions. ✓ Study of process planning sheet ✓ Practice on leveling the job. ✓ Tool holding devices and setting the same. 	<ul style="list-style-type: none"> ✓ Different job holding devices in turning. ✓ Describe the basic method of Work holding devices - three jaw chuck, four jaw chuck, face plate, collet chuck etc. ✓ Describe the basic methods of supporting work – fixed steady, traveling steady.
<p>Measuring job: (40 hours)</p> <ul style="list-style-type: none"> ✓ Measurements using Calipers & standard scale. ✓ Check measurements of components/machined parts, using micrometers and verniers. ✓ Check roundness of components using the dial test indicator and V-blocks. 	<ul style="list-style-type: none"> ✓ Describe the principle of the measuring instruments: its use and care for measurement setting up and assembly operations- Micrometer: internal, external, depth. Vernier: Caliper, depth, height. Gauges: bore gauge, height gauge, depth gauge Dial test indicator: its measurement.
<p>Milling operation: (120 hours)</p> <ul style="list-style-type: none"> ✓ Marking practice. Use of hand tools. ✓ Plain milling, slab milling. ✓ Work alignment, cutting as per sample and parting off. ✓ Checking flatness with tri-square. ✓ Checking squareness with tri-square. ✓ Step milling using side and face milling cutter. ✓ Milling six faces of a cubical block to an accuracy of ± 0.1mm. ✓ Measure using Vernier caliper ✓ Angular milling using angular milling cutter and checking with bevel protractor. ✓ Slot milling using slot milling cutter / slitting saw. 	<ul style="list-style-type: none"> ✓ Describe the geometry of the milling tool including tool angles and its effect on machining operation. ✓ Cutting fluid, properties & applications. ✓ Selection of speed feed and depth of cut.
<p>CNC Milling: (120 hours)</p> <ul style="list-style-type: none"> ✓ Personal and CNC machine Safety. ✓ Select, use, clean and store personal protective equipment. ✓ CNC machine console board ✓ Machine over travel limits and emergency stop. ✓ Machine starting & operating in Reference Point, JOG, and Incremental Modes ✓ Work and tool setting. ✓ Co-ordinate system points, assignments and simulations. ✓ Absolute, incremental and polar co- 	<ul style="list-style-type: none"> ✓ Safety Precautions in CNC operation. ✓ State the Safe handling of tools, equipment & CNC machines. ✓ Describe CNC system working. ✓ State CNC Machines Milling, Types, and Machine axes. ✓ Identify cutting tool materials for CNC Milling and its applications. ✓ State the Safe handling of tools, equipment & CNC machines, Conventional & CNC machining. ✓ Explain the working principle of CNC Machine.

<p>ordinate points programming assignments and simulations.</p> <ul style="list-style-type: none"> ✓ Carryout Automatic Mode operation. ✓ Carryout Linear interpolation & Circular interpolation assignments and simulations. ✓ Manual Data Input (MDI) mode ✓ Work off set measurement and Tool off set measurement entry in CNC Control and editing. <ul style="list-style-type: none"> ✓ Part program preparation, Simulation and Automatic Mode Execution of CNC Machine for the machining a pocket with end milling using CRC command. ✓ Tool change in CNC milling & JOG, INC, MPG mode operation. 	<ul style="list-style-type: none"> ✓ Describe Machine tool elements, Feed Drives and spindle drives. ✓ State the use of ISO codes for carbide indexable inserts and tool holders for Milling. ✓ Co-ordinate systems and Points. ✓ Describe the method of Zero off sets and tool off sets in Milling. ✓ Measurement of zero offsets and Tool offsets. ✓ Describe the tooling systems for CNC Machining Centers. ✓ Work locating principle and locating devices for CNC milling, tool selection ✓ Carry out tool path simulation ✓ State the purpose of Cutter Radius Compensation (CRC). ✓ Cutting parameters- cutting speed, feed rate , depth of cut, tool wear, tool life, relative effect of each cutting parameter on tool life. ✓ Cutting parameters selection and process planning. ✓ Tools layout and process sheet preparation. ✓ Using Sub Programs & Cycles in the Main Program. ✓ Describe the Work-piece zero points and ISO/DIN G and M codes for CNC milling. ✓ Indicate Machining parameters for milling for face milling and end milling.
<p>CNC Advance Milling: (120 hours)</p> <ul style="list-style-type: none"> ✓ Part programs & Simulation Automatic Mode Execution of CNC Machine for the exercise on End milling with polar co-ordinates and practical on Simple drilling-G 81. ✓ Geometry and wear offset correction. ✓ Part Program Preparation, entry and simulation on CNC Mill & on Computers. ✓ Practical on Chamfer and counter-sink drilling. ✓ Practical on Deep hole drilling G 83. ✓ Practical on tapping G 84. ✓ Practical on Boring cycles G 85 - G 89. ✓ Part Program Preparation, entry and simulation on CNC Mill & on Computers 	<ul style="list-style-type: none"> ✓ Work locating principle and locating devices for CNC milling, tool selection ✓ Carry out tool path simulation. ✓ Describe the Drilling /Boring cycles in CNC Milling. ✓ Grooving/Threading Tools, Processes and Tool selection. ✓ Programming for Grooving/Threading on OD/ID in CNC Milling. ✓ State the importance of Helical Interpolation and Thread Milling, advantages and limitations in CNC Milling. ✓ Describe the Machining of rectangular / circular pockets on CNC milling.

<p>for Part program exercises.</p> <p>✓ Automatic mode execution of With Block Search and restart.</p>	<p>✓ Explain Drilling, milling patterns on CNC milling.</p>
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TERMINAL COMPRTANCY: The successful candidates should be able to:

- Identify CNC Machining Centre Machine Elements.
- Know the CNC control panel keys and Menu structure.
- Start the CNC Machine and Reference it and move the Machine Slides (Axes) in JOG/INC/MPG Modes.
- Start Spindle ON/OFF, Coolant On/Off, Tool Changing and do axes positioning in JOG/MDI Modes.
- Load Parts in Work holding devices and Tools in tools Magazine/ATC & Spindle.
- Input/edit Part Programs in the CNC Control and do Graphic Simulation to Verify /Check Part Programs.
- Do Machining operations like Face Milling, End Milling, Pocket Milling, Drilling, Boring and Tapping using Automatic / Memory Modes with block search and Repositioning/Restart procedure.

TOOLS AND EQUIPMENTS FOR CNC MILLING:

Sl.No	Item	Quantity
1.	Steel Rule 30 cm graduated both in English & Metric units	10
2.	Divider spring 150 mm	5
3.	Centre punch 100 mm	4
4.	Hammer B.P. 800 gms, with handle	4
5.	Combination plier 150 mm	5
6.	Safety glasses	10
7.	File flat assorted	10
8.	Surface plate 400 mm x 400 mm grade	1
9.	Table for surface plate 900x 900 x 1200 mm	1
10.	Marking off table 1200 x 1200 x 900 mm	1
11.	Scribing block universal 300 mm	2
12.	'V" block 100 mm	2
13.	Vernier gear tooth caliper	1
14.	Try square 300 mm	5
15.	Outside, inside spring caliper	5 each
16.	Oil stone 150 x 50 x 25 mm	5
17.	Hacksaw frame adjustable 250x300 mm with blades	2
18.	Hand vice 50 mm jaw	2
19.	Universal table angle plate	1
20.	Micrometer outside /inside/depth	2 each
21.	vernier caliper 300 mm with least count 0.02 mm	2
22.	Vernier bevel protractor with 150 mm blade	1

- 2) Computers in 5 numbers in LAN with operating systems and accessories
- 3) Multimedia teachware for CNC technology and interactive CNC machine simulators with console emulator software for Fanuc, Siemens, Fagor and Mitsubishi CNC systems. (10 students + 1 faculty): **5 users**

GENERAL INFORMATION FOR TURNING

Name of Sector	Production & Manufacturing
Name of Module	TURNING
MES Code	MAN701
Duration of Course	600 Hrs
Entry Qualification of Trainee	8 th Pass and 14 yrs of age
Unit size (No. Of trainees)	10
Power Norms	14KW
Space Norms (Workshop and Class Room)	60 sq.m Minimum size of one side to be 04m.
Instructors Qualification	Degree in Mechanical Engineering with one year Experience OR Diploma in Mechanical Engineering with two year Experience OR NTC/ NAC in Turner Trade with three years of Experience
Desirable	Craft Instructor Certificate (CIC)

Course Contents for Module Turning

Practical Competencies	Underpinning Knowledge (Theory)
<p>OSH & Safety Practices: (10 hours)</p> <ul style="list-style-type: none"> ✓ Fire Fighting in workplace & Precautions ✓ General Safety of Tools & Equipments ✓ Awareness on OSH related to the job 	<ul style="list-style-type: none"> ✓ Fire Extinguishers & its Types ✓ Safely handling Tools & Equipments ✓ Use of proper Tools & Equipments & its maintenance ✓ OSH & practices to be observed as a precaution
<p>Personnel & Material Safety: (10 hours)</p> <ul style="list-style-type: none"> ✓ Select, use, clean and store personal safety protective equipment. ✓ Use and store of materials in a safe manner. ✓ Demonstrate the use of safety devices on metal cutting machines. ✓ 5S norms 	<ul style="list-style-type: none"> ✓ State the safety precaution specific to turning on the lathe. ✓ Safety related to handling of materials. ✓ Safety devices used for safe machining.
<p>Lathe & Tool specification: (20 hours)</p> <ul style="list-style-type: none"> ✓ Demonstration of turning operation on lathe. ✓ Practice on operation of lathe ✓ Selection of tools, general cleaning and maintenance and safe storage of tools applicable to workshop tasks. 	<ul style="list-style-type: none"> ✓ Introduction to Lathe, description, types of Lathe - constructional features and functions. ✓ Specification of a Center Lathe. ✓ Identify types of lathe tools and their uses. ✓ Classification & properties of tool materials & selection criteria. ISO specification on carbide tools.
<p>Job Holding & Centering: (20 hours)</p> <ul style="list-style-type: none"> ✓ Demonstrate the use of job holding devices on metal cutting machines & safety precautions. ✓ Study of process planning sheet ✓ Practice on centering the job. ✓ Use of three and four-jaw chuck ✓ Soft jaw boring. 	<ul style="list-style-type: none"> ✓ Different job holding devices in turning. ✓ Describe the basic method of Work holding devices - three jaw chuck, four jaw chuck, face plate, collet chuck etc. ✓ Describe the basic methods of supporting work – fixed steady, follower steady, tail stock.
<p>Measuring job: (20 hours)</p> <ul style="list-style-type: none"> ✓ Check measurements using Calipers & standard steel rule : Inch and Metric ✓ Check measurements of components/machined parts, using micrometers and Vernier, bore gauge, height gauge, depth gauge ✓ Check roundness of components using 	<ul style="list-style-type: none"> ✓ Describe the principle of the measuring instruments: its use and care for measurement setting up and assembly operations- Micrometer: internal, external, depth. Gauges: bore gauge, height gauge, depth gauge

the dial test indicator and V-blocks.	Vernier: Caliper, depth, height. Dial test indicator: its measurement.
Turning operation: (100 hours) <ul style="list-style-type: none"> ✓ Simple turning using manual feed. ✓ Practical on work alignment, facing, turning, drilling, filleting, chamfering, grooving and parting off. ✓ Practical on knurling. ✓ Sharpening of turning, boring, grooving, parting off tool on pedestal grinder and inspection. ✓ Carryout general turning between centers, usage of steady and follower rests. 	<ul style="list-style-type: none"> ✓ Describe the geometry of the lathe tool including tool angles and its effect on turning for roughing and finishing operation. ✓ Type of cutting fluids & properties. ✓ Calculation of speed, feed & depth of cut using feed-speed chart. ✓ Carry out Simple machining calculation. ✓ Lathe operations- turn, drill, face, chamfer, and part off knurl, threading, taper and form turn.
Turning & Drilling: (80 hours) <ul style="list-style-type: none"> ✓ Practice on faceplate balancing. ✓ Practical on Taper turning by compound slide. 	<ul style="list-style-type: none"> ✓ Describe the different types of drills and taps used. ✓ Classification of steels, alloy steels and effect of alloying elements. ✓ Taper - types and uses, calculation on taper turning. ✓ Describe the methods of taper turning - compound slide, tailstock off-set, forming tool, taper-turning attachment and their merits and demerits. ✓ Describe the methods of taper inspection- by taper plug gauge and ring gauge. ✓ Identify the turning fault & remedies.
Advance Turning: (120 hours) <ul style="list-style-type: none"> ✓ Turning of non-ferrous metal & non-metals such as plastic, polypropylene etc., ✓ Practical on centering, pilot drilling, counter drilling, and chamfering. ✓ Perform boring operation. ✓ Produce jobs with different diameters within the permissible concentricity. ✓ Check prepared specimens for limits and fits. ✓ Taper turning by tailstock offset method. 	<ul style="list-style-type: none"> ✓ The significance of surface roughness, description of its symbols and its influence on the function of a component. ✓ Precautions while turning soft material like Aluminum ✓ Introduction to Special purpose lathe - Capstan, turret, copying, spinning.
Thread cutting: (120 hours) <ul style="list-style-type: none"> ✓ Set a grooving tool & perform an undercutting operation for threading. 	<ul style="list-style-type: none"> ✓ Types of threads, forms of thread and its depth calculation.

<ul style="list-style-type: none"> ✓ Set a threading tool to cut V thread and cut different types of V thread – BSW and metric ✓ Perform under cut inside the bore on a required length. ✓ Cutting square threads ✓ Cutting double triple start threads. ✓ Cut "V" thread (internal). ✓ Cutting eccentric jobs. 	<ul style="list-style-type: none"> ✓ Calculation of speed, feed & depth of cut for cutting different types of thread on ferrous and non ferrous metals. ✓ Describe the methods of producing internal and external screw threads - single-start, multi-start. ✓ Describe the methods of carrying out drilling, grinding and reaming operations. ✓ Off-set turning techniques, eccentric turning and knurling. ✓ Identify turning fault & correction.
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TERMINAL COMPETENCY: The successful candidate would be able to:

- Use safety devices.
- Familiar with the necessary safety precautions required to run a lathe.
- Plan the sequence of operations.
- Identify and know the purpose of the work-holding and driving accessories
- Identify and know the purpose of the cutting-tool-holding accessories
- Know the various types of materials, cutting tools, measuring instruments and its application.
- To operate the conventional turning lathe machine and produce components involving simple turning, step turning, taper turning, threading and knurling.
- To acquaint themselves in internal drilling & boring operation
- Understand the surface finish symbols, ISO specification on carbide tools.
- Determine spindle speed, feed and depth of cut for different materials as roughing, finishing operation.
- To operate the conventional turning lathe machine, special purpose machine tool and produce components involving step turning, taper turning, eccentric turning, different types of threads and knurled surface.
- To produce components of ferrous and non-ferrous materials involving internal drilling, tapping, reaming, boring & threading.

TOOLS AND EQUIPMENTS FOR TURNING:

Sl.No.	Item	Quantity
1.	Steel Rule 30 cm graduated both in English & Metric units	10
2.	Divider spring 150 mm	10
3.	Centre punch 100 mm	5
4.	Hammer B.P. 800 gms, with handle	5
5.	Combination plier 150 mm	2
6.	Safety glasses	10
7.	File flat assorted	10
8.	Surface plate 400 mm x 400 mm grade	1
9.	Table for surface plate 900x 900 x 1200 mm	1
10.	Marking off table 1200 x 1200 x 900 mm	1
11.	Scribing block universal 300 mm	3
12.	'V' block 100 mm	2
13.	Vernier gear tooth caliper	1
14.	Try square 300 mm	5
15.	Outside, inside spring caliper	10
16.	Oil stone 150 x 50 x 25 mm	1
17.	Hacksaw frame adjustable 250300 mm with blades	5
18.	Hand vice 50 mm jaw	4
19.	Universal table angle plate	2
20.	Micrometer outside /inside/depth	2 each
21.	vernier caliper 300 mm with least count 0.02 mm	2
22.	Taper shank sleeves to suit drill machines	1 set

23.	Vernier height gauge 250 mm with least count of 0.01mm	1
24.	Vernier bevel protractor with 150 mm blade	1
25.	Bevel gauge 200 mm	1
26.	Spirit level 250mm 0.05 least count	1
27.	Spanner D.E.G.P. series 2 (7 pcs. Each)	2sets
28.	Screw driver, heavy duty assorted with handle	4
29.	Nylon/ soft Hammer 1 kg	4
30.	Allen hexagonal keys 2.5 to 12	4
31.	Set of Double ended spanner, set of box spanner with ratchet handle.	2
32.	Adjustable spanner 300 mm	2
33.	Parallel shank HSS twist drill 3mm to 12mm in a step of 1mm	3set
34.	Taper shank HSS twist drill 15mm,19mm,22mm & 25mm	1 each.
35.	Angle plate size 200x100x200 mm with strap clamp	2
36.	HSS turning tools, facing, parting, threading, grooving, boring bars to suit lathe tool post.	2no. each
37.	ISO Carbide tipped turning tools, facing, parting, threading, grooving, boring bars to suit lathe tool post.	1no. each
38.	Carbide inserted tool holders for turning, facing, parting, threading, grooving, boring with inserts.	2 each
39.	Insert for above carbide tool holders	10 set for each
40.	Compound dial gauge with stand (metric)	1
41.	Dial test indicator with magnetic gauge type 1 grade A with magnetic base -0.002mm, 0.010 mm	1
42.	Pedestal grinder, double ended with 170mm wheels (one fine and one rough)	1
43.	Dressing tool for pedestal grinder	2
44.	SS and SC centre lathe (all geared) with minimum centre height 150 mm and centre distance 1200 mm along with 3 jaws, 4 jaw chuck, auto feed system, taper turning attachment, coolant pump, safety guard, dog carriers, face plate and machine light arrangement.	5 nos.

GENERAL INFORMATION FOR CNC TURNING

Name of Sector	Production & Manufacturing
Name of Module	CNC TURNING
MES Code	MAN702
Duration of Course	500 Hrs
Entry Qualification of Trainee	10 th Pass and 14 yrs of age
Unit size (No. Of trainees)	10
Power Norms	10.0KW
Space Norms (Workshop and Class Room)	60 sq.m Minimum size of one side to be 04m.
Instructors Qualification	Degree in Mechanical Engineering with one year Experience OR Diploma in Mechanical Engineering with two year Experience OR NTC/ NAC in Turner Trade Group with three years of Experience
Desirable	Craft Instructor Certificate (CIC)

Course Contents for Module CNC Turning

Practical Competencies	Underpinning Knowledge (Theory)
<p>OSH & Safety Practices: (10 hours)</p> <ul style="list-style-type: none"> ✓ Fire Fighting in workplace & Precautions ✓ General Safety of Tools & Equipments ✓ Awareness on OSH related to the job 	<ul style="list-style-type: none"> ✓ Fire Extinguishers & its Types ✓ Safely handling Tools & Equipments ✓ Use of proper Tools & Equipments & its maintenance ✓ OSH & practices to be observed as a precaution
<p>Personnel & Material Safety: (10 hours)</p> <ul style="list-style-type: none"> ✓ Select, use, clean and store personal safety protective equipment. ✓ Use and store of materials in a safe manner. ✓ Demonstrate the use of safety devices on metal cutting machines. ✓ 5S norms 	<ul style="list-style-type: none"> ✓ State the safety precaution specific to turning on the lathe. ✓ Safety related to handling of materials. ✓ Safety devices used for safe machining.
<p>Lathe & Tool specification: (40 hours)</p> <ul style="list-style-type: none"> ✓ Turning operation on lathe. ✓ Practice on operation of lathe ✓ Selection of tools, general cleaning and maintenance and safe storage of tools applicable to workshop tasks. 	<ul style="list-style-type: none"> ✓ Introduction to Lathe, description, types of Lathe - constructional features and functions. ✓ Specification of a Center Lathe. ✓ Identify types of lathe tools and their uses. ✓ Classification & properties of tool materials & selection criteria. ISO specification on carbide tools.
<p>Job Holding & Centering: (40 hours)</p> <ul style="list-style-type: none"> ✓ Demonstrate the use of job holding devices on metal cutting machines & safety precautions. ✓ Study of process planning sheet ✓ Practice on centering the job. ✓ Use of three and four-jaw chuck ✓ Soft jaw boring. 	<ul style="list-style-type: none"> ✓ Different job holding devices in turning. ✓ Describe the basic method of Work holding devices - three jaw chuck, four jaw chuck, face plate, collet chuck etc. ✓ Describe the basic methods of supporting work – fixed steady, follower steady, tail stock.
<p>Measuring job: (40 hours)</p> <ul style="list-style-type: none"> ✓ Check measurements using Calipers & standard steel rule : Inch and Metric ✓ Check measurements of components/machined parts, using micrometers and Vernier, bore gauge, height gauge, depth gauge ✓ Check roundness of components using 	<ul style="list-style-type: none"> ✓ Describe the principle of the measuring instruments: its use and care for measurement setting up and assembly operations- Micrometer: internal, external, depth. Gauges: bore gauge, height gauge, depth gauge

<p>the dial test indicator and V-blocks.</p>	<p>Vernier: Caliper, depth, height. Dial test indicator: its measurement.</p>
<p>Turning operation: (120 hours)</p> <ul style="list-style-type: none"> ✓ Simple turning using manual feed. ✓ Practical on work alignment, facing, turning, drilling, filleting, chamfering, grooving and parting off. ✓ Practical on knurling. ✓ Sharpening of turning, boring, grooving, parting off tool on pedestal grinder and inspection. ✓ Carryout general turning between centers, usage of steady and follower rests. 	<ul style="list-style-type: none"> ✓ Describe the geometry of the lathe tool including tool angles and its effect on turning for roughing and finishing operation. ✓ Type of cutting fluids & properties. ✓ Calculation of speed, feed & depth of cut using feed-speed chart. ✓ Carry out Simple machining calculation. ✓ Lathe operations- turn, drill, face, chamfer, and part off knurl, threading, taper and form turn.
<p>CNC Turning: (120 hours)</p> <ul style="list-style-type: none"> ✓ Personal and CNC machine Safety. ✓ Select, use, clean and store personal protective equipment. ✓ CNC machine, CNC console. ✓ Machine over travel limits and emergency stop. ✓ Machine starting & operating in Reference Point, JOG, and Incremental Modes ✓ Work and tool setting. ✓ Co-ordinate system points, assignments and simulations. ✓ Absolute and incremental programming assignments and simulations. ✓ Work off set measurement, Tool off set measurement and entry in CNC Control. ✓ Tool nose radius and tool orientation entry in CNC control. ✓ Jaw removal and mounting on CNC Lathe. ✓ Manual Data Input (MDI) and MGP mode operations and checking of zero offsets and tool offsets. ✓ Soft jaw boring. ✓ Program checking in dry run, single block modes. Checking finish size by over sizing through tool offsets. ✓ Part program preparation, Simulation & Automatic Mode Execution for the exercise on Simple turning & Facing (step turning) ✓ Linear interpolation, and Circular interpolation assignments and 	<ul style="list-style-type: none"> ✓ Safety Precautions in CNC operation. ✓ State the Safe handling of tools, equipment & CNC machines, Conventional & CNC machining. ✓ State the types of CNC machines, advantages & limitations of CNC, computer numerical control applications, ✓ Describe CNC interpolation, open and close loop control systems. Co-ordinate systems and Points. ✓ State the CNC Machines - Turning - Milling, -, Machine axes identification. ✓ Identify the CNC Machine Control Unit organization.(Keys & Menus) ✓ Explain working principle of CNC Machine. ✓ Setting work and tool offsets. ✓ Importance of feedback devices for CNC control. ✓ Importance of Tool Nose Radius Compensation (TNRC). ✓ Cutting tool materials for CNC Turning and its applications ✓ ISO nomenclature for turning tool holders, boring tool holders, indexable inserts. ✓ Tool holders and inserts for radial grooving, face grooving, threading, drilling. ✓ Cutting parameters- cutting speed, feed rate , depth of cut, tool wear, tool life,

<p>simulations on soft ware.</p> <ul style="list-style-type: none"> ✓ Part program preparation, Simulation & Automatic Mode Execution for the exercise on Turning with Radius / chamfer with TNRC. ✓ Part program preparation, Simulation & Automatic Mode Execution of CNC Machine for the exercise on Blue print programming contours with TNRC. 	<p>relative effect of each cutting parameter on tool life.</p> <ul style="list-style-type: none"> ✓ Cutting parameters selection from a tool manufacturer's catalog for various operations, process planning. ✓ Describe the tooling systems for CNC TURNING Centers. ✓ State the cutting parameters selection and process planning. ✓ Tools layout and process sheet preparation.
<p>CNC Advance Turning: (120 hours)</p> <ul style="list-style-type: none"> ✓ Geometry Wear Correction.Geometry and wear offset correction. ✓ Part program preparation, Simulation & Automatic Mode Execution of CNC Machine for the exercise on turning. ✓ Stock removal cycle OD ✓ Drilling / boring cycles ✓ Stock removal cycle ID ✓ Part programs for thread cutting for CNC turning centers and simulation on computers. ✓ Machining of Part program exercises of CNC TURNING <ul style="list-style-type: none"> ■ Grooving and thread cutting OD ■ Grooving and thread cutting ID ■ Threading cycle OD ■ Sub programs with repetition <p>Using Sub Programs & Cycles in the Main Program.</p>	<ul style="list-style-type: none"> ✓ Processes sequencing. ✓ Tool path study of machining operations ✓ Work-piece zero points and ISO/DIN G and M codes for CNC. ✓ Describe the stock removal cycle in CNC turning for OD / ID operation. ✓ Describe Tooling system for turning ✓ Carryout Drilling /Boring cycles in CNC Turning. ✓ Grooving/Threading Tools, Processes and Tool selection. ✓ Describe Tapping on CNC turning. ✓ Programming for Grooving/Threading on OD/ID in CNC Turning. ✓ Trouble shooting in CNC lathe machine ✓ Identify Factors affecting turned part quality/ productivity. ✓

TERMINAL COMPETANCY: The successful candidates should be able to:

- Identify CNC Turning Centre Machine Elements & CNC control panel keys and Menu structure.
- Start the CNC Machine and Reference it and move the Machine Slides (Axes) in JOG/INC/MPG Modes.
- Start Spindle ON/OFF, Coolant On/Off, Tool Changing and do axes positioning in JOG/MDI Modes.
- Load Parts in Work holding devices and Tools in tools Turret.
- Input/edit Part Programs in the CNC Control and do Graphic Simulation to Verify &

Check Part Programs.

- Do Machining operations like Turning, Facing, Contour Turning with Roughing/Finish Turning using Stock Removal Cycles, Sub programming.
- Grooving, Thread Cutting, Drilling, Boring and Tapping using Automatic/Memory Modes with block search and Repositioning/Restart procedure.

TOOLS AND EQUIPMENTS FOR CNC TURNING

Sl.No.	Item	Quantity
1.	Steel rule 30 cm graduated both in English & Metric units	10
2.	Outside, inside spring caliper 150 mm	5
3.	Divider spring 150, 200 mm	5
4.	Centre punch 100 mm	2
5.	Ball peen Hammer, 0.5 Kg	2
6.	Combination plier 150 mm	4
7.	Safety goggle	10
8.	Files such as coarse, medium, smooth of flat, half-round, round and tri-angular file of 200mm.	4 each
9.	Surface plate with table 900x900x1200mm	1
10.	Marking table 1200 x 1200 x 900mm high	1
11.	Scribing block universal 300 mm	2
12.	Pitch micrometer 0-25mm with set of anvils.	2
13.	" V " block 100 mm	2
14.	Try Square 150 mm	5
15.	Depth micrometer 200 mm	1
16.	Spirit level 250mm 0.05 least count	1
17.	Screw Driver, heavy duty handle assorted	4
18.	Combination set 300 mm	2
19.	Reduction sleeve MT (to suit the m/c)	1
20.	Compound dial gauge with stand (Metric)	1
21.	Screw pitch gauge for metric pitches (0.5 to 6mm)	1
22.	Pressure feed Oil can 500 mg	1

23.	Twist drills& Drill chucks for exercises	2
24.	Grinding wheel dresser (Diamond)	1
25.	Clamps for "v" block	1
26.	Assorted carbide lathe tools with holder different shapes and sizes	2
27.	Hacksaw frame adjustable 250 -300mm with blades	2
28.	Plier cutting 200 mm	4
29.	Magnifying glass 75 mm	2
30.	Hand hammer 1 Kg	4
31.	Centre drill 2,3,& 4	4
32.	Parting tool holder with HSS tool bit	5
33.	Boring tool holder, with HSS tool bit	5
34.	Micrometer outside-0-25, 25 - 50 mm	1each
35.	Vernier caliper 300mm with Least count 0.02mm	3
36.	Vernier bevel protractor -150 mm	1
37.	Telescopic gauge 13 mm to 300 mm	1
38.	Radius gauge metric set (1- 6 mm)	5
39.	Bevel gauge 200 mm	1
40.	Taper gauge	1set
41.	Depth vernier 0-200 mm	1
42.	Knurling tool -straight and bent type, single and diamond type	2 each
43.	Pedestal grinder, double ended with 170mm wheels (one fine and one rough)	1
44.	SS and SC centre lathe (all geared) with minimum centre height 150 mm and centre distance 1200 mm along with 3 jaws, 4 jaw chuck, auto feed system, coolant pump, and machine light arrangement.	1

Machinery:

- 1) CNC TURNING CENTRE with minimum specifications of dia. 150mm, between center distance 500mm, 8 station turret. Preferably with a popular controller like Fanuc/Siemens, etc. with necessary tools and equipments.
- 2) Computers in 5 numbers in LAN with operating systems and accessories
- 3) Multimedia teachware for CNC technology and interactive CNC machine simulators with console emulator software for Fanuc, Siemens, Fagor and Mitsubishi CNC systems. (10 students + 1 faculty): **5 users**

GENERAL INFORMATION FOR GRINDING

Name of Sector	PRODUCTION & MANUFACTURING
Name of Module	GRINDING
MES Code	MAN706
Duration of Course	600 Hrs
Entry Qualification of Trainee	8 th Pass + 18 yrs of age
Unit size (No. Of trainees)	10
Power Norms	15KW
Space Norms	60 sq.m Minimum size of one side to be 04m.
Instructors Qualification	Degree in Mechanical Engineering with one year Experience OR Diploma in Mechanical Engineering with two year Experience OR NTC/ NAC in Machinist (Grinder) Trade Group with three years of Experience
Desirable	Craft Instructor Certificate (CIC)

Course Contents for Module Grinding

Practical Competencies	Underpinning Knowledge (Theory)
<p>OSH & Safety Practices:</p> <ul style="list-style-type: none"> ✓ Fire Fighting in workplace & Precautions ✓ General Safety of Tools & Equipments ✓ Awareness on OSH related to the job 	<ul style="list-style-type: none"> ✓ Fire Extinguishers & its Types ✓ Safely handling Tools & Equipments ✓ Use of proper Tools & Equipments & its maintenance ✓ OSH & practices to be observed as a precaution
<p>Personnel & Material Safety:</p> <ul style="list-style-type: none"> ✓ Safety precautions followed in grinding, i.e. Wear suitable eye goggles, shoes, clothes etc. ✓ Use and store of materials in a safe manner. ✓ Demonstrate the use of safety devices on grinding machines. 	<ul style="list-style-type: none"> ✓ Describe personal safety measures when grinding. ✓ State the safety precaution specific to grinding operation. ✓ Safety related to handling of materials. ✓ Safety devices used for safe machining.
Surface Grinding	
<ul style="list-style-type: none"> ✓ Grinding m/c specification: ✓ Machine operational system and safety switch ✓ Movement of machine hydraulic or mechanical drive ✓ Longitudinal movement and its limits ✓ Up and down movement and its limits ✓ Machine up and down movement and its minimum feed. ✓ Cross drive movement and its limits ✓ Setting of job in magnetic chuck or vice ✓ Demonstration on operation of grinding m/c. ✓ Practice on operation of grinding machine. ✓ Selection of tools, general cleaning and maintenance and safe storage of tools applicable to workshop tasks. ✓ Identify the controls of surface grinding machine. ✓ Setting on magnetic chuck. 	<ul style="list-style-type: none"> ✓ Describe surface grinding machine -types, construction, parts, and functions. ✓ State the purpose of surface grinding. ✓ Specification of a grinding m/c.
<ul style="list-style-type: none"> ✓ Grinding wheel specification: ✓ Wheel balancing. ✓ Dressing of grinding wheels for rough and finish grinding ✓ Testing a grinding wheel for cracks 	<ul style="list-style-type: none"> ✓ Specifications of grinding wheels. Aluminium oxide A 40 white wheel ✓ Describe the selection criteria of grinding wheels. ✓ Identify the standard grinding wheel shapes.

<ul style="list-style-type: none"> ✓ and defects by tapping method ✓ Practice on mounting of grinding wheel. ✓ Inspect a used grinding wheel & find defects. ✓ Practice on balancing a grinding wheel. ✓ Practice on Truing of a grinding wheel. 	<ul style="list-style-type: none"> ✓ Mounted grinding wheels. ✓ Describe grinding wheel markings. ✓ Describe Handling and storage of grinding wheel. ✓ Describe Diamond wheel identification. ✓ Explain the importance of inspection of wheels. ✓ Describe Balancing, mounting and Truing of a grinding wheel.
<p>Job Holding & Centering:</p> <ul style="list-style-type: none"> ✓ Demonstrate the use of job holding devices on grinding machines & safety precautions. ✓ Use of work holding devices on grinding Machine. 	<ul style="list-style-type: none"> ✓ Different job holding devices in grinding. ✓ Describe work holding devices-Magnetic vice,chucks. ✓ Explain the principles workshop layout, blueprint reading. ✓ Describe type of grinding fluids and purposes
<p>Measuring job:</p> <ul style="list-style-type: none"> ✓ Check measurements of components/machined parts with vernier calipers, micrometer, and Depth gauges and slip gauges 	<ul style="list-style-type: none"> ✓ Describe the principle of the measuring instruments: its use and care for measurement setting up and assembly operations- Micrometer: internal, external, depth. Vernier: Caliper, depth, height.
<p>Surface Grinding operation:</p> <ul style="list-style-type: none"> ✓ Grinding parallel surface to an accuracy of ± 0.02 mm. ✓ Grinding a surface at 90° to an accuracy of 5'. ✓ Grinding steeped surface to an accuracy of ± 0.04 mm. ✓ Grinding a slot to an accuracy of ± 0.02 mm. ✓ Grinding Angular surface using universal vice. ✓ Grinding parallel blocks. ✓ Practice on taper grinding using sine wise. ✓ Grinding thin plates. ✓ Grinding on two vertical faces parallel & centered. ✓ Grinding "vee" using disc wheel. ✓ Grinding dovetails. ✓ Grinding radii (male & female) 	<ul style="list-style-type: none"> ✓ Describe surface grinding operation- Horizontal,Vertical, Angular, and edges of a surface. ✓ Explain the importance of surface roughness and measuring methods. ✓ Describe the importance of demagnetizations of jobs. ✓ Identify surface grinding faults, causes & remedies. ✓ Describe Annealing of work material -steel, cast-iron, Aluminum. ✓ Describe normalizing of Forging, Casting & Machined jobs. ✓ Practice for dressing with angular dresser and use for grinding V block ✓ Check the centre shift of the V block using surface plate and dial. ✓ Educate use of different types of grinding wheels for Cast Iron, Steel, stainless Steel, and Carbide. ✓ Dressing of diamond wheels.
<p>Cylindrical Grinding</p>	

Cylindrical Grinding Machine Specification

Training of cylindrical grinding operational system , hydraulic operational system , stroke limits longitudinal and cross feed movement of machine, work head chuck mounting , change from chuck mounting to between center, mounting of carrier / dog, use of dead center and Half center for min dia grinding, mounting of grinding wheel in wheel flange and balancing , dressing attachment mounting , use of study and follow rest for grinding long shaft, use and application specification of coolant fluid and proportion of mixing of water , learn to use appropriate grinding wheel according to the material spec , hardness , material and application of travers feed with depth of cut , use of lapping wheel and the control limit in the pre preparation of job.

Cylindrical Grinding operation:

- | | |
|---|---|
| <ul style="list-style-type: none"> ✓ Check measurements of components/machined parts with vernier calipers, Depth gauges, inside/outside and bore dialgauges. ✓ Identify the controls of cylindrical grinding machine. ✓ Practice on balancing a grinding wheel. ✓ Practice on mounting a grinding wheel. ✓ Practice on Truing of a grinding wheel. ✓ Plunge grinding a parallel diameter to a dimensional accuracy of ± 0.05 mm. ✓ Grinding slow taper surfaces with in a accuracy of 5minutes. ✓ Grinding fast taper surfaces with in a accuracy of 5minutes. ✓ Grinding radii. ✓ Grinding parallel bore. ✓ Grinding a bore up to a shoulder. ✓ Grinding a bore and shoulder. ✓ Grinding a face. ✓ Grinding a bore in a long work piece. ✓ Grinding a tapered bore. ✓ Grind cylindrical plain internal surfaces on a cylindrical grinder to an accuracy of ± 0.05 mm. ✓ Wheel dressing for face grinding. ✓ Use of male or female taper plug /ring gauge for grinding Morse taper and ISO 40/50 taper. ✓ Checking the taper with sine bar and slip gauge. ✓ Use of bore dial indicator with | <ul style="list-style-type: none"> ✓ State the purpose of cylindrical grinding. ✓ Describe Cylindrical-grinding machine -types, parts, function and operation. ✓ Describe the procedure of Balancing, mounting and Truing of a grinding wheel. ✓ Describe work holding devices- 4- jaw independent chuck, 3 - jaw chuck, faceplate and carriers. ✓ Describe the type of grinding fluids and purposes. ✓ Describe the methods of producing external and internal cylindrical surfaces of plain taper and stepped surfaces. ✓ Describe the main factor of grinding parameters- wheel speed, work speed, depth, and work traverse speed, depth in feed. ✓ Describe the method of Inspection of cylindrical surfaces. ✓ Concept of Centreless Grinding & Profile Grinding. Identify cylindrical grinding defects, causes and remedy. ✓ Describe the main factor of Hardening & Tempering of chisels (water hardening) cutting tools Describe (Oil hardening) & H. S. S (Air Hardening) ✓ Describe the Importance of case hardening & stress relieving. |
|---|---|

<p>0.01 to 0.001 accuracy.</p> <ul style="list-style-type: none"> ✓ Grinding of bush ID ground by using taper mandrel for OD grinding ✓ Mounting of spindle for ID grinding using study ✓ Grinding of center for center correction ✓ Use of radius dresser attachment for radius grinding ✓ Lear to measure radius jobs with micrometer 	
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TERMINAL COMPETENCY: The successful candidate should be able to:

- Use safety devices.
- Familiar with the necessary safety precautions required to perform while surface grinding.
- Know the measuring instruments and its application.
- Select the proper grinding wheel for each type of work material.
- Know the application of grinding wheels and abrasive products.
- Operate the surface-grinding machine along with magnetic chuck and standard accessories.
- Balancing, mounting and dressing of grinding wheel.
- Grinding of parallel surface, angular surface and stepped surfaces.
- Know the purpose of heat treatment process.
- Identify surface grinding faults, causes and remedies.
- Operate the cylindrical grinding machine along with magnetic chuck and standard accessories.
- Set up and grinding stepped, taper cylindrical internal and external surfaces.
- Balancing, mounting and dressing of grinding wheel.
- Know the purpose of hardening and tempering cutting tools.
- Identify surface grinding faults, causes and remedies.

TOOLS AND EQUIPMENTS FOR GRINDING:

sl.no	Item	Quantity
1.	Micrometer outside 0-25 mm, 25-50mm	2each
2.	Micrometer depth gauge 0 - 200 mm	1
3.	Spirit level 250mm 0.05 least count	1
4.	Telescopic gauge	2
5.	Oil stone	5
6.	Pair of V blocks 50/5-40A	2
7.	Adjustable angle vise	1
8.	Nylon/ soft Hammer 1 kg	4
9.	Screw Driver, heavy duty with handle	2
10.	Combination set 300 mm	1set
11.	Angular Sine vise	1
12.	C-clamp	4
13.	Wheel balancer kit	2
14.	Try square 150mm	5
15.	Double end spanner	1 set
16.	Files such as coarse, medium, smooth of flat, half-round, round and tri-angular file of 200mm.	4 each
17.	Vernier caliper 200 mm with least count 0.02mm	2
18.	Testing mandrel.	2
19.	Compound dial gauge with stand - Metric	1
20.	Dial test indicator with magnetic gauge type 1 grade A with magnetic base least count 0.01mm	1
21.	Vernier bevel protector with least count 5 minutes	1
22.	Radius gauge set	1set

23.	Angle plates size 200 x 100 x 200 mm	1
24.	Adjustable angle plate	1
25.	Grinding wheel dresser (diamond)	2
26.	Sine dressing tool	1
27.	Safety goggles	10
28.	Allen keys 2.5 to 12	2sets
29.	Grinding wheels- (Different types as desired)	As required
30.	Wheel truing attachment	1
31.	Pedestal grinder, double ended with 170mm wheels (one fine and one rough)	1
32.	Surface grinding machine wheel dia 180 mm (or near) reciprocating table, longitudinal table traverse 200 mm (or near) fitted with adjustable traverse stop, magnetic chuck 250 mm x 120 mm. With set of grinding wheels, diamond tool holders for dressing & set of spanner etc with standard accessories & form grinding attachment.	03
33.	Cylinder grinder with internal grinding attachment, center height - 130mm with standard accessories including 3 Jaw self centering chuck, 4 Jaw independent chuck with set of grinding wheels internal grinding spindles etc with standard accessories with form grinding attachment & steadies.	02

GENERAL INFORMATION FOR DRAFTING (MECHANICAL)

Name of Sector	PRODUCTION & MANUFACTURING
Name of Module	DRAFTING (MECHANICAL)
MES Code	MAN705
Duration of Course	500 Hrs
Entry Qualification of Trainee	10 th Pass + 16 yrs of age
Unit size (No. Of trainees)	20
Power Norms	5.0 KW
Space Norms	60 sq.m Minimum size of one side to be 04m.
Instructors Qualification	Degree in Mechanical Engineering with one year Experience OR Diploma in Mechanical Engineering with two year Experience OR NTC/ NAC in Draughtsman (Mech)Trade Group with three years of Experience
Desirable	Craft Instructor Certificate (CIC)

Course Contents for Module Drafting (Mechanical)

Underpinning Knowledge (Theory)	Practical Competencies
<p>OSH & Safety Practices:</p> <ul style="list-style-type: none"> ✓ Fire Extinguishers & its Types ✓ Safely handling Tools & Equipments ✓ Use of proper Tools & Equipments & its maintenance ✓ OSH & practices to be observed as a precaution 	<ul style="list-style-type: none"> ✓ Fire Fighting in workplace & Precautions ✓ General Safety of Tools & Equipments ✓ Awareness on OSH related to the job
<p>Personnel & Material Safety:</p> <ul style="list-style-type: none"> ✓ Describe personal safety measures when grinding. ✓ State the safety precaution specific to grinding operation. ✓ Safety related to handling of materials. ✓ Safety devices used for safe machining. 	<ul style="list-style-type: none"> ✓ Safety precautions followed in w/shop i.e. Wear suitable eye goggles, shoes, clothes etc. ✓ Use and store of materials in a safe manner. ✓ Demonstrate the use of safety devices on grinding machines.
Engineering drawing & it's Types	
Drawing Equipments	Use of Drawing Equipments
Lettering	Type of letter i) vertical single stroke letters ii) slanted single stroke letters iii) Gothic Letters
Geometrical Construction	Construction of various geometrical figures
Scales & it types	Construction of various scale like i) Plain scale ii) Diagonal scale iii) scale of chords
Conic section & curves	Construction of various curves like Ellipse, Parabola, Hyperbola, cycloids, Epicycloids, Hypocycloids, Archimedean curve, spiral.
Conventional lines	Drawing different type line & their application
Conventional symbols & abbreviation	Drawing various symbols & abbreviation used in engineering drawing
Dimensioning	Drawing different method & dimension techniques used in mechanical drawing
Projection	Projection point, line, plane, solid
Ortho graphic projection 1 st angle projection 3 rd angle	Views of different object in both 1 st & 3 rd angle projection method

projection	
Pictorial drawings i) Isometric Projection ii) Oblique Projection	Drawing isometric & oblique projection plans, solid & objects-cube,triangular prism,cylinder,cone &pyramid in isometric Scale.
Section & its types	Drawing sectional views of different object cube,triangular prism, cylinder,cone &pyramid
Development of surface	Making development surface of various solid object - cube, triangular prism, cylinder, cone & pyramid.
Section of solid	Drawing different method of section in solid-cube, triangular prism, cylinder, cone &pyramid
Intersection & interpenetration of solid	Making drawing of different curves obtained at Intersection & interpenetration of solids
Surface Texture	Application of various surface symbol in drawing
Shaft Coupling	Sketching muff coupling and flange coupling used in machinery
Shaft Bearing	Sketching bush bearing & Plummer block
Key, Pins, & Knuckle joint	Drawing various key joint ,pins & cotter joint used in machinery
Screw thread	Drawing different form of thread, conventional symbol used in threads
Thread fasteners	Drawing different various type of nut, bolt, screw, studs, locking method of nuts & foundation bolts
Pulleys	Sketching Cast Iron pulley & fast & loose pulley
Rivet & riveted jointed	Construction of various types of riveted joints used In industries
Welding	Sketching various weld joint with symbol
Structural drawing	Sketching various standard shapes
Spur gear	Nomenclature of gears and types of gears.

Cams	Construction of simple cam design
Limits, Tolerance & Fits	Application of tolerance in drawing & geometrical tolerance.
Production drawing i) Assembly drawing ii) Detail drawing	Simple assignment drawing like i) Stuffing Box ii) Non Return valve iii) Tool post of lathe iv) knuckle Joint
Jig & fixture	Jig components-jig body,jig plate,jig bushes,locators & clamping arrangements
Pipe fitting & joints	Sketching different pipe fitting & pipe joint like CI pipe joint & spigot and socket pipe joints
Piping drawing	Sketching pipe symbols used in drawing
Familiar with SP:46 -2003	Practice on BIS SP:46 -2003
PRACTICE ON COMPUTER Practice on two useful software via MS-Word & MS Excel, MS Office & operating system	Introduction to computer, windows
Introduction to Auto CAD Advantages of using Autocad	Introduction to Auto CAD, Auto CAD main Menu, screen menu, command line, model space Drawing layouts, Tool bars, File creation, Save, Open existing drawings, creation of Drawing Sheet as per ISO.
Absolute Co-ordinate system , Polar Co-ordinate System and Relative Co-ordinate System Create Line, Break, Erase, Undo	Related Exercises using Absolute Co-ordinate system, Polar Co-ordinate System and Relative Co-ordinate System, Exercise using Line, Break, Erase, Undo commands
Trim, Offset, Fillet, Chamfer, Arc and Circle commands.	CAD: Exercise using Trim, Offset, Fillet, Chamfer Commands.
Move, Copy, Array, Insert Block, Make Block, Scale, Rotate, Hatch Commands.	CAD: Exercise using Move, Copy, Array, Insert Block, Make Block, Scale, Rotate, Hatch

	Commands.
Creating templates, Inserting drawings, Layers Modify Layers.	CAD: Practice using Creating templates, Inserting drawings, Layers and Modify Layers.
Dimensioning drawings, Creating styles in dimensioning.	CAD: Drawing practice using Dimensioning drawings.
Modifying styles in dimensioning.	CAD: Creating styles in dimensioning. Modifying styles in dimensioning.
CAD Introduction to 3D, 3D primitives, Extrude, Revolve command Setting User co-ordinate Systems, Rotating, Plotting, Print preview	CAD Drawing practice using 3D primitives, Extrude, Revolve command, subtract, union 3D drawing by using User co-ordinate systems. Plotting, Print preview
Modify Layers on CAD	Practices on Modify Layers

TERMINAL COMPETENCY: The successful candidate should be able to:

- read & draw various geometrical figures.
- construct various curves, scales, lines.
- draw Views of different object in both 1st & 3rd angle projection method
- draw isometric & oblique projection plans, solid & objects, sectional views of different object
- develop surface of various solid object in parallel & Radial Method
- draw different curves obtained at intersection & interpenetration of solids
- read & draw simple Machine Parts & Industrial Drawings.
- work with CAD.

TOOLS AND EQUIPMENTS FOR Drafting (Mechanical):

SR. NO.	TRAINEES KIT	QUANTITY
1	DRAWING INSTRUMENTS BOX (COMPASS, DIVIDER, PROTECTOR, etc.)	20 each
2	DRAWING BOARD (700 X 500 mm) IS : 1444	
3	TEE - SQUARE (700 MM BLADE) IS : 1360	
4	SET SQUARE CELLUOID 45 ⁰ (250 X 250 mm) IS : 1561	
5	SET SQUARE CELLUOID 30 ⁰ - 60 ⁰ (250 X 200 mm) IS : 1561	
6	CELLUOID SCALE (300 mm) INCHES & MILLIMETERS	
7	FRENCH CURVE	
8	PENCILS & RUBBERS	
9	COMPUTER WITH LATEST CONFIGURATION & CAD SOFTWARE ALONGWITH SUITABLE FURNITURES	10 Nos
10	CAD PLOTTERS	1 No

SR. NO.	DESCRIPTION	QUANTITY
2	TRAINEE STOOL	20
3	BLACK/WHITE BOARD	1
4	INSTRUCTOR DESK	1
5	INSTRUCTOR CHAIR	1

GENERAL INFORMATION FOR DIE INSPECTION & HANDLING

Name of Sector	PRODUCTION & MANUFACTURING
Name of Module	Die Inspection & Handling
MES Code	MAN707
Duration of Course	500 Hrs
Entry Qualification of Trainee	8 th Pass + 16 yrs of age
Unit size (No. Of trainees)	10
Power Norms	4.0 KW
Space Norms	60sq.m Minimum size of one side to be 04m.
Instructors Qualification	Degree in Mechanical Engineering with one year Experience OR Diploma in Mechanical Engineering with two year Experience OR NTC/NAC in Tool & Die Maker (Dies & Moulds)Trade Group with three years of Experience
Desirable	Craft Instructor Certificate (CIC)

Course Contents for Module Die Inspection & Handling

Practical competencies	Under pinning knowledge
<p>OSH & Safety Practices:</p> <ul style="list-style-type: none"> ✓ Fire Fighting in workplace & Precautions ✓ General Safety of Tools & Equipments ✓ Awareness on OSH related to the job& Maintenance ✓ Practice of 5S 	<ul style="list-style-type: none"> ✓ Fire Extinguishers & its Types ✓ Safely handling Tools & Equipments ✓ Use of proper Tools & Equipments & its maintenance ✓ OSH & practices to be observed as a precaution ✓ Awareness, concept & importance of 5S
<p>Personnel & Material Safety:</p> <ul style="list-style-type: none"> ✓ Select, use, clean and store personal safety protective equipment. ✓ Use and store of materials in a safe manner. ✓ Demonstrate the use of safety devices on Die Manufacturing. 	<ul style="list-style-type: none"> ✓ State the safety precaution specific to turning on the lathe. ✓ Safety related to handling of materials, machines, press, devices. ✓ Safety devices used for safe Die Manufacturing.
<ul style="list-style-type: none"> ✓ Familiarization with Die and punch and their application. ✓ Identification of different elements of die and punch assembly. ✓ Die inspection using measuring instruments. ✓ Die Quenching, Grinding and Finishing. ✓ Die Mould Shop layout orientation ✓ Different types material handling equipments (EOT & Forklift) (He should have valid Driving/Operating license) ✓ Practical on Die manufacturing processes ✓ Practical on Die/Mould Defects, Causes & Remedies ✓ Practical on Basic Hand skills like Filing, hack sawing, drilling, drill sharpening, Countersinking/Counterboring/blind hole drilling, reaming, Int/Ext thread machining, use of Diamond needle files, etc 	<ul style="list-style-type: none"> ✓ Introduction to Die and punch and their application and importance in manufacturing. ✓ Die material and manufacturing of dies and tooling , Heat treatment processes & Different grade materials used for dies and tooling's ✓ Die manufacturing process; CNC, HSM machines, EDM machines, cutting tools, graphite electrode grades. ✓ Die/Mould defects; cracks, mismatch, hold- up, under fill, etc. ✓ Theory on Basic Hand skills

- Terminal Competency** : The successful candidate would be able to:
1. Understand the manufacturing process of Die
 2. Inspect the manufactured Die
 3. Upkeep & routine maintenance of Die.
 4. Handling process of Die.

List of Tools & Equipments:

Sl No	Description of Tools/Equipment	Quantity
1	Die grinder (pneumatic) With stand	1
2	Pining Punch	4
3	Spanners	2 sets
4	Polish pins	2 sets
5	Buffing wheels	2 sets
6	Mounted Points of various sizes	2 sets
7	Compresses air line with Pressure 6-7 bar	1
8	Hose clips	4
9	Pencil Grinder	2
10	Welding Machine set	1
11	Special Electrodes 3.15 & 4 mm	As required
12	De Scalar	2
13	Rotary Burrs of various sizes (carbide Burr cutters)	2 sets
14	Lubricating oil & Emery Papers (120,300,420 grits)	2 sets
15	Vernier caliper 150mm, 300mm	2 each
16	Bevel Angle protector	1
17	Micrometer 0-25, 25-50, 50-75	1 each
18	Vernier height gauge	1
19	Angle plate 200x200mm, surface plate 500x1000	1 each
20	Magnifying glass	3
21	Straight edge	1
22	Filler gauge, radius gauge	2 each
23	C-clamp (200mm)	4
24	Digital vernier caliper 300mm	1
Safety Equipments		
1	Helmet	20
2	Ear plug	20
3	Mask (respirators)	20
4	Safety Goggles	20
5	Apron	20
6	Hand Gloves	20
7	Safety Shoes	20
8	Face Shield	20

Note:

1. Tool Kit and safety equipment should be available one for each student
2. Heavy M/C Set up one for whole institute.

GENERAL INFORMATION FOR FORGING & HEAT TREATMENT

Name of Sector	PRODUCTION & MANUFACTURING
Name of Module	FORGING & HEAT TREATMENT
MES Code	MAN709
Duration of Course	600 Hrs
Entry Qualification of Trainee	8 th Pass + 16 yrs of age
Unit size (No. Of trainees)	20
Power Norms	25.0 KW
Space Norms	60 sq.m Minimum size of one side to be 04m
Instructors Qualification	Degree in Mechanical Engineering with one year Experience OR Diploma in Mechanical Engineering with two year Experience OR NAC in Forger & Heat Treater Trade Group with three years of experience
Desirable	Craft Instructor Certificate (CIC)

Course Contents for Module – Forging & Heat Treatment

Practical Competencies	Under Pinning Knowledge
<p>OSH & Safety Practices:</p> <ol style="list-style-type: none"> 1. Fire Fighting in workplace & Precautions 2. General Safety of Tools & Equipments 3. Awareness on OSH related to the job 	<ol style="list-style-type: none"> 1. Fire Extinguishers & its Types 2. Safely handling Tools & Equipments 3. Use of proper Tools & Equipments & its maintenance 4. OSH & practices to be observed as a precaution
<p>Personnel & Material Safety:</p> <ol style="list-style-type: none"> 1. Select, use, clean and store personal safety protective equipment. 2. Use and store of materials in a safe manner. 3. Demonstrate the use of safety devices on Forging & Heat Treatment. 	<ol style="list-style-type: none"> 1. State the safety precaution specific to turning on the lathe. 2. Safety related to handling of materials. 3. Safety devices used for Forging & Heat Treatment.
<p>Forging and Heat Treatment</p> <ol style="list-style-type: none"> 1. Forging line induction 2. Identification of parts of forging machine. 3. Use of various mechanical measuring instruments 4. Black smithy 5. Billet cutting, job holding, unloading. 6. Reduce rolling /performing forging operation 7. Die lubrication 8. Forging inspection 9. Heat treatment and forging operations 	<ol style="list-style-type: none"> 1. Billet preparation – cutting, sizing methods. Hack sawing and sawing with mechanical and hydraulic saws. Filing – use of different types of files – needle, diamond files, half round and square files. Handling of billets during forging 2. Forging – basics and methods. Cold and hot forging, open and closed die forging, upsetting and extrusion, flashless forging. Benefits of forging with different methods. Demerits of forging over manufacturing methods. 3. Materials for forged parts/components – ferrous and non-ferrous alloys. Heat treatment and different methods. Equipment for heat treatment – furnaces, heat treatment cycles. Mechanical properties – hardness, toughness. Formability of materials – definition and procedures. 4. Equipment used for forging – hammers, mechanical and hydraulic power presses – different parts and their functions. Presses used for performing, forging, trimming and other operations. 5. Tooling for forging – punches and dies, constructional details and features,

	<p>setting up tooling for forging – alignment and clearances. Die lubrication and maintenance.</p> <p>6. Reading of component drawings for forging. Methods of inspection of forged components – visual and dimensional inspection, non-destructive methods. Usage of instruments for inspection of forged parts.</p> <p>7. Stages of forging – heating, reducing, upsetting, edger, flattener, fuller, buster, blocker, finisher, trimmer, padding and piercing.</p> <p>8. Safety precautions in forging industries, during forging and inspection. Use of protective devices and safety enclosures</p> <p>9. Definition of Heat treatment , purpose, different methods, furnaces and cycles of heat treatment, material properties and composition and its effects on heat treatment, hardness checking, hardness checking techniques and methods.</p>
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- Terminal Competency** : The successful candidate would be able to:
- 1 Know Forging process and stages of Forgings
 - 2 Perform forging operations.
 - 3 Follow Safety aspects
 - 4 Know Forging instruments,
 - 5 Use & care of measuring instruments
 - 6 Understand the Heat Treatment process,
 - 7 Design aspects of forging
 - 8 Advanced forging techniques and its process

List of Tools & Equipments:

Sl No	Description of Tools/Equipment	Qty.
1	Hammer (Pneumatic)---- 25001 Lb,25002Lb,10 ton	1
2	Hammer (Pneumatic)---- 12000 Lb,5 ton	1
3	Blacksmith Hammer (Pneumatic)--- 2ton/3ton/4ton	1
4	Up setter ----- 4",6",7.5"	1
5	Material cutting m/c	1
6	Furnace	1
7	Trimming press (Mechanical/Hydraulic)	1
8	Twisting & Padding press	1
9	Compressor	1
10	Metal cutting blade	1
11	Spanners	1
12	Coolant oil Furnace oil	1
13	LDO, LPG	1each
14	Die key	1
15	Dowel	1
16	Liner & shank liner	1
17	Over head crane	1
18	Ram & key driver for key tightening	1
19	Fork lifter	1
20	Manipulator	1
21	Hand hammer	1
22	Gas burner	1
23	Air blower pipe	1
24	Tong	1
25	Trolley	1
26	Chain along with pulley	1
27	Peel	1
28	Hoist	1
29	Compressed air	1
30	Pallet & Box	1
31	Hook, T bolt & Studs	As required
32	Outside & Inside caliper	2
33	Vernier caliper	2
34	Vernier Height gauge	1
35	Bevel protector	1
36	Radius gauge	1
37	Filler gauge	1
38	Parallel block	4
39	Roller block	2
40	V block block & C clamp block & U clamp	2 each
41	Screw jack	2
42	Pistol caliper	1
43	Inspection table,	1

44	Jumbo truck vehicle	1
45	MPI M/C	1

Sl No	Description of Tools/Equipments	Quantity
1	Over Head Crane	1
2	Hoist	1
3	Fork lift	1
4	Charger Machine	1
5	Tray, Support, Hangers, Clamp& Fixtures	1 set
6	Air Compressor & Blower	1 set
7	Heating sources: DO, SKO, LPG, Furnace oil, Electricity	1 set
8	Continuous Hardening Furnace	1
9	Continuous Tempering Furnace	1
10	Austenitising Furnace	1
11	Sealed Quench Hardening Furnace	1
12	Sealed Quench Tempering Furnace	1
13	Batch Hardening Furnace	1
14	Batch Tempering Furnace	1
15	PIT Hardening Furnace	1
16	PIT Tempering Furnace	1
17	Bogie Tempering Furnace	1
18	Bogie Hardening Furnace	1
19	Stress Relieving Furnace	1
20	Nitrocarburising Furnace	1
21	Pre Nitrocarburising Furnace	1
22	Recirculating Fan	2 sets
23	Recuparation System	1
24	Burner	2 sets
25	Heat Pumping unit	1 set
26	Oil Heaters	1 set
27	Regulators	2 sets
28	Air Gas Regulators	2 sets
29	Sensetrols	1
30	Thermocouple/Solenoid valves/Recorders/ON-OFF/PID	As required
31	Temperature Controlers& Indicators	1
32	Quenching System	1
33	Exhaust systems	1
34	Cylinders:Oxygen,CO2,Ammonia,DCP,Foam	1 each
35	Eddy current M/C	1
36	Dynamic Hardness Tester	1
37	Hardness M/C	1
38	Microscope Calibration Scale	1
39	Poldi Harness/Hardness test Bar	1

40	Refractometer	1
41	Pyrometer /Thermometer	1
42	Viscous Meter/PH Meter/Gas flow Meter/Oil flow meter/Gas Analyser	1
43	Measurement & calibration Instruments	2 sets

Note:

1. Tool Kit and safety equipment should be available one for each student
2. Heavy M/C Set up one for whole institute.

GENERAL INFORMATION FOR QUALITY INSPECTOR

Name of Sector	PRODUCTION & MANUFACTURING
Name of Module	QUALITY INSPECTOR
MES Code	MAN708
Duration of Course	500 Hrs
Entry Qualification of Trainee	8 th Pass + 18 yrs of age
Unit size (No. Of trainees)	20
Power Norms	2.0 KW
Space Norms	60 sq.m Minimum size of one side to be 04m. (Dust proof room/ AC Room)
Instructors Qualification	Degree in Mechanical Engineering with one year Experience OR Diploma in Mechanical Engineering with two year Experience OR NTC/ NAC in Mechanical Trade Group with three years of Experience
Desirable	Craft Instructor Certificate (CIC)

Course Contents for Module Quality Inspector

Practical Competencies	Underpinning Knowledge (Theory)
<p>OSH & Safety Practices:</p> <ul style="list-style-type: none"> ✓ Fire Fighting in workplace & Precautions ✓ General Safety of Tools & Equipments ✓ Awareness on Occupational Safety & Health related to the job 	<ul style="list-style-type: none"> ✓ Fire Extinguishers & its Types ✓ Safely handling Tools & Equipments ✓ Use of proper Tools & Equipments & its maintenance ✓ OSH & practices to be observed as a precaution
<p>Personnel & Material Safety:</p> <ul style="list-style-type: none"> ✓ Safety precautions followed in inspection. ✓ Use and store of materials in a safe manner. ✓ Demonstrate the use of safety devices for inspection. 	<ul style="list-style-type: none"> ✓ Describe personal safety measures while inspecting. ✓ State the safety precaution specific to inspection. ✓ Safety related to handling of materials. ✓ Safety devices used for safe inspection.
QUALITY INSPECTOR	
<ul style="list-style-type: none"> ✓ Introduction to Quality inspector role and its importance. ✓ Describe in brief about the various role of inspection and its area of working ✓ Explain the importance of a inspector and the application for the industries being used and role they perform 	<ul style="list-style-type: none"> ✓ Describe the vernier scale reading and how it is been applied in the Vernier. ✓ Describe the role of inspection and how it is to be recorded in the Inspection Report ✓ Explain the various types of general inspection report. ✓ Explain with a small Drawing with 0.5 tolerance on linear and to generate a Inspection report with dimensions and tolerance. ✓ Describe the reasoning about the tolerance and why been provided in drawing. ✓ Explain about a drawing with simple view to identify about 1 st angle and 3 rd angle projection ✓ Describe about a regular drawing used in industries and how to identify what to inspect. ✓ Describe about process drawing and final drawing and its application. ✓ Describe about the normal used geometrical tolerance and how to identify and types of measurements

	<ul style="list-style-type: none"> ✓ Describe about of types of instruments and its usages. ✓ Describe about surface plate and leveling its importance.
<p>Vernier its usage and its Least Count</p> <ul style="list-style-type: none"> ✓ Practice on usage of Vernier and how to read a vernier ✓ Measurement with Vernier and use to measure with inside of a vernier and outside of a vernier. ✓ Practice on usage of Vernier Height Gauge and its application. ✓ Practice and usage of Angle Plate and its application Hold job and to use height gauge and inspect the height on 2 surfaces with 0.5 mm accuracy. ✓ Practice to use vernier for depth measurement application. ✓ Practice to use Micrometer for OD to and accuracy of 0.01 mm measurement application and thickness. ✓ Practice to use Dial Bore Gauge to check the ID dimensions of a part to an accuracy of 0.01 mm ✓ Practice to use Hardness Tester to check the hardness of a part for HRC, from 24 to 60 HRC and to use the load factor in the machine and its application ✓ Practice to use radius gauge. And to identify various radius inside and outside radius. ✓ Practice to use surface analyzer to feel for surface roughness and compare to the part with the analyzer for 0.8 Ra to 3.2 Ra value. ✓ Practice to use profile projector to measure the linear dimension of a part and the outer dimensions of a part to an extent of 0.1 mm accuracy. And to check and practice for the radius of a profile. ✓ Practice to use between center to check concentricity and run out to an extent of 0.05mm accuracy. ✓ Practice to use Bevel Protractor to check various angle to an accuracy of +/- 5 minutes. 	<ul style="list-style-type: none"> ✓ Describe about the usage of Micrometer and its application. ✓ Describe the usage of depth micrometer and its application. ✓ Describe the usage of slip gauge and its application. ✓ Describe the usage of V block its application. ✓ Describe the usage of bore dial gauge its application. ✓ Describe the usage of Hardness Tester and its application. ✓ Describe the usage of Sine Bar its application. ✓ Describe the usage of Radius gauge and its application. ✓ Describe the usage of Surface Finish analyzer and its application. ✓ Explain the usage of Profile Projector and its application. ✓ Describe the usage of usage of Between Center in Surface plate and its application. ✓ Describe the usage of Bevel Protractor and its application. ✓ Describe the use of digital height gauge and its advantage application. ✓ Describe the use of casting hollow block and its application for inspection, marking a raw casting and checking five surface of a part. ✓ Describe the usage of 2 D height master (Trimos) and its application . ✓ Describe the use of slip gauge and sine bar to check for the angle to the required tolerance. ✓ Teach the calculation for using sine bar and its formula with scientific calculator. ✓ Describe to check the hole position with

	<p>digital height gauge.</p> <ul style="list-style-type: none"> ✓ Describe to check the hole position with 2 D height master (Trimos) ✓ Describe how to calculate to build a slip gauge to the required size. ✓ Describe the use of slip gauge to inspect a key position. ✓ Describe to prepare a inspection Report using a blueprint drawing . ✓ Describe how to plan for inspection with the blueprint drawing. ✓ Describe to prepare a inspection for process drawing. ✓ Describe to prepare a first off approval inspection report using a process drawing. ✓ Describe use of plug gauge for bore size GO, NOGO, thread plug Guage for thread inside and external.
<p>Job Holding & Inspection</p> <ul style="list-style-type: none"> ✓ Practice to hold job in Angle Plate and to inspect for dimensions on 2 surfaces. ✓ Practice to inspect a Raw Casting and mark for the Machining dimensions and to lean to inspect the casting . ✓ Practice for inspecting a shaft for key way position using Magnetic V block, lever dial and height guage. ✓ Practice for checking run out on bush using V block lever dial and height gauge. ✓ Practice to check a part in Profile Projector for dia, length, step length of a shaft to a accuracy of 0.01 mm ✓ Practice to check a position tolerance of a job using digital height gauge for one axis. ✓ Practice using angle block and digital height gauge to check for 2 surface positional dimensions. ✓ Practice to check using V block and slip gauge for key way position. ✓ Practice to check angle of a shaft or flat angle milled piece using slip gauge and sine bar. ✓ Practice using Hollow casting block 	<ul style="list-style-type: none"> ✓ Describe the normal general commonly used geometrical symbols in regular process drawing and simple jobs and to understand them. ✓ Use of feeler gauge ✓ Use of try square to find the squareness of a job. ✓ Brief explanation about PRE CONTROL CHART. ✓ Brief Explanation about Gauge and Instrument Calibration and its importance.

<p>and magnetic V block to hold a part and check for hole position with digital height gauge for five surfaces.</p> <ul style="list-style-type: none"> ✓ Practice to check casting in Hollow casting Block to mark casting for machining dimensions. ✓ Practice to inspect a part on granite surface plate with 2D height master (Trimos) for positional tolerance. ✓ Practice to inspect a part using angle plate to check 2 surface using 2 D height master (Trimos) ✓ Practice to use Hollow casting block with magnetic V block to inspect part for five sides using 2 D height master. ✓ Practice the use of 2D Height master for various jobs and nature of safety it is to be handled 	
<ul style="list-style-type: none"> ✓ Visit to nearby work shop to explain the use of instrument in the working process. 	

TOOLS AND EQUIPMENTS FOR QUALITY INSPECTOR

Sl. No.	Item	Quantity
1.	Surface Plate Cast Iron 800x800	1 with stand
2.	Surface plate Granite 1000x1500 mm	1 no with stand
3.	Vernier Height Guage 300mm	1
4.	Digital height gauge 600 mm	1
5.	Cubical Hollow block cast Iron 300x200x200mm	1
6.	Angle plate 300x200 mm with slots cast iron	1
7.	Angle plate 200x200mm with slots cast iron	1

8.	Vee block 100 mm with U clamp	2
9.	Magnetic Vee block 100 mm	2
10.	Bevel protractor with 5 minutes least count	2
11.	Bevel edge try square 150x100 mm	2
12.	Micrometer 0-25 outside	1
13.	Micrometer 25-50 outside	1
14.	Micrometer 50 to 150 mm	1
15.	Vernier 0 -150 mm	1
16.	Vernier 0-300 mm	1
17.	Digital Vernier 0-150 mm (Inside and outside)	1 each
18.	Magnetic dial stand	1
19.	Depth vernier 1-150 mm	1
20.	Depth Micrometer 0-150 mm	1
21.	Slip gauge one set	1
22.	2 D height master 0-500mm	1
23.	Feeler gauge	1
24.	Hardness tester HRC - A scale B scale and C scale	1
25.	Sine Bar 200mm	1
26.	Bore dial gauge 12-35 mm and 35-65 mm one set each with Dial indicator with 0.1 mm accuracy	1
27.	Profile projector with DRO (digital Read out Scale) 500 mm x 500 mm	1
28.	Lever dial indicator 0.1 mm accuracy	2

29.	C clamp 0-150mm and 0-300mm	1
30.	T bolts and T nuts to suit slot in Angle Plate and Cubical Hollow block with studs and Nuts with washers	As required
31.	Spanner set 6-27 mm 1 set and Allen Key 2 mm to 10 mm 1 set	2 set
32.	Work Bench 500x1000 mm fabricated with wooden planks and rubber sheet/plastic sheet on top min 3 mm thick	2
33.	Cloth cotton waste to be available in the quality lab all the time.	As required

GENERAL INFORMATION FOR CNC INSTALLATION AND COMMISSIONING

Name of Sector	PRODUCTION & MANUFACTURING
Name of Module	CNC INSTALLATION AND COMMISSIONING
MES Code	MAN710
Duration of Course	500 Hrs
Entry Qualification of Trainee	<p>1) Min 10th class pass with at least 16 years of Age, Having passed any of Module :- (a)MAN702 or (b) MAN704 with 2 years relevant industrial experience OR</p> <p>2) CTS passed in any of the Trade i.e. Fitter, Machinist, Turner Electrician, Instrument Mechanic, Electronic Mechanic with 2 years relevant industrial experience</p>
Unit size (No. Of trainees)	20
Power Norms	14.0 KW
Space Norms	45 sq.m Minimum size of one side to be 04m.
Instructors Qualification	<p style="text-align: center;">Degree in Mechanical / Electronics / Electrical / Production / Industrial Engineering with one year Experience in CNC Operation and Maintenance OR</p> <p style="text-align: center;">Diploma in Mechanical / Electronics / Electrical Engineering with two years experience in CNC Operation and Maintenance OR</p> <p style="text-align: center;">NTC/ NAC in any Trade with three years experience in CNC machine operation and maintenance.</p>
Desirable	Craft Instructor Certificate (CIC)

Contents for Module CNC installation and commissioning

Practical Competencies	Underpinning Knowledge (Theory)
<ul style="list-style-type: none"> • Demonstration of General and Special Industrial Safety & Health Hazards in CNC working environment. • Demo on Safety Devices. 	<ul style="list-style-type: none"> • General and Special Industrial Safety & Health Hazards in CNC working environment
<ul style="list-style-type: none"> • Demo on a CNC Machine and CNC Functionality • Identification of various Mechanical Parts/Sections/ Modules like spindle, LM guide ways, ball screws Hydraulic and Pneumatic Systems Electrical. • Machine operation • Cutting parts 	<ul style="list-style-type: none"> • Introduction to CNC machines. • Types of CNC machines. • CNC system block diagram and Machine Layout drawing. • Understanding machine specifications. • Machine function parameters – pitch error compensation, acceleration rate, gain, keep relays setting. • CNC programming, entry on machine. • Parameter setting
<ul style="list-style-type: none"> • Checking of electronic Parts Servo drives, motors, feedback elements, limit Switch, proximity switch, and CNC control panel. 	<ul style="list-style-type: none"> • Function of Mechanical Parts – hydraulic, pneumatic, electrical, electronic, like spindle, guide ways, ball screws, tool change electrical Electronic Parts like drives and motors, feedback elements and CNC control systems.
<ul style="list-style-type: none"> • Identification of packed Mechanical Parts/Sections/ Modules like spindle, guide ways, ball screws, Electrical & Electronic Parts like drives and motors, feedback elements and CNC control systems. Unpacking, visual and physical checking. 	<ul style="list-style-type: none"> • Unpacking Mechanical Parts like spindle, guide ways, ball screws, Electrical & Electronic Parts like drives and motors, feedback elements and CNC control systems.

<ul style="list-style-type: none"> • Physical installation and levelling of the machine. • Floor preparation for mounting the machine – fixing grouting bolts, vibration pads. • Levelling the machine – various methods. • Lifting and shifting of machines – different lifting methods, crane, block and tackle, using roller, jack. • Electrical wiring and installation of various electrical Parts. Connecting compressed air connections. Commissioning Tools and their use . Testing of electrical earthing, voltage stabilizer and input power supply. Setting output voltages from stabilizer. • Practice on hydraulic, penumatic and electrical connections. 	<ul style="list-style-type: none"> • Understanding installation guidelines. Machine Layout and Circuit Diagrams – hydraulic, pneumatic, electrical - foundation details of machine. • Machine shifting, Devices used for m/c shifting. Types of foundation, M/c erection, Lifting, Safety while Shifting & Lifting, Grouting procedure & Curing. • Power Supply with concepts of individual Earthing. Reading electrical wiring diagrams. Understanding compressors and their installation. Check list for hydraulic, pneumatic and electrical connections.
<ul style="list-style-type: none"> • Initialization and testing of functions - axes and spindle, work holding devices, ATC / Tool Turret, hydraulic and Pneumatic systems, chip disposal, coolant systems. Checking lubrication points. 	<ul style="list-style-type: none"> • Test procedure and test checklist of machine functions. • Elements and Functioning of hydraulic, Pneumatic System.
<ul style="list-style-type: none"> • Inspection of geometrical accuracies as per the test chart of machine tool manufacturer. • Practice on component trials. 	<ul style="list-style-type: none"> • Concepts of Geometrical accuracy Parameters – perpendicularity, parallelism, backlash, positioning accuracy, repeatability, etc. • Study of machine test charts. • Concept of part programming for component trial. • Writing & Checking simple part program • Report generation for the commissioning

<ul style="list-style-type: none"> • Correcting installation errors – mechanical, electrical, hydraulic, pneumatic. 	<ul style="list-style-type: none"> • Types of geometrical errors, error identification and correction. • Servo and system errors.
<ul style="list-style-type: none"> • Practice on making installation and handing over documents. 	<ul style="list-style-type: none"> • Installation documentation. • Delivery note, Inspection report, minutes of meeting, service report. Handing over documents.

Terminal Competency: The successful candidate would be able to Install, Test and commission CNC Machine doing following activities:

1. Carry out Physical installation Carryout Electrical Installation
2. Identify Mechanical, Electrical and Electronics Sections/Parts
3. Back up of vital M/C data's of the CNC Machine
4. load & start CNC Machine/system
5. Geometrical Accuracy Testing.

TOOLS AND EQUIPMENTS FOR CNC INSTALLATION AND COMMISSIONING:

Sl.No	Machinery/Tools/Equipments/Hardware/Software Required	Quantity
1	<ul style="list-style-type: none"> • CNC TRAINING RACKS with CNC System, PLCs including all Control cards like Main board. I/O, CPU, Memory, power supply, Drives control & PLC and with servo motors-(X,Y,Z & spindle motors) and feedback system elements like encoders/ Tacho generators integrated (FANUC or Siemens latest control system) • Relevant CNC System, PLC ,Drives commissioning, Diagnostic/Trouble shooting & networking software pack complete • Complete Manuals set containing: <ul style="list-style-type: none"> • CNC System operation & programming • CNC PLC Description, programming, Data Listing, commissioning & Maintenance • CNC Function /Interface Manual • Maintenance/Service Manual (DVD & Hard copy) 	1 Set
2	X-Y-Z (500x400x300 mm) Tables for Connection with Training Racks containing LM guides fitted on High accuracy surface Bed/ Base,& Saddle with Ball Screw & Nut Assembly and Provision for mounting /Coupling of X,Y, Z axes. CNC Servo Motors with encoder/Linear Scale feedback incorporated for the Training Racks. System Integration work with training racks and getting X,Y movement with positioning accuracy ± 0.010 mm and Repeatability ± 0.005 mm.	1set (Siemens or Fanuc control system)
3	Tool holder as per the machine requirement	As required
4	Test mandrel	1 No
5	Dial Gauge with magnetic stand	1 No
6	Granite surface Plates grade 0	1 No
7	Spirit level	1 No
8	Digital Vernier caliper(least count 0.01)	1 No
9	Digital Micrometer (least count 0.001)	1 No
10	Clamp tester	1 No

11	Height gauge 600mm	1 No
12	Digital inclinometer (0.01°)	1 No
13	Slip gauge (steel alloy) grade 2 87pin	1 No
14	Maintenance Tools kit	2Sets.

List of Furnitures:

Sl.No.	Name & Specification of Furniture	Quantity
1	Steel Almirah	2 Nos.
2	Tables	10 Nos.
3	Chairs	20Nos.
4	Faculty Chairs	1Nos.
5	Faculty Tables	1 Nos.
6	LCD Projector with screen	1 Nos.
7	Interactive Board	1 Nos.
8	Lab Tables	8 Nos.
9	Personal computers with Chair	2 Nos.

GENERAL INFORMATION FOR CNC MACHINE TOOL MAINTENANCE

Name of Sector	PRODUCTION & MANUFACTURING
Name of Module	CNC MACHINE TOOL MAINTENANCE
MES Code	MAN711
Duration of Course	600 Hrs
Entry Qualification of Trainee	<p>1) Min 10th class pass with at least 16 years of age having passed any of Module :- (a)MAN702 or (b) MAN704 with 2 years relevant industrial experience or</p> <p>2) CTS passed in any of the Trade i.e. Fitter, Machinist, Turner Electrician, Instrument Mechanic, Electronic Mechanic with 2 years relevant industrial experience.</p>
Unit size (No. Of trainees)	20
Power Norms	14.0 KW
Space Norms	45 sq.m Minimum size of one side to be 04m.
Instructors Qualification	<p>Degree in Mechanical / electrical / electronics Engineering, with one year Experience in CNC Operation and Maintenance or</p> <p>Diploma in Mechanical / electrical / electronics Engineering with two year Experience in CNC Operation and Maintenance or</p> <p>NTC/ NAC in any Trade with three years experience CNC Operation and Maintenance.</p>
Desirable	Craft Instructor Certificate (CIC)

Course Contents for Module CNC Machine Tool Maintenance

Practical Competencies	Underpinning Knowledge (Theory)
<ul style="list-style-type: none"> • Demonstration of General and Special Industrial Safety & Health Hazards in CNC working environment, Demo on safety devices 	<ul style="list-style-type: none"> • General and Special Industrial Safety & Health Hazards in CNC working environment
<ul style="list-style-type: none"> • Identification of various Mechanical Parts like spindle, LM guide ways, ball screws, Electrical & Electronic Parts -- Servo drives and motors, control elements like proximity and limit switches, feedback elements, CNC control panel. • Operating the machine. 	<ul style="list-style-type: none"> • Introduction to CNC machines, • Types of CNC machines. • CNC System block diagram • Functions of Mechanical Parts like Spindle, Guide ways, Ball screw. • Electrical & Electronic parts like Servo drive and motors, feedback elements and CNC control systems. • Part programming.
<ul style="list-style-type: none"> • Identification of Hydraulic components involved in CNC. • CNC system Operation • Identifying system backup battery, CNC Programs, Parameters and Machine data. • Investigating the conditions under which failures occur. • Study of CNC system and Machine Tool Maintenance Manuals. • Investigation of failure of operating modes with related alarms. • Over travel conditions & retrieval to operating range. • Feedback system trouble shooting. • Absolute pulse coder / incremental pulse coder connections, operation, signals and serial pulse coder failures. • Spindle alarms. • Setting spindle orientation angle for tool change. 	<ul style="list-style-type: none"> • Hydraulics and pneumatics system and Lubrication System. • Coolant system • Tool changer system – lathe turret, VMC magazine, turret, spindle orientation • Job carrying and loading systems – pallet changer, rotary table, bar feeder, parts catcher • Chip conveyor system. • Work holding system. • Overview of CNC System & Machine hardware elements • The CNC boot system operation and corresponding screens like: <ul style="list-style-type: none"> ○ CNC system files ○ CNC & Servo control ○ User files (PMC/PLC sequence program) • CNC alarm lists & errors related to: <ul style="list-style-type: none"> ○ Programs ○ Machine ○ Servo & Spindle drive ○ Emergency stop. ○ I/O Interface, Reference Point, JOG, MDI, EDIT, Automatic, Single Block operation modes and faults.

<ul style="list-style-type: none"> • Diagnosis and fixing of faults in job carrying and loading systems – pallet changer, rotary table, bar feeder, parts catcher 	<ul style="list-style-type: none"> • Axes over travel limit switches / proximity switches and retrieval. • Alarms related to feedback encoders (Absolute/Incremental) • Fault & Alarms related to overload of servo & overheat of power supply module
<ul style="list-style-type: none"> • Practice on identifying and correcting errors. • Practice on monitoring PLC Ladder diagram and control logics in CNC. • Trouble shooting of axes servo system • Excessive positioning error during stop & move. • Digital servo error • Overload / overheat of servomotor and drive • Servomotor servicing – brush replacement • Ready signal of servo (feed) amplifier turned off • Trouble shooting of spindle Servo amplifier and Motors • Servo tuning and diagnostic functions • PLC system alarms and trouble shooting • CNC machine tool builder related alarms and trouble Shooting • Identification of I/Os in PLC diagnostics mode. • Trouble shooting of I/Os signals and failures of hydraulic system elements. 	<ul style="list-style-type: none"> • PLC basics, PLC programming and ladder Diagram. • Alarms related to machine tool builder. • Excessive positioning error during stop & move. • Serial spindle speed fluctuation and communication error. • Spindle serial link cannot be started • PLC/PMC control module overview • PLC alarms • I/Os • PLC module faults and user program errors • Review of alarm codes related to : Axes, Servo, PLC & Spindle and machine start up.
<ul style="list-style-type: none"> • Study of electrical wiring diagram & control circuits for the machine • How to replace the CNC system backup batteries, Replacing of 	<ul style="list-style-type: none"> • Replacing the CNC backup battery for memory backup. • Replacing the fuses for power supply of control unit and LCD units and other circuits.

<ul style="list-style-type: none"> fuses. Replacing the printed circuit board and modules of CNC system. Replacing the fan motor Power supply settings Adjusting display Remedial action for noise control 	<ul style="list-style-type: none"> Main PCB Input/output board and other configuration and LED display. Study types of modules mounted like PMC, PLC control module memory (FROM & SRAM) and spindle module, Servo modules. Module mounting locations, connections and block diagram overview
<ul style="list-style-type: none"> Identify the main drive components and their uses within the CNC system. Carry out electrical connection and commissioning of the drive unit. Configure drive for spindle operation. Speed optimization 	<ul style="list-style-type: none"> CNC Drive development Drive architecture Power module and DC link Connecting up the supply module, control module. Configure drive for speed control. Spindle & Feed A/C servo motors Speed optimization
<ul style="list-style-type: none"> Configure the drive for position control Position control optimization Use the trace function Configuration, maintenance, diagnostics with software Application of drive functions 	<ul style="list-style-type: none"> Functioning of drive, construction, wiring Drive configuration parameters – gain, acceleration, deceleration, drift, etc.
<ul style="list-style-type: none"> Preparation of different type of maintenance schedules : Daily, weekly, monthly, quarterly, half yearly and Annual Schedule 	<ul style="list-style-type: none"> Types of maintenance and its schedule: - preventive, predictive, corrective and break down maintenance. MTTR, MTBF.
<ul style="list-style-type: none"> Mechanical fault finding by visual and audio inspection. Bearing noise, slide wear out, wipers, telescopic guards, coolant and hydraulic filter clogging. Identifying effects of collisions, rectifying them. Detecting and fixing shift of limits dogs. 	<ul style="list-style-type: none"> Mechanical faults. Bearing wear out, slide wear out, wipers wear out, telescopic guards damage, coolant and hydraulic filter clogging. Timer belt damage. Encoder coupling damage. Effect of collisions on different machines. End limit dog.

Terminal Competency: The successful candidate would be able to:

1. One should be able to Troubleshoot, Repair and maintain a CNC machine i.e. Identify Mechanical, Electrical and Electronics Sections/Parts.
2. Identify the hydraulics and pneumatics components and system.

3. Back up of vital M/C data's of the CNC Machine Reload & restart CNC Machine/system Program / trouble shoot Rectify Servo Drives & optimize
4. Carry out overall CNC System/CNC Machine Electrical & Electronics Maintenance
5. Geometrical Accuracy Testing.

LIST OF TOOLS & EQUIPMENTS FOR CNC MACHINE TOOL MAINTENANCE

Sl.No	Machinery/Tools/Equipments/Hardware/Software Required	Quantity
1	Multimedia Software for working principle of hydraulic System	1 Set
2	<p>a) CNC turning centre with a popular control system – Fanuc or Siemens etc. Servo Drives, and spindle & feed servo Motors for 2 axes-complete</p> <p>b) 2-Axes X & Z with Linear Motion guides and Ball lead screw 20 mm dia x10mm pitch & Nut transmission with suitable end support Bearing Blocks-Provision for Mounting Spindle & Feed AC Servo Motors with Suitable Coupling & Automatic oil lubrication -Axes movement 400mm minimum. Positioning Accuracy : $\pm 0.010\text{mm}$; Repeatability $\pm 0.005\text{mm}$. Spindle Motor power 2kw(minimum) & 4000 RPM The Feed servo Motors should have at least 25% excess reserve power /torque than to drive the X &Z-axes and with absolute or Incremental position feedback encoders</p> <p>c) Integration of a & b for smooth operation</p>	<p>1 set (a)</p> <p>1 set (b)</p>
3	Discrete Hydraulic component like DC valve, PRV,FCV, etc. & mechanical sub assemblies (Cut section Modules) - Ball screw assembly, spindle & turret assy.	1 set
4	PLC based trainer kit with I/O modules and sensors (Siemens or FANUC)	1 set
5	Test mandrel	1 No.
6	Dial Gauge with magnetic stand	1 No.
7	Granite surface Plate grade 0	1 No.
8	Spirit level	1 No.
9	Digital Vernier caliper(least count 0.01)	1 No.
10	Digital Micrometer (least count 0.001)	1 No.

11	Clamp tester	1 No.
12	Height gauge 600mm	1 No.
13	Digital inclinometer (0.01°)	1 No.
14	Slip gauge (steel alloy) grade 2	1 set.
15	Maintenance Tools kit	2 Sets.

List of Furniture

Sl.No	Name & Specification of Furniture	Quantity
1	Steel Almirah	2 Nos.
2	Tables	10 Nos.
3	Chairs	20Nos.
4	Lab Tables	8 Nos.
5	Personal computers with Chair	12 Nos.

GENERAL INFORMATION FOR
MAINTENANCE OF SERVO DRIVES OF CNC MACHINES

Name of Sector	PRODUCTION & MANUFACTURING
Name of Module	MAINTENANCE OF SERVO DRIVES OF CNC MACHINES
MES Code	MAN712
Duration of Course	500 Hrs
Entry Qualification of Trainee	1) Min 10 th class pass with at least 16 years of age, having passed any of module :- (a) MAN702 or (b) MAN704 with 2 years relevant industrial experience or 2) CTS passed in any of the Trade i.e. Fitter, Machinist, Turner Electrician, Instrument Mechanic, Electronic Mechanic with 2 years relevant industrial experience.
Unit size (No. Of trainees)	20
Power Norms	14.0 KW
Space Norms	45 sq.m Minimum size of one side to be 04m.
Instructors Qualification	Degree in Mechanical / Production Engineering with one year Experience in CNC Operation and Maintenance or Diploma in Mechanical / Production Engineering with two year Experience in CNC Operation and Maintenance or NTC/ NAC in any Trade with three years experience CNC Operation and Maintenance.
Desirable	Craft Instructor Certificate (CIC)

Course Contents for Module Maintenance of Servo Drives of CNC Machines

Practical Competencies	Underpinning Knowledge (Theory)
<ul style="list-style-type: none"> Demonstration of General and Special Industrial Safety & Health Hazards in CNC working environment, Demo on safety devices 	<ul style="list-style-type: none"> General and Special Industrial Safety & Health Hazards in CNC working environment
<ul style="list-style-type: none"> Demo on a CNC Machine and CNC Functionality Identification of various Mechanical Parts like spindle, LM guide ways, Ball screws, Electrical & Electronic Parts/ Servo drives and motors, feedback elements and CNC control panel. Demo on Component Trials 	<ul style="list-style-type: none"> Introduction to CNC machines. Classification & Types of CNC machines. CNC System block diagram Functions of Mechanical Parts like Spindle, Guide ways, Ball screw. Electrical & Electronic parts like Servo drive and motors, feedback elements and CNC control systems.
<ul style="list-style-type: none"> Identify the main drive components and their uses within the CNC system(Siemens) : Carry out electrical connection and commissioning of the drive unit. Configure drive for spindle operation. Speed optimization. Configure the drive for position control Position control optimization. Use the trace function. Configuration, maintenance, diagnostics with software. Application of drive functions 	<ul style="list-style-type: none"> CNC Drive development Drive architecture Power module and DC link Connecting up the supply module, control module. Configure drive for speed Control Spindle & Feed A/C servo Motors Speed optimization Configure the drive for position control Position control Optimization Use the trace function Configuration, maintenance, diagnostics with Software Application of drive Function Troubleshooting
<ul style="list-style-type: none"> Identify the main drive components and their uses within the CNC system(FANUC) : Carry out electrical connection and commissioning of the drive unit Configure drive for spindle operation Speed optimization Configure the drive for position Control Position control loop optimization Use the trace function Configuration, maintenance, diagnostics 	<ul style="list-style-type: none"> CNC Drive development Drive architecture Power module and DC link Connecting up the supply Module The control module Configure drive for speed Control Spindle & Feed A/C servo Motors

<ul style="list-style-type: none"> with software. • Applications of drive functions 	
<ul style="list-style-type: none"> • Fault diagnosis of Siemens & Fanuc Drives. • Control of Siemens & Fanuc Drives via network. 	<ul style="list-style-type: none"> • Configure the drive for position control • Use the trace function • Configuration, maintenance, diagnostics with software • Application of drive functions • Troubleshooting

- Terminal Competency:** The successful candidate would be able to Identify and replace, commissioning of Drives of CNC machine i.e.
1. Identify Mechanical, Electrical and Electronics Sections/Parts Trace , locate, and Rectify Fault Servo drives of CNC machines
 2. Back up of vital M/C data's of the CNC Machine Reload, & Restart CNC Machine/system Program / trouble shoot with respect to servo Drives.
 3. Carry out overall CNC System/CNC Machine Electrical & Electronics Maintenance.
 4. Geometrical Accuracy Testing.

TOOLS MACHINERY & EQUIPMENTS FOR MAINTENANCE OF SERVO DRIVES OF CNC MACHINE

Sl.No.	Name of Tools & Equipments	Quantity
1	CNC System, PLC & Drives Training Rack with Siemens & Fanuc -CNC System & Spindle & Feed A/C Servo Drives with speed and position control -Hardware & Software integrated.	1 Set (One each of Siemens & Fanuc)

List of Furniture

Sl.No	Name & Specification of Furniture	Quantity
1	Steel Almirah	2 Nos.
2	Tables	10 Nos.
3	Chairs	20Nos.
4	Lab Tables	8 Nos.
5	Personal computers with Chair	12 Nos.
6	Digital multi meter	2 Nos
7	Hand Tools kit	2 Nos

LIST OF TRADE COMMITTEE MEMBERS

Sl. No.	Name & Designation Sh/Mr/Ms.	Organization	Mentor Council Designation
Members of Sector Mentor council			
1.	A. D. Shahane, Vice-President, (Corporate Trg.)	Larsen & Turbo Ltd., Mumbai:400001	Chairman
2.	Dr. P.K.Jain, Professor	IIT, Roorkee, Roorkee-247667, Uttarakhand	Member
3.	N. Ramakrishnan, Professor	IIT Gandhinagar, Gujarat-382424	Member
4.	Dr. P.V.Rao, Professor	IIT Delhi, New Delhi-110016	Member
5.	Dr. Debdas Roy, Asstt. Professor	NIFFT, Hatia, Ranchi-834003, Jharkhand	Member
6.	Dr. Anil Kumar Singh, Professor	NIFFT, Hatia, Ranchi-834003, Jharkhand	Member
7.	Dr. P.P.Bandyopadhyay Professor	IIT Kharagpur, Kharagpur- 721302, West Bengal	Member
8.	Dr. P.K.Ray, Professor	IIT Kharagpur, Kharagpur- 721302, West Bengal	Member
9.	S. S. Maity, MD	Central Tool Room & Training Centre (CTTC), Bhubaneswar	Member
10.	Dr. Ramesh Babu N, Professor	IIT Madras, Chennai	Member
11.	R.K. Sridharan, Manager/HRDC	Bharat Heavy Electricals Ltd, Ranipet, Tamil Nadu	Member
12.	N. Krishna Murthy Principal Scientific Officer	CQA(Heavy Vehicles), DGQA, Chennai, Tamil Nadu	Member
13.	Sunil Khodke Training Manager	Bobst India Pvt. Ltd., Pune	Member
14.	Ajay Dhuri	TATA Motors, Pune	Member
15.	Uday Apte	TATA Motors, Pune	Member
16.	H B Jagadeesh, Sr. Manager	HMT, Bengaluru	Member
17.	K Venugopal Director & COO	NTTF, Peenya, Bengaluru	Member
18.	B.A.Damahe, Principal	L&T Institute of Technology,	Member

	L&T Institute of Technology	Mumbai	
19.	Lakshmanan. R Senior Manager	BOSCH Ltd., Bengaluru	Member
20.	R C Agnihotri Principal	Indo- Swiss Training Centre Chandigarh, 160030	Member
Mentor			
21.	Sunil Kumar Gupta (Director)	DGET HQ, New Delhi.	Mentor
Members of Core Group			
22.	N. Nath. (ADT)	CSTARI, Kolkata	Co-ordinator
23.	H.Charles (TO)	NIMI, Chennai.	Member
24.	Sukhdev Singh (JDT)	ATI Kanpur	Team Leader
25.	Ravi Pandey (V.I)	ATI Kanpur	Member
26.	A.K. Nasakar (T.O)	ATI Kolkata	Member
27.	Samir Sarkar (T.O)	ATI Kolkata	Member
28.	J. Ram Eswara Rao (T.O)	RDAT Hyderabad	Member
29.	T.G. Kadam (T.O)	ATI Mumbai	Member
30.	K. Mahendar (DDT)	ATI Chennai	Member
31.	Shrikant S Sonnavane (T.O)	ATI Mumbai	Member
32.	K. Nagasrinivas (DDT)	ATI Hyderabad	Member
33.	G.N. Eswarappa (DDT)	FTI Bangalore	Member
34.	G. Govindan, Sr. Draughtsman	ATI Chennai	Member
35.	M.N.Renukaradhya, Dy.Director/Principal Grade I.,	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
36.	B.V.Venkaatesh Reddy. JTO	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
37.	N.M.Kajale, Principal,	Govt. ITI Velhe, Distt: Pune, Maharashtra	Member
38.	Subrata Polley, Instructor	ITI Howrah Homes, West Bengal	Member
39.	VINOD KUMAR.R Sr.Instructor	Govt.ITI Dhanuvachapuram Trivendrum, Dist., Kerala	Member
40.	M. Anbalagan, B.E., Assistant Training Officer	Govt. ITI Coimbatore, Tamil Nadu	Member
41.	K. Lakshmi Narayanan, T.O.	DET, Tamil Nadu	Member
Other industry representatives			
42.	Venugopal Parvatikar	Skill Sonics, Bangalore	Member
43.	Venkata Dasari	Skill Sonics, Bangalore	Member

44.	Srihari, D	CADEM Tech. Pvt. Ltd., Bengaluru	Member
45.	Dasarathi.G.V.	CADEM Tech. Pvt. Ltd., Bengaluru	Member
46.	L.R.S.Mani	Ohm Shakti Industries, Bengaluru	Member