

Course Curricula

for

**Short Term Courses based on
Modular Employable Skills (MES)**

in

Production & Manufacturing Sector



**DIRECTORATE GENERAL OF EMPLOYMENT AND TRAINING
MINISTRY OF LABOUR & EMPLOYMENT
GOVERNMENT OF INDIA**

**Course Curricula for Short Term Courses based on Modular
Employable Skills (MES) in the Production & Manufacturing Sector**

CONTENTS

1. Background	2
2. Frame Work for Skill Development based on Modular Employable Skills	2
3. Age of Participants	3
4. Curriculum Development Process	3
5. Development of Core Competencies.....	3
6. Duration of the Programmes	4
7. Pathways to acquire Qualification	4
8. Methodology	5
9. Instructional Media Packages.....	5
10. Assessment.....	5
11. Certificate	5
12. Course Matrix	6
13. Module.....	7
14. Turning	7
15. Advance Turning10	10
16. CNC Turning.....	13
17. Milling	15
18. Advance Milling	18
19. CNC Milling.....	21
20. Surface Grinding.....	23
21. Cylindrical Grinding	25
22. List of Expert/Trade Committee Members.....	27

Skill Development based on Modular Employable Skills (MES)

Background

The need for giving emphasis on the Skill Development, especially for the less educated, poor and out of school youth has been highlighted in various forums. The skill level and educational attainment of the work force determines the productivity, income levels as well as the adaptability of the working class in changing environment. Large percentage of population in India is living below poverty line. One of the important causes is lower percentage of skilled persons in the workforce

The skill development at present is taking place mostly in the informal way, i.e. persons acquire skill at the work-place when they help their parents, relatives and employers etc. Such persons do not have a formal certificate and thus earn lower wages and are exploited by employers. They have come through informal system due to socio-economic circumstances of the family and the compulsions of earning a livelihood rather than attending a formal course. While their productivity is low, their contribution to the national GDP cannot be ignored. If the country can create a system of certification which not only recognizes their skills but also provides education and training in a mode that suits their economic compulsions, it will not only benefit the workforce to earn a decent living but also contribute to the national economy by better productivity of this workforce.

Another related problem to be tackled is large number of students drop outs (About 63% of the school students drop out at different stages before reaching Class-X).

Frame work for Skill Development based on 'Modular Employable Skills (MES)'

Very few opportunities for skill development are available for the above referred groups (out of school youth & existing workers especially in the informal sector). Most of the existing Skill Development programmes are long term in nature. Poor and less educated persons can not afford long term training programmes due to higher entry qualifications, opportunity cost etc. Therefore, a new frame work for Skill Development for the Informal Sector has been evolved by the DGET to address to the above mentioned problems. The **key features of the new frame work for skill development** are:

- ◆ Demand driven Short term training courses based on modular employable skills decided in consultation with Industry
- ◆ Flexible delivery mechanism (part time, weekends, full time)
- ◆ Different levels of programmes (Foundation level as well as skill upgradation) to meet demands of various target groups
- ◆ Central Government will facilitate and promote training while Vocational Training (VT) Providers under the Govt. and Private Sector will provide training
- ◆ Optimum utilisation of existing infrastructure to make training cost effective.
- ◆ Testing of skills of trainees by independent assessing bodies who would not be involved in conduct of the training programme, to ensure that it is done impartially.
- ◆ Testing & certification of prior learning (skills of persons acquired informally)

The Short Term courses would be based on 'Modular Employable Skills (MES)'.

The **concept for the MES** is :

- ❑ Identification of 'minimum skills set' which is sufficient to get an employment in the labour market.
- ❑ It allows skills upgradation, multiskilling, multi entry and exit, vertical mobility and life long learning opportunities in a flexible manner.
- ❑ It also allows recognition of prior learning (certification of skills acquired informally) effectively.
- ❑ The modules in a sector when grouped together could lead to a qualification equivalent to National Trade Certificate or higher.
- ❑ Courses could be available from level 1 to level 3 in different vocations depending upon the need of the employer organisations.
- ❑ MES would benefit different target groups like :
 - Workers seeking certification of their skills acquired informally
 - workers seeking skill upgradation
 - early school drop-outs and unemployed
 - previously child labour and their family

Age of participants

The minimum age limit for persons to take part in the scheme is 14 years but there is no upper age limit.

Curriculum Development Process

Following procedure is used for developing course curricula

- Identification of Employable Skills set in a sector based on division of work in the labour market.
- Development of training modules corresponding to skills set identified so as to provide training for specific & fit for purpose
- Organization of modules in to a Course Matrix indicating vertical and horizontal mobility. The course matrix depicts pictorially relation among various modules, pre requisites for higher level modules and how one can progress from one level to another.
- Development of detailed curriculum and vetting by a trade committee and by the NCVT

(Close involvement of Employers Organizations, State Governments, experts, vocational training providers and other stake holders is ensured at each stages).

Development of Core Competencies

Possession of proper attitudes is one of the most important attribute of a competent person. Without proper attitudes, the performance of a person gets adversely affected. Hence, systematic efforts will be made to develop attitudes during the training programme.

The trainees deal with men, materials and machines. They handle sophisticated tools and instruments. Positive attitudes have to be developed in the trainees by properly guiding them and setting up examples of good attitudes by demonstrated behaviors and by the environment provided during training.

Some important core competencies to be developed are:

1. Safety consciousness and safe working practices
2. Care of equipment and tools
3. Punctuality, discipline and honesty
4. Concern for quality
5. Respect for rules and regulations
6. Concern for health and hygiene
7. Cordial relationship and Cooperation with co-workers and team Work
8. Positive attitude and behavior
9. Responsibility and accountability
10. Learn continuously
11. Communication Skills
12. Concern for environment and waste disposal

Following competencies should also be developed during level-II and higher courses:

1. Ability for planning, organizing and coordinating
2. Creative thinking, problem solving and decision making
3. Leadership
4. Ability to bear stress
5. Negotiation

Duration of the Programmes

Time taken to gain the qualification will vary according to the pathway taken and will be kept very flexible for persons with different backgrounds and experience. Duration has been prescribed in hours in the curriculum of individual module, which are based on the content and requirements of a MES Module. However, some persons may take more time than the prescribed time. They should be provided reasonable time to complete the course.

Pathways to acquire Qualification:

Access to the qualification could be through:

- An approved training programme; **Or**
- A combination of an approved training programme plus recognition of prior learning including credit transfer; **Or**
- The recognition of prior learning that provides evidence of the achievement of the competencies for the qualification.

Methodology

The training methods to be used should be appropriate to the development of competencies. The focus of the programme is on “performing” and not on “Knowing”. Lecturing will be restricted to the minimum necessary and emphasis to be given for ‘hands on training’.

The training methods will be individual centered to make each person a competent one. Opportunities for individual work will be provided. The learning process will be continuously monitored and feedback will be provided on individual basis.

Demonstrations using different models, audio visual aids and equipment will be used intensively.

Instructional Media Packages

In order to maintain quality of training uniformly all over the country, instructional media packages (IMPs) will be developed by the National Instructional Media Institute (NIMI), Chennai.

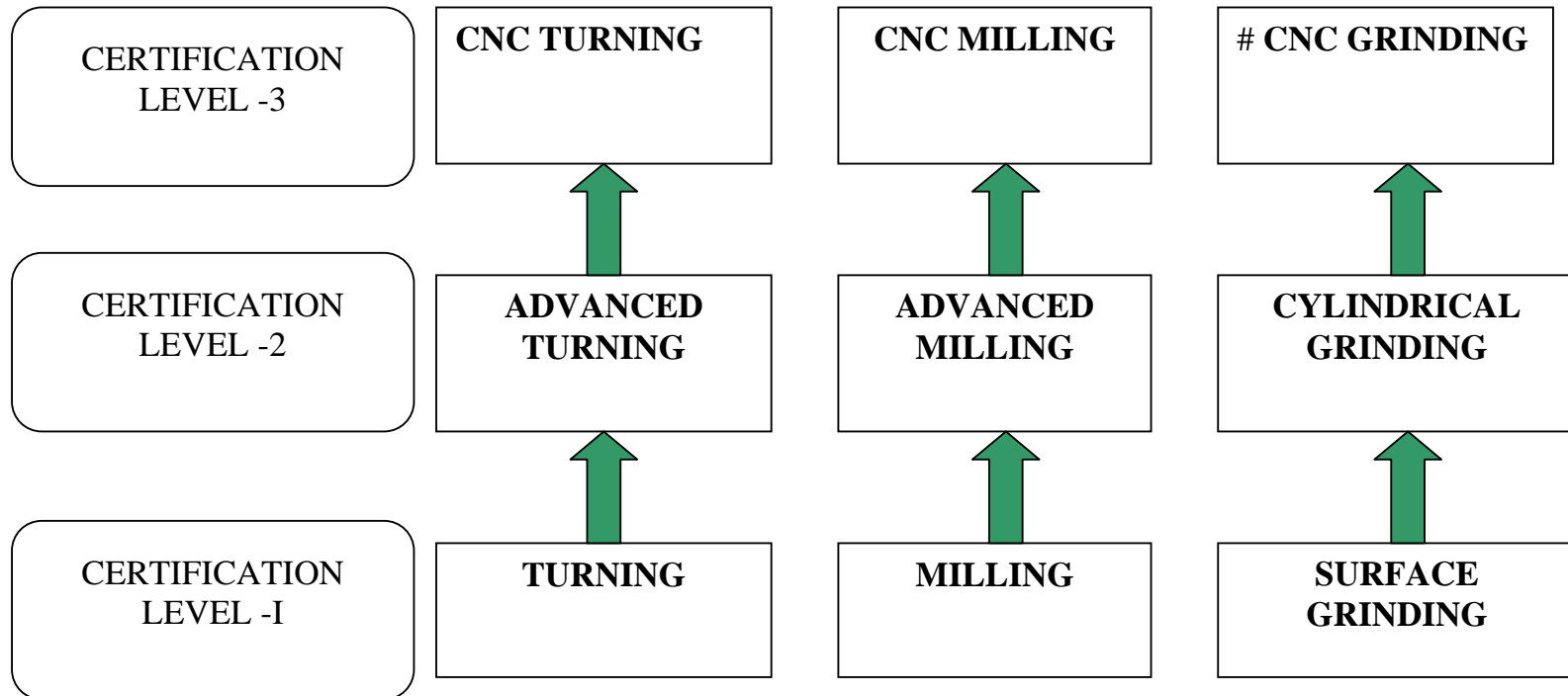
Assessment

DGE&T will appoint assessing bodies to assess the competencies of the trained persons. The assessing body will be an independent agency, which will not be involved in conducting the training programmes. This, in turn, will ensure quality of training and credibility of the scheme. Keeping in view the target of providing training/testing of one million persons through out the country and to avoid monopoly, more than one assessing bodies will be appointed for a sector or an area.

Certificate

Successful persons will be awarded certificates issued by National Council for Vocational Training (NCVT).

**COURSE MATRIX based on MODULAR EMPLOYABLE SKILLS (MES) for the
Production & Manufacturing Sector**



Note:# Curriculum of CNC grinding is under preparation

Turning

NAME : **TURNING**
 SECTOR : **PRODUCTION AND MANUFACTURING**
 CODE : **MAN 101**
 ENTRY REQUIREMENT : Min. 8TH STD. & 14 yrs

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.

DURATION : 210 hours

CONTENTS:

Practical Competencies	Underpinning Knowledge (Theory)
<ul style="list-style-type: none"> ➤ Select, use, clean and store personal safety protective equipment. ➤ Demonstrate the use of safety devices on metal cutting machines ➤ Demonstrate the use of work holding devices on metal cutting machines. ➤ Use and store of materials in a safe manner. ➤ Preparation of process planning sheet ➤ Check measurements of components/machined parts, using micrometers and verniers. ➤ Check roundness of components using the dial test indicator and vee blocks. ➤ Practice on faceplate balancing. ➤ Re-sharpen of plain turning tool on pedestal grinder and inspection ➤ Practical on work alignment, facing, turning, drilling, chamfering, and parting off. ➤ Carryout general turning between centers, such as stepped shafts using fixed and traveling steadies. ➤ 	<ul style="list-style-type: none"> ➤ State the safety precaution specific to turning on the lathe. ➤ Explain the principles workshop layout ➤ State the purpose of turning. ➤ Describe the principle of the measuring instruments: its action, care and use for measurement setting up and assembly operations- Micrometer: internal, external, depth. vernier : Caliper, depth, height. ➤ Identify types of lathe tools and their uses. ➤ 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. ➤ Carry out Simple machining calculation. ➤ Calculation of speed, feed & depth of cut using chart. ➤ 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.

<ul style="list-style-type: none"> ➤ Practical on Taper turning by compound slide method. ➤ Use sine bars and sine centers to set up and check tapers. ➤ Cut and chase screw threads. ➤ Simple Form turning using manual feed. ➤ Practical on Knurling. 	<ul style="list-style-type: none"> ➤ Introduction to Lathe, description, types of Lathe – constructional features and functions. ➤ Specification of a Center Lathe. ➤ Lathe operations- turn, drill, face, chamfer, and part off knurl, threading, taper and form turn. ➤ Describe the different types of drills and taps used. ➤ Classification of steels, alloy steels and effect of alloying elements. ➤ Identify the turning fault & remedies.
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TOOLS AND EQUIPMENTS(SUGGESTED)

s.no	Item	s.no	Item
1	Steel rule 30 cm graduated both in English & Metric units	22	Grinding wheel dresser
2	Outside, inside spring caliper 150 mm	23	Clamps for "v" block
3	Divider spring 150, 200 mm	24	Assorted carbide lathe tools with holder different shapes and sizes
4	Centre punch 100 mm	25	Hacksaw frame adjustable 250 - 300mm with blades
5	Ball peen Hammer, 0.5 Kg	26	Universal table angle plate
6	Combination plier 150 mm	27	Plier cutting 200 mm
7	Safety goggle	28	Magnifying glass 75 mm
8	Files such as coarse, medium, smooth of flat, half-round, round and tri-angular file of 200mm.	29	Hand hammer 1 Kg
9	Surface plate with table 900x900x1200mm	30	Centre drill 2,3,& 4
10	Marking table 1200 x 1200 x 900mm high	31	Parting tool holder with HSS tool bit
11	Scribing block universal 300 mm	32	Micrometer outside-0-25, 25 - 50 mm
12	" V " block 100 mm	33	Vernier caliper 300mm with Least count 0.02mm
13	Try Square 150 mm	34	Vernier bevel protractor -150 mm
14	Depth micrometer 200 mm	35	Telescopic gauge 13 mm to 300 mm

15	Spirit level 250mm 0.05 least count	36	Radius gauge metric set (1- 6 mm)
16	Screw Driver, heavy duty handle assorted	37	Thread chasers-1, 1.5 & 2mm pitch
17	Reduction sleeve MT (to suit the m/c)	38	Taper gauge
18	Compound dial gauge with stand (Metric)	39	Depth vernier 0-200 mm
19	Screw pitch gauge for metric pitches (0.5 to 6mm)	40	Knurling tool –straight and bent type, single and diamond type
20	Pressure feed Oil cane 500 mg	41	Pedestal grinder, double ended with 170mm wheels (one fine and one rough)
21	Twist drills& Drill chucks for exercises	42	Sliding, Surfacing; and Screw cutting lathe with standard sets of gears, and accessories.

Advanced Turning

NAME : **ADVANCED TURNING**
 SECTOR : **PRODUCTION AND MANUFACTURING**
 CODE : **MAN 202**
 ENTRY REQUIREMENT : Min. 8TH STD. & 14 yrs + MES Modules on TURNING (Level – 1)

TERMINAL COMPETENCY: The successful candidate would be able:

- Use safety devices.
- Familiar with the necessary safety precautions required to run a lathe.
- 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.
- Know the purpose of heat treatment process.

DURATION : 240 hours: (SUGGESTED)

Practical Competencies	Underpinning Knowledge (Theory)
<ul style="list-style-type: none"> ➤ Select, use clean and store personal protective equipment. ➤ Demonstration on work holding devices on metal cutting machines & safety precautions. ➤ Selection of tools, general cleaning and maintenance and safe storage of tools applicable to workshop tasks. ➤ Check measurements of components/machined parts, using micrometers and verniers. ➤ Check roundness of components using the dial test indicator and vee blocks. ➤ Check measurements with inside, outside, pitch micrometers. ➤ Preparation of process planning sheet. ➤ Turning of non-ferrous metal & non-metals such as plastic, polypropylene etc., ➤ Produce jobs with different diameters within the permissible concentricity. ➤ Check prepared specimens for limits and fits. ➤ Turn an angular surface – By offset method. ➤ Turning of Morse taper on the lathe. ➤ Use sine bars and sine centers to set up and check tapers. ➤ Set a grooving tool & perform an undercutting operation for threading ➤ Set a threading tool to cut 'V' thread and cut different types of 'V' thread. ➤ Cutting different types of threads like square, knuckle, buttress etc. ➤ Cutting double triple start threads. ➤ Practical on centering, pilot drilling, counter drilling, and 	<ul style="list-style-type: none"> ➤ State the safety precaution specific to turning on the lathe. ➤ The significance of surface roughness, description of its symbols and its influence on the function of a component. ➤ Classification & properties of tool materials & selection criteria . ISO specification on carbide tools. ➤ Basic knowledge of different tool materials (including their temperature ranges) in use. ➤ Calculation of spindle speeds, feeds & depth of cut for different material and the respective lathe operations such as roughing, finish turning, Grinding etc., ➤ 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. ➤ Types of threads, forms of thread and its depth calculation. ➤ 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 ,

<p>chamfering.</p> <ul style="list-style-type: none"> ➤ Perform boring operation. ➤ Cut "V" thread (internal). ➤ Perform under cut inside the bore on a required length. ➤ Use of four-jaw chuck and setting the same. ➤ Cutting eccentric jobs. ➤ Drilling eccentric holes. 	<p>multi-start.</p> <ul style="list-style-type: none"> ➤ Describe the methods of carrying out drilling, grinding and reaming operations. ➤ Precautions while turning non ferrous & non-metals specially for material like Magnesium etc. ➤ Off-set turning techniques, eccentric turning and knurling. ➤ Introduction to Special purpose lathe – Capstan, turret, copying, spinning. ➤ Heat treatment process – uses and types ➤ Identify turning fault & correction.
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TOOLS AND EQUIPMENTS(SUGGESTED)

s.no	Item	s.no	Item
1	Steel rule 30 cm graduated both in English & Metric units	24	Twist drills& Drill chucks for exercises
2	Outside, inside spring caliper 150 mm	25	Grinding wheel dresser (diamond)
3	Divider spring 150, 200 mm	26	Clamps for "v" block
4	Centre punch 100 mm	27	Assorted carbide lathe tools with holder different shapes and sizes
5	Ball peen Hammer, 0.5 Kg	28	Hacksaw frame adjustable 250 - 300mm with blades
6	Combination plier 150 mm	29	Plier cutting 200 mm
7	Safety goggle	30	Magnifying glass 75 mm
8	Files such as coarse, medium, smooth of flat, half-round, round and tri-angular file of 200mm.	31	Hand hammer 1 Kg
9	Surface plate with table 900x900x1200mm	32	Centre drill 2,3,& 4
10	Marking table 1200 x 1200 x 900mm high	33	Thread chasers-1, 1.5 & 2mm pitch
11	Scribing block universal 300 mm	34	Micrometer outside- 0-25, 25 - 50 mm
12	" V " block 100 mm	35	Vernier caliper 300mm with Least count 0.02 mm
13	Try Square 150 mm	36	Vernier bevel protractor -150 mm
14	Depth micrometer 200 mm	37	Bevel gauge 200 mm

15	Spirit level 250mm 0.05 least count	38	Telescopic gauge 13 mm to 300 mm
16	Screw Driver, heavy duty handle assorted	39	Radius gauge metric set (1- 6 mm)
17	Combination set 300 mm	40	3 pin micrometer 10 – 25 mm
18	Reduction sleeve MT (to suit the m/c)	41	Taper gauge
19	Compound dial gauge with stand (Metric)	42	Depth vernier 0-200 mm
20	Screw pitch gauge for metric pitches (0.5 to 6mm)	43	Knurling tool –straight and bent type, single and diamond type
21	Boring tool holder, with HSS tool bit	44	Pitch micrometer 0-25mm with set of anvils.
22	Parting tool holder, with HSS tool bit	45	Pedestal grinder, double ended with 170mm wheels (one fine and one rough)
23	Pressure feed Oil cane 500 mg		Sliding, Surfacing; and Screw cutting lathe with standard sets of gears, and accessories.

CNC Turning

NAME : CNC TURNING
 SECTOR : PRODUCTION AND MANUFACTURING
 CODE : MAN 307
 ENTRY REQUIREMENT : Min. 10TH STD. & 14 yrs + MES Modules on TURNING (Level -1) & MES Modules on Advance Turning (Level -2)

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.

DURATION : 240 hours

Practical Competencies	Underpinning Knowledge (Theory)
<ul style="list-style-type: none"> • Demo on <ol style="list-style-type: none"> 1. Personal and Industrial Safety. 2. Select, use, clean and store personal protective equipment. • Study of CNC machine, key board & specifications. • Demonstrate Machine starting & operating in Reference Point, JOG, and Incremental Modes • Carryout Co-ordinate system points, assignments and simulations. • Carryout Absolute and incremental programming assignments and simulations. • Demonstration of machine over travel limits and emergency stop. • Demonstrate Work and tool setting. • Carryout Part program preparation, Simulation & Automatic Mode Execution for the exercise on Simple turning & Facing (step turning) • Carryout Linear interpolation, and Circular interpolation assignments and simulations on soft ware. • Carryout Work off set measurement, Tool off set measurement and entry in CNC Control. • Carryout Part program preparation, Simulation & Automatic Mode Execution for the exercise on Turning with Radius / chamfer with TNRC • Demonstrate Chuck removal and mounting on CNC Lathe. • Demonstrate Tool change in CNC turning & MPG mode operation. • Carryout Manual Data Input (MDI) mode operations and checking of zero offsets and tool offsets. • Carryout Part program preparation, Simulation & Automatic Mode Execution of CNC Machine for the exercise on Blue print programming contours with TNRC. 	<ul style="list-style-type: none"> • Safety Precautions • 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, Future of computer numerical control technology. • Describe CNC interpolation, open loop & close loop control systems. Co-ordinate systems and Points. • State the CNC Machines – Turning - Milling, - Types, Machine axes. • Identify the CNC Machine Control Unit organization.(Keys & Menus) • Explain working principle of CNC Machine • Carryout Zero off sets and tool off sets in SIEMENS /FANUC CNC TURNING. Centers • State the importance of feedback devices for CNC control. • State the importance of tTool Nose Radius Compensation (TNRC). • Identify Cutting tool materials for CNC Turning and its applications. Component Materials. • Identify ISO codes for carbide indexable inserts and tool holders for turning. • Describe the tooling systems for CNC TURNING Centers. • State the cutting parameters selection and process planning. • Tools layout and process sheet preparation. •

<ul style="list-style-type: none"> ● Carryout Geometry Wear Correction. ● Carryout Geometry and wear offset correction. ● Carryout Part program preparation, Simulation & Automatic Mode Execution of CNC Machine for the ● Practical on stock removal cycle OD ● Practical on Drilling / boring cycles ● Practical on Stock removal cycle ID ● Preparations of part programs for thread cutting for CNC turning centers and simulation on computers. ● Carryout Machining of Part program exercises of CNC TURNING <ul style="list-style-type: none"> ▪ Practical on Grooving and thread cutting OD ▪ Practical on Grooving and thread cutting ID ▪ Practical on Threading cycle OD ▪ Practical on Sub programs with repetition 	<ul style="list-style-type: none"> ● Using Sub Programs & Cycles in the Main Program. Blue print programming/ Direct dimension programming. ● Part Features identification and process selection. ● Processes sequencing. ● Tool path planning. ● Carryout 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 and tooling strategies for CNC turning machines. ● Carryout Drilling /Boring cycles in CNC Turning ● Grooving/Threading Tools, Processes and Tool selection. ● Programming for Grooving/Threading on OD/ID in CNC Turning. ● Trouble shooting in CNC Turning. Tool wear ● Patterns and optimization of cutting parameters. ● Identify Factors affecting Turned part quality/ productivity. ● Describe Tapping / rigid tapping on CNC turning.
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Machinery:

- 1) CNC TURNING CENTRE with FANUC-0i- CONTROL OR SIEMENS 810D/802D and necessary tools and equipments.
- 2) Simulation Software (Turning Milling) with Computers.

Milling

NAME : **MILLING**

SECTOR : **PRODUCTION AND MANUFACTURING**

CODE : **MAN 103**

ENTRY REQUIREMENT : Min. 8TH STD. & 14 yrs

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.
- Produce components using plain milling, angular milling, slotting and key-way cutting.
- Milling six faces of a cubical block to an accuracy of $\pm 0.1\text{mm}$

DURATION : 210 hours:

Practical Competencies	Underpinning Knowledge (Theory)
<ul style="list-style-type: none"> ➤ Select, use, clean and store personal safety protective equipment. ➤ Demonstrate the use of safety devices on metal cutting machines ➤ Demonstrate the use of work holding devices on metal cutting machines. ➤ Use and store of materials in a safe manner. ➤ Preparation of process planning sheet ➤ Check measurements of components/machined parts, using micrometers and verniers. ➤ Check roundness of components using the dial test indicator and vee blocks. ➤ Demo on ➤ Identifying different types of cutter used in Horizontal milling machine. ➤ Identifying different types of cutter used in Vertical milling machine. ➤ Study of Horizontal milling machine -Identifying different parts, importance of each part. ➤ Study of Vertical milling machine -Identifying different parts, importance of each part ➤ Use of Tool holding devices. ➤ Practice on dividing head. ➤ Practical on plain milling, slab milling. ➤ Checking the flatness with tri-square. ➤ Milling six faces of a cubical block to an accuracy of $\pm 0.1\text{mm}$. 	<ul style="list-style-type: none"> ➤ State the safety precaution specific to milling operations. ➤ Explain the principles workshop layout, blue print reading. ➤ Describe the principle of the measuring instruments: its action, care and use for measurement setting up and assembly operations- Micrometer: internal, external, depth. vernier : Caliper, depth, height. ➤ State the purpose of Milling. ➤ Classification & properties of tool materials & selection criteria . ISO specification on carbide tools. ➤ Basic knowledge of different tool materials (including their temperature ranges) in use. ➤ Milling machine – Types, constructional features, Specifications - Merits and demerits ➤ Describe Work holding methods and work holding devices for milling operations. ➤ Type of dividing head and indexing method ➤ Nomenclature of milling cutters. ➤ Classification of different types of milling cutters and their uses. ➤ Processes of milling – up milling, down

<ul style="list-style-type: none"> ➤ Checking the square ness with tri-square. ➤ Measure the job size with vernier caliper. ➤ Step milling using side and face milling cutter. ➤ 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"> milling, face milling and end milling. ➤ Describe 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. ➤ Cutting fluid, properties & applications. ➤ Selection of speed feed and depth of cut. ➤ Identify Milling fault & correction.
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TOOLS AND EQUIPMENTS(SUGGESTED)

s.no	Item	s.no	Item
1	Steel Rule 30 cm graduated both in English & Metric units	21	Digital Vernier height gauge 250 mm with least count of 0.01mm
2	Divider spring 150 mm	22	Vernier bevel protractor with 150 mm blade
3	Centre punch 100 mm	23	Bevel gauge 200 mm
4	Hammer B.P. 0.5 kg.	24	Spirit level 250mm 0.05 least count
5	Combination plier 150 mm	25	Screw driver, heavy duty assorted with handle
6	Safety glasses	26	Nylon/ soft Hammer 1 kg
7	File flat assorted	27	Allen hexagonal keys 2.5 to 12
8	Surface plate 400 mm x 400 mm grade	28	Set of Double ended spanner, set of box spanner with ratchet handle.
9	Table for surface plate 900x 900 x 1200 mm	29	Adjustable spanner 300 mm
10	Marking off table 1200 x 1200 x 900 mm	30	Angle plate size 200x100x200 mm with strap clamp
11	Scribing block universal 300 mm	31	Solid parallels in pairs (different sizes)
12	"V" block 100 mm	32	Milling cutters of different sizes, shapes etc. including End mills and drills
13	Try square 300 mm	33	Compound dial gauge with stand (metric)
14	Outside, inside spring caliper	34	Dial test indicator with magnetic gauge type 1 grade A with magnetic base -0.002mm, 0.010 mm

15	Oil stone 150 x 50 x 25 mm	35	Centre gauge 60°
16	Hacksaw frame adjustable 250-300 mm with blades	36	Slip gauge set (normal set) Metric
17	Hand vice 50 mm jaw	37	Limit plug gauges 5 mm to 25 mm by 2.5 mm range
18	Universal table angle plate	38	Pedestal grinder, double ended with 170mm wheels (one fine and one rough)
19	Micrometer outside /inside/depth	39	Milling machine –horizontal, machine size no.1 with standard accessories & universal dividing end.
20	vernier caliper 300 mm with least count 0.02 mm	40	Milling machine –vertical, machine size no.1 with standard accessories

Advanced Milling

NAME : **ADVANCED MILLING**

SECTOR : **PRODUCTION AND MANUFACTURING**

CODE : **MAN 204**

ENTRY REQUIREMENT : Min. 8TH STD. & 14 yrs+ MES Modules on MILLING (Level – 1)

TERMINAL COMPETENCY : The successful candidate should be able to:

- Use safety devices.
- Familiar with the necessary safety precautions required to run a milling machine Plan the sequence of operations.
- 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.
- 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.

DURATION : 240 hours: (SUGGESTED)

Practical Competencies	Underpinning Knowledge (Theory)
<ul style="list-style-type: none"> ➤ Select, use, clean and store personal safety protective equipment. ➤ Demonstrate the use of safety devices on metal cutting machines ➤ Use and store material in a safe manner. ➤ Demonstrate the use of safety devices and work holding devices. ➤ Selection, care and maintenance of tools. Store tools applicable to workshop tasks. ➤ Check measurements of components/machined parts with inside, outside micrometers.. ➤ Preparation of process planning sheet. ➤ Marking practice. Use of hand tools. ➤ Milling a square, hexagon on a round rod using direct indexing. ➤ Slot milling using vertical milling machine. ➤ Milling a V-block, Dovetail & T-slot ➤ Cut Spur gear on horizontal milling machine by using indexing head ➤ Check gear tooth proportions using gear tooth vernier caliper. ➤ Milling a rack, by linear indexing method ➤ Cutting of RH helical gear on a universal milling machine ➤ Checking the gear tooth using flange micrometer, and other instruments for related parameters. 	<ul style="list-style-type: none"> ➤ State the safety precaution specific to milling operations. ➤ Describe Dividing head – types, parts, function and uses. ➤ Calculation of spindle speeds, feeds & depth of cut for different material for relevant milling operations. Such as roughing and finishing etc., ➤ Cutting fluids & properties. ➤ Calculation of direct indexing to mill a polygon. ➤ Describe universal indexing head – parts and function. ➤ Describe methods of indexing and their calculation ➤ Nomenclature of spur gear, their proportion and calculation. ➤ Describe Racks – types, nomenclature and calculation ➤ Describe methods of producing racks on milling machine. ➤ Helical gear tooth proportion and calculation ➤ Calculation for milling helical gear on a universal Milling machine. ➤ Identify milling fault & correction ➤ Inspection of gears.

TOOLS AND EQUIPMENTS(SUGGESTED)

s.no	Item	s.no	Item
1	Steel Rule 30 cm graduated both in English & Metric units	23	Vernier bevel protractor with 150 mm blade
2	Divider spring 150 mm	24	Bevel gauge 200 mm
3	Centre punch 100 mm	25	Spirit level 250mm 0.05 least count
4	Hammer B.P. 0.5 kg.	26	Hammer B.P. 800 gms, with handle
5	Combination plier 150 mm	27	Screw driver, heavy duty assorted with handle
6	Safety glasses	28	Nylon/ soft Hammer 1 kg
7	File flat assorted	29	Allen hexagonal keys 2.5 to 12
8	Surface plate 400 mm x 400 mm grade	30	Spanner D.E.G.P. series 2 (7 pcs. Each)
9	Table surface plate 900x 900 x 1200 mm	31	Adjustable spanner 300 mm
10	Marking off table 1200 x 1200 x 900 mm	32	Angle plate size 200x100x200 mm
11	Scribing block universal 300 mm	33	Solid parallels in pairs (different sizes)
12	Vee block 100/7-80-A	34	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 and slot drills suitable to milling machine arbor.
13	Try square 300 mm	35	Involutes milling cutter 2 module
14	Outside, inside spring caliper	36	Compound dial gauge with stand (metric)
15	Oil stone 150 x 50 x 25 mm	37	Dial test indicator with magnetic gauge type 1 grade A with magnetic base-0.002mm, 0.010mm
16	Hacksaw frame adjustable 250-300 mm with blades	38	Centre gauge 60°
17	Hand vice 50 mm jaw	39	Slip gauge set (normal set) Metric
18	Universal table angle plate	40	Limit plug gauges 5 mm to 25 mm by 2.5 mm range
19	Micrometer outside /inside/depth	41	Pedestal grinder, double ended with 170mm wheels (one fine and one rough)

20	Direct reading vernier caliper 300 mm –least count 0.02 mm	42	Milling machine –horizontal, machine size no.1 with standard accessories universal dividing end.
21	Digital Vernier height gauge 250 mm with least count 0.02mm	43	Milling machine –vertical, machine size no.1 with standard accessories
22	Vernier gear tooth caliper	44	Milling machine universal, machine size No.1 with standard accessories and the following attachments: i. Universal dividing head with set of change gears-1no ii. Long arbors dia 16, 22, 27 and 32 mm - 1each iii. Machine vice swivel base 150mm - 1 No

CNC Milling

NAME : CNC MILLING
 SECTOR : PRODUCTION AND MANUFACTURING
 CODE : MAN 308
 ENTRY REQUIREMENT : Min. 10TH STD. & 14 yrs + MES Modules on Milling (Level -1) & MES Modules on Advance Milling (Level -2)

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.

DURATION : 240 hours

Practical Competencies	Underpinning Knowledge (Theory)
<ul style="list-style-type: none"> • Demo on <ol style="list-style-type: none"> 1. Personal and Industrial Safety. 2. Select, use, clean and store personal protective equipment. • Study of CNC Machining centre, key board & specifications. • Demonstrate Machine starting & operating in Reference Point, JOG, and Incremental Modes. • Carryout Co-ordinate system points, assignments and simulations. • Carryout Absolute, incremental and polar co-ordinate points programming assignments and simulations. • Demonstration of machine over travel limits and emergency stops. • Demonstrate Work and tool setting. • Carryout Automatic Mode operation. • Practical on Face Milling. • Carryout Linear interpolation & Circular interpolation assignments and simulations.-Milling • Demonstrate Work off set measurement and Tool off set measurement entry in CNC Control and editing. • Carryout Part program preparation, Simulation & Automatic Mode Execution of CNC Machine for the practical on Chamfering and end milling with CRC • Demonstrate Tool change in CNC milling & JOG, INC, MPG mode operation. • Manual Data Input (MDI) mode operations and checking of zero offsets and tool offsets. • Preparation of 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. 	<ul style="list-style-type: none"> • Safety Precautions • State the Safe handling of tools, equipment & CNC machines, CNC Mill with FANUC CNC CONTROL-/SIEMENS latest CNC Machine &Control specifications. • Describe CNC system organization Fanuc-0i-M. Co-ordinate systems and Points. • State CNC Machines Milling, Types, and Machine axes. • Describe Machine tool elements, Feed Drives and spindle drives. • Explain the working principle of CNC Machine. • Describe the method of Zero off sets and tool off sets in Milling. • Measurement of zero offsets and Tool offsets. • Identify cutting tool materials for CNC Milling and its applications. Component Materials. • State the use of ISO codes for carbide indexable inserts and tool holders for Milling. • Describe the tooling systems for CNC Machining Centers. • State the purpose of Cutter Radius Compensation (CRC). • 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. • Work locating principle and locating devices for CNC milling, tool selection • Carry out tool path simulation • Describe the Drilling /Boring cycles in CNC Milling.

<ul style="list-style-type: none"> • 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. • Preparations of part programs for thread milling for CNC machining centers. • Part Program Preparation, entry and simulation on CNC Mill & on Computers for Part program exercises. • Automatic mode execution of With Block Search and restart. 	<ul style="list-style-type: none"> • 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. • Explain Drilling, milling patterns on CNC milling.
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Machinery:

- 1) 3axis-CNC Machining Centre with SIEMENS /FANUC LATEST CNC CONTROL and necessary tools and equipments.
- 2) SIMULATION software with Computers.

Surface Grinding

NAME : **SURFACE GRINDING**

SECTOR : **PRODUCTION AND MANUFACTURING**

CODE : **MAN105**

ENTRY REQUIREMENT : Min. 8TH STD. & 14 yrs

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.

DURATION : 210 hours: (SUGGESTED)

Practical Competencies	Underpinning Knowledge (Theory)
<ul style="list-style-type: none"> ➤ Safety precautions followed in grinding, i.e. Wear suitable eye goggles, shoes, clothes etc. ➤ Check measurements of components/machined parts with vernier calipers, micrometer, and Depth gauges. ➤ Identify the controls of surface grinding machine. ➤ Use of work holding devices on grinding Machine. ➤ Practice on balancing a grinding wheel. ➤ Practice on mounting a grinding wheel. ➤ Practice on Truing of a grinding wheel. ➤ Setting on magnetic chuck ➤ 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 personal safety measures when grinding. ➤ State the purpose of surface grinding ➤ Explain the principles workshop layout, blue print reading. ➤ Describe the principle of the measuring instruments: its action, care and use for measurement setting up and assembly operations- Micrometer: internal, external, depth. vernier : Caliper, depth, height. ➤ Describe surface grinding machine –types, construction, parts, and functions. ➤ Describe Annealing of work material –steel, cast-iron, Aluminum. ➤ Describe normalizing of Forging, Casting & Machined jobs. ➤ Specifications of Grinding wheels. ➤ Describe the selection criteria of grinding wheels. ➤ Identify the standard grinding wheel shapes. ➤ Mounted grinding wheels. ➤ Describe grinding wheel markings. ➤ Describe Handling and storage of grinding wheels. ➤ Describe Diamond wheel identification. ➤ Explain the importance of inspection of wheels. ➤ Describe work holding devices-Magnetic vice, chucks.

	<ul style="list-style-type: none"> ➤ Describe Balancing, mounting and, Truing of a grinding wheel. ➤ Describe type of grinding fluids and purposes. ➤ 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.
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TOOLS AND EQUIPMENTS(SUGGESTED)

s.no	Item	s.no	Item
1	Micrometer outside 0-25 mm, 25-50mm	14	Compound dial gauge with stand - Metric
2	Micrometer depth gauge 0 – 200 mm	15	Dial test indicator with magnetic gauge type 1 grade A with magnetic base least count 0.002mm
3	Spirit level 250mm 0.05 least count	16	Vernier bevel protector with least count 5 minutes
4	Nylon/ soft Hammer 1 kg	17	Radius gauge set
5	Screw Driver, heavy duty with handle	18	Angle plates size 200 x 100 x 200 mm
6	Combination set 300 mm	19	Adjustable angle plate
7	Angular Sine vise	20	Grinding wheel dresser (diamond)
8	C-clamp	21	Sine dressing tool
9	Wheel balancer kit	22	Safety goggles
10	Try square 300 mm	23	Allen keys 2.5 to 12
11	Double end spanner 1 set	24	Grinding wheels- (Different types as desired)
12	Vernier caliper 200 mm with least count 0.02mm	25	Pedestal grinder, double ended with 170mm wheels (one fine and one rough)
13	Sine bar with Slip gauge (normal set) metric	26	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.

Cylindrical Grinding

NAME : **CYLINDRICAL GRINDING**

SECTOR : **PRODUCTION AND MANUFACTURING**

CODE : **MAN206**

ENTRY REQUIREMENT : Min. 8TH STD. & 14 yrs + MES Modules on Surface Grinding (Level -1)

TERMINAL COMPETENCY: The successful candidate should be able to:

- Use safety devices.
- Familiar with the necessary safety precautions required to perform while cylindrical 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 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.

DURATION : 210 hours: (SUGGESTED)

Practical Competencies	Underpinning Knowledge (Theory)
<ul style="list-style-type: none"> ➤ Safety precautions followed in grinding, i.e. Wear suitable eye goggles, shoes, clothes etc. ➤ Check measurements of components/machined parts with vernier calipers, Depth gauges, inside/outside/three pin micrometers and bore dial gauges. ➤ Use and store material in a safe manner. ➤ Demonstrate the use of safety devices on metal cutting machines. ➤ Select, clean and store tools applicable to workshop tasks. ➤ 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 5 minutes. ➤ Grinding fast taper surfaces with in a accuracy of 5 minutes ➤ 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 	<ul style="list-style-type: none"> ➤ Describe personal safety measures when grinding. ➤ State the purpose of cylindrical grinding. ➤ Explain the principles workshop layout, blue print reading. ➤ Describe the principle of the measuring instruments: its action, care and use for measurement setting up and assembly operations- Micrometer: inside/outside/three pin micrometers, depth. vernier : Caliper, depth, height. ➤ Describe Cylindrical-grinding machine –types, parts, function and operation. ➤ Describe Grinding wheels classification, standard marking system, and selection criteria. ➤ Identify the standard grinding wheel shapes. ➤ Identify mounted grinding wheels. ➤ Describe Handling and storage of grinding wheels. ➤ Explain the importance of inspection of wheels. ➤ Describe work holding devices- 4- jaw independent chuck, 3 - jaw chuck, faceplate and carriers. ➤ Describe the procedure of Balancing, mounting and, Truing of a grinding wheel. ➤ 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

	<p>surfaces.</p> <ul style="list-style-type: none"> ➤ 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.
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TOOLS AND EQUIPMENTS(SUGGESTED)

s.no	Item	s.no	Item
1	Micrometer outside 0-25 mm, 25-50 mm	15	Median file
2	Micrometer depth gauge 0 – 200 mm	16	Bore micrometer
3	Vernier caliper 200 mm with least count 0.02mm	17	Pair of ‘v’ blocks 50/5-40A
4	Spirit level 250mm 0.05 least count	18	Bore dial gauge 25-50 mm
5	Safety goggles	19	Sine bar with slip gauge set
6	Screw Driver, heavy duty with handle	20	Dial test indicator with magnetic gauge type 1 grade A with magnetic base least count 0.002mm
7	Combination set 300 mm	21	Adjustable angle vise
8	Telescopic gauge	22	Grinding wheel dresser (diamond)
9	Three pin micrometer	23	Sine dressing tool
10	Wheel balancer kit	24	Allen hexagonal keys 2.5 to 12
11	Try square 300 mm	25	Grinding wheels- (Different types as desired)
12	Double end spanner 1 set	26	Testing mandrel.
13	Oil stone	27	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.
14	Wheel truing attachment		

List of Expert/Trade Committee Members

CURRICULUM DEVELOPMENT FOR SHORT TERM COURSES BASED ON MODULAR EMPLOYABLE SKILLS

SECTOR/AREA: Production & Manufacturing

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