GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT & ENTREPRENEURSHIP
DIRECTORATE GENERAL OF TRAINING

COMPETENCY BASED CURRICULUM

TURNER (OF)

(Duration: 1200 hrs.)

FLEXI MoU SCHEME

NSQF Level 4

Sector – Capital Goods & Manufacturing

Directorate General of Training

TURNER (OF)

FLEXI MoU SCHEME

(Designed in 2020)

Version: 1.0

NSQF LEVEL - 4

Developed By

Ministry of Defense

Directorate General of Ordnance Factories

ORDNANCE FACTORY BOARD

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&

Ministry of Skill Development and Entrepreneurship

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1. COURSE INFORMATION

During the 8 months' (40 Weeks) duration a candidate is trained on subjects Professional Skill, Professional Knowledge & Engineering Drawing. The practical skills are imparted in simple to complex manner to understand the operations & simultaneously basic theory subject is taught to understand the terminology and definition of the topics while executing tasks.

The trainees will be imparted safety aspects which covers components like use of PPs, Fire extinguishers, First Aid, OSH&E. In addition, trainees will be imparted knowledge of 5S and safely use of Tools and equipment's. The practical part starts with basic fitting to the complex operations. The topics covered under this course are filing, drilling, Different turning operation – Plain turning, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, drilling, Reaming, boring, internal recess, knurling, measurement, produce taper/ angular components, threaded components, irregular shaped job, produce components on CNC turn centre, etc.

The course element of employability skills, library & extracurricular activities, project work and revision has not been considered in this course being as trainees are NCVT complied Govt. Servants and course is meant to re-skill the working employees to other engineering trades.

2. TRAINING SYSTEM

2.1 GENERAL

OFB is a giant industrial setup which functions under the Department of Defence Production of the Ministry of Defence Mission of OFB is Production of State of the Art Battle Field Equipment. It needs large number of skilled resources in various fields. With the changing need of the armed forces there is shift in production requirements because of which there is a pressing need for re-skilling of employees working in the tailoring and other trades.

Flexible Memorandum of Understanding or Flexi-MoU scheme, a pioneer program of DGT, is designed to cater to the needs of both industry as well as trainee, allowing industries to train candidates as per their skill set requirements and providing trainees with an industry environment aligned with the market demand and latest technology to undergo training. The scheme gives the industry the flexibility to create tailored skilling programs with customized courses, having content and curriculum that is market relevant and meets the industry requirements.

Candidates broadly need to demonstrate that they are able to:

- Read & interpret technical parameters/document, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge& core skills while performing jobs.
- Check the job/assembly as per drawing for functioning, identify and rectify errors in job/assembly.
- Document the technical parameters related to the task undertaken.

2.2 PROGRESSION PATHWAYS:

Training is imparted to re-skill the employees in other trades to make them align with the changing demands. The carrier progression will be as : -

Semi-Skilled (SS) > Skilled (SK) > High Skilled-II (HS-II) > High Skilled-I (HS-I) > Master Craftsman (MCM).

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements: -

S No.	Course Element	Proposed hours
1	Professional Skill (Trade Practical)	**900**
2	Professional Knowledge (Trade Theory)	**220**
3	Workshop Calculation & Science	**40**
4	Engineering Drawing	**40**
	Total	**1200**
	NOTE : Employability subject is exempted as entrants are NCVT qualified Govt Employees	

2.4 ASSESSMENT & CERTIFICATION:

The training will be tested for skill and knowledge during the period of course. There will be internal assessment in every two months conducted by faculty/trainer for the course element covered during the period.

The final assessment will be in the form of summative assessment method. The Trade Test for awarding NCVT equivalent certification will be conducted by Controller of examinations, DGT as per the guidelines. The pattern and marking structure are being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment in accordance with above course elements. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

The minimum pass percentage for practical is 60% & minimum pass percentage of theory subjects is 33%. There will be no Grace marks.

2.4.2 ASSESSMENT GUIDELINE

Assessment will be evidence based comprising the following:

- Job carried out in workshop
- Record book/Daily Diary maintained by trainee and countersigned by Trainer.
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality

Evidences and records of internal assessments are to be preserved until forthcoming examination for audit and verification by examination body.

3. JOB ROLE

Turner OF: - Lathe Operator makes metal articles to required specifications using lathe and cutting tools. Studies drawings and other specifications of parts to be made. Selects metal, holds it in chuck, fixture on lathe as required, centers it by manipulating chuck jaws or otherwise using dial indicator or marking block and securely tightens it in position. Selects correct cutting tool, grinds it if necessary and holds it tight in tool post at correct height. Sets feed and speed and starts machine. Manipulates hand wheels or starts automatic controls to guide cutting tool into or along metal. Controls flow of coolant (cutting lubricant) on edge of tool. Arranges gears in machine to obtain required pitch for screw cutting. Calculates tapers and sets machine for taper turning, controls lathe during operation by means of hand wheels and levers and frequently checks progress of cutting with measuring instruments such as calipers and rule, micrometers, etc. Stops machine, removes completed part and checks it further with instruments to ensure accuracy. Repeats operations if necessary. Cleans and oils machine. Demonstrate the setting & operation of CNC turning machine and produce components as per drawing by preparing part programmes. May be designated as Turner according to nature of work done. May improvise devices and make simple adjustments to machine. May recondition lathe tools.

Reference NCO 2015:7223.0601 – Turner

4. GENERAL INFORMATION

Name of the Trade	**TURNER (OF)**
Trade Code	DGT/7013
NCO - 2015	7223.0601
NSQF Level	**Level 4**
Duration of Craftsmen Training	1200 Hours
Entry Qualification	NCVT qualified Govt Employees
Minimum Age	18 years as on first day of academic session.
Eligibility for PwD	N/A
Unit Strength (No. Of Student)	20
Space Norms	110 Sq.m.
Power Norms	18.5 KW
Instructors Qualification for	
1. Turner (OF) Trade, Workshop Calculation & Science and Engineering Drawing	B.E./B.Tech/B.Voc. Degree in Mechanical Engineering from recognized Engineering College/ university **OR** 03 years Diploma in Mechanical Engineeringfrom AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT. ***Note- Trainer should have minimum3-4 years' experience in the field of Engg. production.***
2. Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

Learning outcomes are reflection of total competencies of a trainee and assessment will be carried out as per assessment criteria.

5.1 LEARNING OUTCOMES

1. Recognize & comply safe working practices, environment regulation and housekeeping.

2. Plan and organize the work to make job as per specification applying different types of basic fitting operations & check for dimensional accuracy[Basic Fitting Operation – Marking, Hack sawing, filing, drilling, taping etc.].

3. Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. [Different chucks: - 3 jaws & 4 jaws, different shaped jobs: - round, hexagonal, square]

4. Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations.[Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH), Appropriate accuracy: - ±0.06mm, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, internal recess, knurling.

5. Test the alignment of lathe by checking different parameters and adjust the tool post. [Different parameters – Axial slip of main spindle, true running of head stock, parallelism of main spindle, alignment of both the centres.]

6. Set different components of machine & parameters to produce taper/ angular components and ensure proper assembly of the components. [Different component of machine: - Form tool, Compound slide, tail stock offset, taper turning attachment. Different machine parameters- Feed, speed, depth of cut.]

7. Set the different machining parameter & tools to prepare job by performing different boring operations. [Different machine parameter- Feed, speed & depth of cut; Different boring operation – Plain, stepped & eccentric]

8. Set the different machining parameters to produce different threaded components applying method/ technique and test for proper assembly of the components[Different thread: - BSW, Metric, Square.]

9. Set the different machining parameter & lathe accessories to produce components applying techniques and rules and check the accuracy. [Different machining parameters: -

Speed, feed & depth of cut; Different lathe accessories: - Driving Plate, Steady rest, dog carrier and different centres.]

10. Plan and perform basic maintenance of lathe & grinding machine and examine their functionality.

11. Plan & set the machine parameter to produce precision engineering component to appropriate accuracy by performing different turning operation. [Appropriate accuracy - ±0.02mm/ (MT - 3) (proof turning); Different turning operation – Plain turning, taper turning, boring threading, knurling, grooving, chamfering etc.]

12. Set & Produce components on irregular shaped job using different lathe accessories. [Different Lathe accessories: - Face plate, angle plate]

13. Plan and set the machine using lathe attachment to produce different utility component/ item as per drawing. [Different utility component/ item – Crank shaft (single throw), stub arbour with accessories etc.]

14. Set the machining parameters and produce & assemble components by performing different boring operations with an appropriate accuracy. [Different boring operation – stepped boring; appropriate accuracy - ±0.05mm]

15. Calculate to set machine setting to produce different complex threaded component and check for functionality. [Different complex threaded component- multi start threads (BSW, Metric)]

16. Set (both job and tool) CNC turn centre and produce components as per drawing by preparing part programme.

17. Manufacture and assemble components to produce utility items by performing different operations & observing principle of interchangeability and check functionality. [Utility item: - screw jack/ vice spindle/ Box nut, Marking block, drill chuck, collet chuck etc.; different operations: - threading (Square, BSW, Metric), different boring (Plain, stepped)]

18. Make a process plan to produce components by performing special operations on lathe and check for accuracy. [Accuracy - ±0.02mm or proof machining & ±0.05mm bore; Special operation –boring, threading etc.]

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Recognize & comply safe working practices, environment regulation and housekeeping.	Demonstrate use of Personal Protective Equipment (PPE)
	Explain disposal procedure of waste materials
	Explain Safety signs for Danger & caution
	Demonstrate use of Fire extinguishers
2. Plan and organize the work to make job as per specification applying different types of basic fitting operations & check for dimensional accuracy [Basic Fitting Operation – Marking, Hack sawing, filing, drilling, taping etc.].	Plan & Identify tools, instruments and equipment for marking and make this available for use in a timely manner.
	Select raw material and visually inspect for defects.
	Mark as per specification applying desired mathematical calculation and observing standard procedure.
	Measure all dimensions in accordance with standard specifications and tolerances.
	Identify Hand Tools for different fitting operations and make these available for use in a timely manner.
	Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding.
	Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job.
	Observe safety procedure during above operation as per standard norms and company guidelines.
	Check for dimensional accuracy as per standard procedure.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
3. Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. [Different chucks: - 3 jaws & 4 jaws, different shaped jobs: - round, hexagonal,	Identify and acquaint with lathe machine operation with its components.
	Identify different work holding devices and acquaint with functional application of each device.
	Mount the appropriate work holding device and check for its functional usage to perform turning operations.
	Set the job on chuck as per shape.
	Set the lathe on appropriate speed & feed.
	Operate the lathe to demonstrate lathe operation, observing

square]	standard operating practice.
	Observe safety procedure during above operation as per standard norms and company guidelines.
4. Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations. [Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH), Appropriate accuracy: - ±0.06mm, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, internal recess, knurling	Identify cutting tool materials used on lathe machine as per the specification and their application.
	Plan and Grind cutting tools
	Measure the tool angles with gauge and Bevel protractor as per tool signature.
	Mount the job and set machine parameter.
	Perform turning operations viz., facing, Parallel Turning, Step Turning, chamfering, grooving, U -cut, parting, drilling, boring (counter & stepped),Reaming, internal recess and knurling to make component as per specification.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
5. Test the alignment of lathe by checking different parameters and adjust the tool post. *[Different parameters – Axial slip of main spindle, true running of head stock, parallelism of main spindle, alignment of both the centres.]*	Plan for testing alignment of lathe
	Select appropriate items and tools for testing the alignment.
	Demonstrate possible solutions and agree tasks within the team.
	Perform testing of alignment and adjust the tool post as per instruction of machine manual/ standard testing procedure.
	Check for desired functionality.
	Record the different parameters in a standard format.
6. Set different components of machine& parameters to produce taper/ angular components and ensure proper assembly of the components. [Different component of machine: - Form tool, Compound slide, tail stock offset, taper	Plan and select appropriate method to produce taper/ angular components.
	Evaluate angles to set up the tool and machine component for machining.
	Demonstrate possible solutions and agree tasks within the team.
	Produce taper/ angular components as per standard operating procedure.
	Check accuracy/ correctness of job using appropriate gauge and

turning attachment. Different machine parameters- Feed, speed, depth of cut.]	measuring instruments for their functional requirement.
	Assemble the components to ascertain functionality.
7. Set the different machining parameter & tools to prepare job by performing different boring operations. [Different machine parameter- Feed, speed & depth of cut; Different boring operation – Plain, stepped & eccentric]	Plan for different boring (Plain, stepped & eccentric), Select appropriate tools and counterbalance while holding the work piece as per requirement.
	Set the different machining parameters as per requirement.
	Demonstrate possible solutions within the team.
	Set job and produce component following the standard operating procedure.
	Measure with instruments/gauges as per drawing.
	Comply with safety rules when performing the above operations.
	Avoid wastage, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
8. Set the different machining parameters to produce different threaded components applying method/ technique and test for proper assembly of the components. [Different thread: - BSW, Metric, Square.]	Plan and select appropriate method to produce threaded components.
	Plan and prepare thread cutting tool in compliance to standard thread parameters.
	Produce components as per drawing.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments for their functional requirement and suit to male /female part.
	Test the proper assembly of the threaded components.
9. Set the different machining parameter & lathe accessories to produce components applying techniques and rules and check the accuracy. [Different machining parameters: - Speed, feed & depth of cut; Different lathe accessories: - Driving Plate, Steady rest, dog carrier and	Identify different lathe accessories of lathe machine as per functional application.
	Mount appropriate lathe accessories to set up a job for machining.
	Observe safety/ precaution during mounting the accessories.
	Check for the alignment of accessories to machine as per standard procedure.
	Set the machining parameter and produce the component applying technique/ machine.
	Check the accuracy of the component using instruments.

different centres.]	
10. Plan and perform basic maintenance of lathe & grinding machine and examine their functionality.	Plan for periodic and preventive maintenance of lathe/ grinding machine.
	Select appropriate items and tools for maintenance.
	Demonstrate possible solutions and agree tasks within the team.
	Perform maintenance as per schedule of machine manual.
	Check for desired functionality.
11. Plan & set the machine parameter to produce precision engineering component to appropriate accuracy by performing different turning operation. .[Appropriate accuracy - ±0.02mm/ (MT - 3) (proof turning); Different turning operation – Plain turning, taper turning, boring threading, knurling, grooving, chamfering etc.]	Plan and select appropriate method to produce components.
	Grind form cutting tool.
	Set the machine parameters.
	Produce components by performing different turning operations as per standard operating procedure and as per drawing.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
12. Set & Produce components on irregular shaped job using different lathe accessories. [Different Lathe accessories: - Face plate, angle plate]	Plan and select appropriate method to produce irregular shaped components with internal taper turning.
	Work out different parameters to set up the tool for machining.
	Set the lathe accessories and mount the job.
	Produce components as per standard operating procedure by using appropriate tools.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
13. Plan and set the machine using lathe attachment to produce different utility component/ item as per drawing. [Different utility component/ item – Crank shaft (single throw), stub	Select appropriate tools and plan for turning and counterbalance while holding the work piece as per requirement.
	Comply with safety rules when performing the above operations.
	Demonstrate possible solutions within the team.
	Set the lathe attachment as per requirement and produce component observing standard operating procedure.

arbour with accessories etc.]	Measure with instruments/gauges as per drawing.
14. Set the machining parameters and produce & assemble components by performing different boring operations with an appropriate accuracy. [Different boring operation – stepped boring; appropriate accuracy - ±0.05mm]	Plan for different boring (Plain, stepped) and counterbalance while holding the work piece as per requirementandselect appropriate tools.
	Set the different machining parameters as per requirement.
	Demonstrate possible solutions within the team.
	Set job and produce component following the standardoperating procedure.
	Measure with instruments/gauges as per drawing.
	Comply with safety rules when performing the above operations.
	Avoid wastage, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
15. Calculate to set machine setting to produce different complex threaded component and check for functionality. [Different complex threaded component- multi start threads (BSW, Metric)]	Plan and select appropriate method to produce components with multi start threading.
	Prepare appropriate tool for generating required thread form.
	Calculate and set machine
	Mount the job and turn multi start thread (male and female).
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
	Match the male & female component for checking for functionality
16. Set (both job and tool) CNC turn centre and produce components as per drawing by preparing part programme.	Plan and prepare part programme as per drawing, simulate for it's correctness with appropriate software.
	Prepare tooling layout and select tools as required
	Set selected tools on to the machine
	Test/Dry run the part programme on the machine
	Set up the job and machine the component as per standard operating procedure involving parallel, step, taper, drilling, boring, radius, grooving and threading operations, etc.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments.
	Observe safety/ precaution during machining.
	Avoid wastage, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.

Turner (OF)

17. Manufacture and assemble components to produce utility items by performing different operations & observing principle of interchangeability and check functionality. [Utility item: - screw jack/ vice spindle/ Box nut, Marking block, drill chuck, collet chuck etc.; different operations: - threading (Square, BSW, Metric), different boring (Plain, stepped)]	Plan and select tools and materials for the part components and make this available for use in a timely manner.
	Produce part components as per drawing
	Check for accuracy of all the part components and suitability to the higher assembly.
	Assemble all the part components as per the guidelines given in the drawing.
	Check for functionality of the screw jack, vice spindle/ Box nut, marking block, drill chuck, collet chuck etc., as per standard operating procedure.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
18. Make a process plan to produce components by performing special operations on lathe and check for accuracy. [Accuracy - ±0.02mm or proof machining & ±0.05mm bore; Special operation – boring, threading etc.]	Plan and select appropriate method to produce components with bore and thread cutting.
	Prepare appropriate tool for producing required bore and thread.
	Set the job and turn bore and thread, match for accurate fitting with female gauge.
	Check accuracy/ correctness of job using appropriate gauge and measuring instruments.

7.TRADE SYLLABUS

TURNER (OF)			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skills – 20 Hrs Professional Knowledge – 06 Hrs	Recognize & comply safe working practices, environment regulation and housekeeping.	Importance of trade training, List of tools & Machinery used in the trade Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE) First Aid Method and basic training Safe disposal of waste materials like cotton waste, metal chips/burrs etc Hazard identification and avoidance Safety signs for Danger, Warning, caution & personal safety message Preventive measures for electrical accidents & steps to be taken in such accidents Use of Fire extinguishers Practice and understand precautions to be followed while working in fitting jobs Safe use of tools and equipment used in the trade	All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. Soft Skills: its importance and Job area after completion of training. Importance of safety and general precautions observed in the in the industry/shop floor. Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Response to emergencies e.g.; power failure, fire, and system failure. **Importance of housekeeping & good shop floor practices.** Introduction to 5S concept & its application. **Occupational Safety & Health**: Health, Safety and Environment guidelines, legislations & regulations as applicable.
Professional Skills – 60 Hrs Professional Knowledge – 16 Hrs	Plan and organize the work to make job as per specification applying different types of basic fitting operations & check for dimensional accuracy. [Basic Fitting Operation – Marking, Hack	Identification of tools & equipment as per desired specifications for marking & sawing (Hand tools, Fitting tools & Measuring tools) Selection of material as per application Visual inspection of raw material for rusting, scaling, corrosion etc Marking out lines, gripping suitably in vice jaws, hack	Measurement, line standard and end standard, steel rule-different types, graduation and limitation. Hammer and chisel-materials, types Vice – types and uses, Files-different types of uses, cut, grade, shape, materials etc. Try square-different types, parts, material used etc.

	sawing, filing, drilling, taping etc.]	sawing to given dimensions, sawing different types of metals of different sections Practice on hammering, marking out, chipping, chisel grinding Filing practice on plain surfaces, right angle by filing Use of calipers and scale measurement Filing at right angle, marking & hack sawing Marking operation on flat & round job Drilling operation: Drill on flat, square bar and round bar of different material (Sensitive drill machine) Different threading (BSW, BSP, Metric) with the help of taps and dies both external & internal (including pipes) using collet chuck Extraction of broken tap	Calipers-types and uses (firm joint). Vee – block, scribing block, straight edge and its uses. Hacksaw-their types & uses. Center punch- materials, construction & material uses. Drill machine-different parts. Hacksaw blades- sizes, different Parts. Hacksaw blades-sizes, different pitch for different materials. Nomenclature of drill. Surface plate its necessity and use. Tap - different types (Taper 2nd and bottoming) care while tapping. Dies different types and uses. Calculation involved to find Out drill size (Metric and Inch).
Professional Skills – 50 Hrs Professional Knowledge – 12 Hrs	Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. [Different chucks: - 3 jaws & 4 jaws, different shaped jobs: - round, hexagonal, square]	Identify & function of different parts of lathe Practice on operation of lathe (dry/idle run) Setting lathe on different speed and feed Mounting of chuck on machine spindle and unloading –3-jaw chuck & 4-jaw chuck Setting practice on round & square/ hexagonal bar Dismantling and assembling of 3 jaw and 4 jaw chucks Turning of round stock and square/hexagonal as per availability on 4-jaw independent chuck	Getting to know the lathe with its main components, lever positions and various lubrication points as well. Definition of machine & machine tool and its classification. History and gradual development of lathe. Classification of lathe in Function and construction of different parts of Lathe.
Professional Skills – 75 Hrs Professional Knowledge –	Prepare different cutting tool to produce jobs to appropriate	Turning of round stock on 3jaw self centering chuck Grinding of RH and LH , V- tool, side cutting tools, parting tool	Types of lathe drivers, merit and demerit. Description in details-head stock- cone pulley

16 Hrs	accuracy by performing different turning operations. *[Different cutting tool – V tool, side cutting, parting, thread cutting (both LH & RH), Appropriate accuracy: - ±0.06mm, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U -cut, Reaming, internal recess, knurling.*	Checking of angles with angle gauge / bevel protractor Grinding of "V" tools for threading of Metric 60 degree threads Facing operation to correct length Centre drilling and drilling operation to required size Make square block by turning using 4-jaw chuck and perform drilling, boring and grooving operation Parallel turning, step turning, parting, grooving, chamfering practice Measurement with scale and outside caliper to ± 05mm accuracy Step turning within ± 006 mm with different shoulder, U/cut on outside diameter Drilling on Lathe-step drilling, drill grinding practice Boring practice-Plain counter & step, internal recessing Reaming in lathe using solid and adjustable reamer Make bore by trepanning Drill grinding Turning practice-between centres on mandrel (Gear blanks) Fitting of dissimilar materials-MS in brass, aluminium, in cast iron etc. Knurling practice in lathe (Diamond, straight, helical & square)	type- all geared type-construction & function. Tumbler gear set. Reducing speed-necessary & uses. Back Gear Unit –its construction use. Lathe cutting tool-different types, shapes and different angles (clearances and rake), specification of lathe tools Combination drill-appropriate selection of size from chart of combination drill. Drill, chuck- its uses. Lathe accessories, chuck independent, self centering, collet, magnetic etc., its function, construction and uses. Vernier caliper-its construction, principle graduation and reading, least count etc. Digital vernier caliper. Outside micrometer – different parts, principle, graduation, reading, construction. Digital micrometer. Cutting speed, feed depth of cut, calculation involved-speed feed R.P.M. etc. recommended for different materials. Different types of micrometer, Outside micrometer. Vernier scale graduation and reading. Sources of error with micrometer & how to avoid them. Use of digital measuring instruments. Drills-different parts, types, size etc., different cutting angles, cutting speed for different material. Boring

			tool. Counter -sinking and Counter boring. Letter and number drill, core drill etc. Reamers-types and uses. Lubricant and coolant-types, necessity, system of distribution, selection of coolant for different material: Handling and care. Knurling meaning, necessity, types, grade, cutting speed for knurling. Lathe mandrel-different types and their uses. Concept of interchangeability, Limit, Fit and tolerance as per BIS: 919-unilateral and bilateral system of limit, Fits- different types, symbols for holes and shafts. Hole basis & shaft basis etc. Representation of Tolerance in drawing.
Professional Skills – 30 Hrs **Professional Knowledge – 08 Hrs**	Test the alignment of lathe by checking different parameters and adjust the tool post. [Different parameters – Axial slip of main spindle, true running of head stock, parallelism of main spindle, alignment of both the centres.]	Checking alignment of lathe centres such as Levelling, axial slip of main spindle, true running of head stock centre, parallelism of the main spindle to saddle movement, alignment both the centres Adjustment of tool post Mounting job in between centres	Driving plate. Face plate & fixed & traveling steadies-construction and use. Transfer caliper-its construction and uses. Lathe centers-types and their uses. Lathe carrier-function, types & uses. Mandrel – Different types and its use. Magnetic stand dial indicator, its used and care.

Turner (OF)

Professional Skills – 50 Hrs **Professional Knowledge – 12 Hrs**	Set different components of machine & parameters to produce taper/ angular components and ensure proper assembly of the components. *[Different component of machine: - Form tool, Compound slide, tail stock offset, taper turning attachment. Different machine parameters- Feed, speed, depth of cut.]*	Make taper turning by form tool and compound slide swivelling Male and female taper turning by taper turning attachment, offsetting tail stock Matching by Prussian Blue Checking taper by bevel protector and sine bar Make MT3 lathe dead centre and check with female part	Taper – different methods of expressing tapers, different standard tapers. Method of taper turning, important dimensions of taper. Taper turning by swivelling compound slide, its calculation. Bevel protector & Vernier bevel protractor-its function & reading. Method of taper angle measurement. Sine bar-types and use. Slip gauges - types, uses and selection.
Professional Skills – 50 Hrs **Professional Knowledge – 12 Hrs**	Set the different machining parameter & tools to prepare job by performing different boring operations. *[Different machine parameter- Feed, speed & depth of cut; Different boring operation – Plain, stepped & eccentric]*	Turning and boring practice on CI (preferable) or steel Tip brazing on shank Eccentric marking practice Perform eccentric turning Use of Vernier height Gauge and V-block Make a simple eccentric with dia of 22mm and throw/offset of 5mm	Method of brazing solder, flux used for tip tools. Basic process of soldering, welding and brazing. Vernier height gauge, function, description & uses, templates-its function and construction. Screw thread-definition, purpose & it's different elements. Driving plate and lathe carrier and their usage. Fundamentals of thread cutting on lathe. Combination setsquare head. Center head, protractor head-its function construction and uses.
Professional Skills – 75 Hrs **Professional Knowledge – 18 Hrs**	Set the different machining parameters to produce different threaded components applying method/	Screw thread cutting (BSW) external (including angular approach method) R/H & L/H, checking of thread by using screw thread gauge and thread plug gauge Screw thread cutting (BSW)	Different types of screw thread- their forms and elements. Application of each type of thread. Drive train. Chain gear formula calculation. Different methods of forming

	technique and test for proper assembly of the components. [Different thread: - BSW, Metric, Square]	internal R/H & L/H, checking of thread by using screw thread gauge and thread ring gauge Fitting of male & female threaded components (BSW) Prepare stud with nut (standard size) Grinding of "V" tools for threading of Metric 60 degree threads and check with gauge Screw thread cutting (External) metric thread- tool grinding Screw thread (Internal) metric & threading tool grinding Fitting of male and female thread components (Metric) Make hexagonal bolt and nut (metric) and assemble Cutting metric threads on inch lead screw and inch threads on Metric Lead Screw Practice of negative rake tool on non-ferrous metal and thread cutting along with fitting with ferrous metal Cutting Square thread (External) Cutting Square thread (Internal) Fitting of male and female Square threaded components Tool grinding for Square thread (both External & Internal) Make square thread for screw jack (standard) for minimum 100mm length bar	threads. Calculation involved in finding core dia., gear train (simple gearing) calculation. Calculations involving driver-driven, lead screw pitch and thread to be cut. Thread chasing dial function, construction and use. Calculation involving pitch related to ISO profile. Conventional chart for different profiles, metric, B.A., With worth, pipe etc. Calculation involving gear ratios and gearing (Simple & compound gearing). Screw thread micrometer and its use. Calculation involving gear ratios metric threads cutting on inch L/S Lathe and vice-versa. Tool life, negative top rake-its application and performance with respect to positive top rake Calculation involving tool Thickness, core dia., pitch proportion, depth of cut etc. of sq. thread.

Turner (OF)

Professional Skills – 30 Hrs Professional Knowledge – 08 Hrs	Set the different machining parameter & lathe accessories to produce components applying techniques and rules and check the accuracy. *[Different machining parameters: - Speed, feed & depth of cut; Different lathe accessories: - Driving Plate, Steady rest, dog carrier and different centres.]*	Make job using different lathe accessories viz , driving plate, steady rest, dog carrier and different centres Make test mandrel (L=200mm) and counter bore at the end	Different lathe accessories, their use and care.
Professional Skills – 25 Hrs Professional Knowledge – 10 Hrs	Plan and perform basic maintenance of lathe & grinding machine and examine their functionality.	Balancing, mounting & dressing of grinding wheel (Pedestal) Periodical lubrication procedure on lathe Preventive maintenance of lathe	Lubricant-function, types, sources of lubricant. Method of lubrication. Dial test indicator use for parallelism and concentricity etc. in respect of lathe work Grinding wheel abrasive, grit, grade, bond etc.
Professional Skills – 50 Hrs Professional Knowledge – 20 Hrs	Plan & set the machine parameter to produce precision engineering component to appropriate accuracy by performing different turning operation. [Appropriate accuracy - ±0.02mm/ (MT - 3) (proof turning); Different turning operation – Plain turning, taper	Form turning practice by hand Re-sharpening of form tools using bench grinder Tool machine handle turning by combination feed Turn Morse taper plug (different number) and check with ring gauge / suitable MT sleeve Make revolving tail stock centre- Bush type (C-40) Make Morse taper sleeve and check by taper plug gauge Make mandrel/ plug gauge with an accuracy of ±002mm using tungsten carbide tools including throw-away tips	Form tools-function-types and uses, Template-purpose & use. Dial test indicator-construction & uses Calculation involving modified rake and clearance angles of lathe tool at above and below the center height. Subsequent effect of tool setting. Jig and fixture-definition, type and use. Chip breaker on tool-purpose and type Cutting tool material-H.C.S., HSS, Tungsten. Carbide, Ceramic etc, - Constituents and their percentage. Tool life, quality of a cutting

	turning, boring threading, knurling, grooving, chamfering etc.]		material. Checking of taper with sin bar and roller-calculation involved Cutting speed, feed, turning time, depth of cut calculation, cutting speed chart (tungsten carbide tool) etc. Basic classification of tungsten carbide tips.
Professional Skills – 30 Hrs Professional Knowledge – 06 Hrs	Set & Produce components on irregular shaped job using different lathe accessories. [Different Lathe accessories: - Face plate, angle plate]	Setting and turning operation involving face and angle plate	Accessories used on face plate –their uses. Angle plate- its construction & use. Balancing-its necessity. Surface finish symbols used on working blueprints- I.S. system lapping, honing etc.
Professional Skills – 50 Hrs Professional Knowledge – 12 Hrs	Plan and set the machine using lathe attachment to produce different utility component/ item as per drawing. [Different utility component/ item – Crank shaft (single throw), stub arbour with accessories etc.]	Holding and truing of Crankshaft – single throw (Desirable) Turning of long shaft using steady rest (within 01 mm) Use of attachments on lathe for different operations Turning standard stub arbor with accessories collar, tie rod, lock nut	Preventive maintenance, its necessity, frequency of lubrication. Preventive maintenance schedule., TPM (Total Productive Maintenance), EHS (Environment, health, Safety) Marking table-construction and function. Angle plate-construction, eccentricity checking. Roller and revolving steadies, Necessary, construction, uses etc. Different types of attachments used in lathe. Various procedures of thread measurement thread screw pitch gauge. Screw thread micrometer, microscope etc.

Turner (OF)

Professional Skills – 40 Hrs **Professional Knowledge – 08 Hrs**	Set the machining parameters and produce & assemble components by performing different boring operations with an appropriate accuracy. *[Different boring operation – stepped boring; appropriate accuracy - ±0.05mm]*	Position boring using tool maker's button Boring and stepped boring (within ± 005 mm) Cutting of helical grooves in bearing and bushes (Oil groove) Turning & boring of split bearing – (using boring bar and fixture)	Tool maker's button and its parts, construction and uses, telescopic gauge its construction and uses. Inside micrometer principle, construction graduation, reading, use etc. (Metric & Inch.) Care for holding split bearing. Fixture and its use in turning.
Professional Skills – 50 Hrs **Professional Knowledge – 12 Hrs**	Calculate to set machine setting to produce different complex threaded component and check for functionality. *[Different complex threaded component- multi start threads (BSW, Metric)]*	Cutting thread of 8 and 11 TPI Multi start thread cutting (BSW) external & internal Multi start thread cutting (Metric) (External & internal)	Calculation involving fractional threads. Odd & even threads. Multiple thread function, use, different between pitch & lead, formulate to find out start, pitch, lead. Gear ratio etc. Indexing of start - different methods. Tool shape for multi-start thread. Setting of a lathe calculation for required change wheel Calculation involving shape of tool, change wheel, core dia etc. Calculation involving shape, size pitch, core dia. Etc. Helix angle, leading angle & following angles. Thread dimensions-tool shape, gear, gear calculation, pitch, depth, lead etc.
Professional Skills – 125 Hrs **Professional Knowledge – 26 Hrs**	Set (both job and tool) CNC turn centre and produce components as per drawing by preparing part programme.	Personal and CNC machine Safety: Safe handling of tools, equipment and CNC machine Identify CNC machine, CNC console Demonstration of CNC lathe machine and its parts - bed,	CNC technology basics: Difference between CNC and conventional lathes. Advantages and disadvantages of CNC machines over conventional machines. Machine model,

		spindle motor and drive, chuck, tailstock, turret, axes motor and ball screws, guide ways, LM guides, console, control switches, coolant system, hydraulic system, chip conveyor, steady rest Working of parts explained using Multimedia based simulator for CNC parts shown on machine Identify machine over travel limits and emergency stop Conduct a preliminary check of the readiness of the CNC turning centre viz , cleanliness of machine, referencing – zero return, functioning of lubrication, coolant level, correct working of sub-system Identification of safety switches and interlocking of DIH modes Machine starting & operating in Reference Point, JOG and Incremental Modes Check CNC part programming with simple exercises and using various programming codes and words Check the programme simulation on machine OR practice in simulation software in respective control system Absolute and incremental programming assignments and simulations Linear interpolation, and Circular interpolation assignments and simulations on soft ware Perform Work and tool setting: - Job zero/work coordinate system and tool setup and live tool setup Carryout jaw adjustment	control system and specification. Axes convention of CNC machine - Machine axes identification for CNC turn centre. Importance of feedback devices for CNC control. Concept of Co-ordinate geometry, concept of machine axis. Programming – sequence, formats, different codes and words. Co-ordinate system points and simulations. Work-piece zero points and ISO/DIN G and M codes for CNC. Different types of programming techniques of CNC machine. Describe the stock removal cycle in CNC turning for OD / ID operation. L/H and R/H tool relation on speed. Describe CNC interpolation, open and close loop control systems. Coordinate systems and Points. Program execution in different modes like manual, single block and auto. Absolute and incremental programming. Canned cycles. Cutting parameters- cutting speed, feed rate , depth of cut, constant surface speed, limiting spindle speed, tool wear, tool life, relative effect of each cutting parameter on tool life. Selection of cutting parameters from a tool manufacturer’s catalog for various operations.

		according to Diameter and tooling setup on Turret CNC turning centre operation in various modes: JOG, EDIT, MDI, SINGLE BLOCK, AUTO Program entry Set the tool offsets, entry of tool nose radius and orientation Conduct work off set measurement, Tool off set measurement and entry in CNC Control Make Tool nose radius and tool orientation entry in CNC control Jaw removal and mounting on CNC Lathe Manual Data Input (MDI) and MPG mode operations and checking of zero offsets and tool offsets Program checking in dry run, single block modes Checking finish size by over sizing through tool offsets Machining parts on CNC lathe with parallel, taper, step, radius turning, grooving Carryout Drilling /Boring cycles in CNC Turning Geometry Wear Correction Geometry and wear offset correction Produce components on CNC Machine involving different turning operations viz • Stock removal cycle OD • Drilling / boring cycles • Stock removal cycle ID • Data Input-Output on CNC machine	Process planning & sequencing, tool layout & selection and cutting parameters selection. Tool path study of machining operations Prepare various programs as per drawing. Tool Nose Radius Compensation (G41/42) and its importance (TNRC). Cutting tool materials, cutting tool geometry – insert types, holder types, insert cutting edge geometry. - Describe Tooling system for turning - Setting work and tool offsets. - Describe the tooling systems for CNC TURNING Centers. - 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. - Prepare various part programs as per drawing & check using CNC simulator. Processes and Tool selection related to grooving, drilling, boring & threading. - Programming for Grooving on OD/ID in CNC Turning. - Trouble shooting in CNC lathe machine - Identify Factors affecting turned part quality/

			productivity. - Parting off operation explanation. - Input and Output of Data.
Professional Skills – 50 Hrs **Professional Knowledge – 12 Hrs**	Manufacture and assemble components to produce utility items by performing different operations & observing principle of interchangeability and check functionality. *[Utility item: - screw jack/ vice spindle/ Box nut, Marking block, drill chuck, collet chuck etc.; different operations: - threading (Square, BSW, Metric), different boring (Plain, stepped)]*	Manufacturing & Assembly of Screw jack/vice/Box nut by performing different lathe operation (To use earlier produce screw jack) Prepare different types of documentation as per industrial need by different methods of recording information Turn Bevel gear blank	Heat treatment – meaning & procedure hardening, tempering, carbonizing etc. Different types of metal used in engineering application. Interchangeability meaning, procedure for adoption, quality control procedure for quality production. Importance of Technical English terms used in industry –(in simple definition only)Technical forms, process charts, activity logs in required formats of industry, estimation, cycle time, productivity reports, job cards.
Professional Skills – 40 Hrs **Professional Knowledge – 06 Hrs**	Make a process plan to produce components by performing special operations on lathe and check for accuracy. *[Accuracy - ±0.02mm or proof machining & ±0.05mm bore; Special operation – boring, threading etc.]*	Read a part drawing, make a process plan for turning operation and make arbor with clamping nut (hexagonal) Boring on lathe using soft jaws to make bush with collar (standard) on non ferrous metal and check with dial bore gauge to accuracy of +/-05 mm Make Arbor support bush (Proof Machining)	Terms used in part drawings and interpretation of drawings – tolerances, geometrical symbols - cylindricity, parallelism. etc. Automatic lathe-its main parts, types diff. Tools used-circular tool etc Related theory and calculation.

SYLLABUS FOR CORE SKILLS

Workshop Calculation & Science

LEARNING OUTCOME	ASSESSMENT CRITERIA
1. Demonstrate basic mathematical concept and principles to perform practical operations.	Solve different problems like unit conversion etc. with the help of a calculator.
	Demonstrate conversion of Fraction to Decimal and vice versa.
	Solve simple problems on area, perimeter etc of regular shapes.
	Solve simple trigonometric ratios and height & distance.
2. Understand and explain basic science in the field of study including simple machine.	Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure.
	Explain relationship between different scales of temperature, concept of heal and temperature.
	Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.

Sl.	Syllabus	Time in

Turner (OF)

No.		hrs.
I.	**Unit, Fractions**	**4**
1	Classification of Unit System	
2	Fundamental and Derived Units F.P.S, C.G.S, M.K.S and SI Units	
3	Measurement Units and Conversion	
4	Factors, HCF, LCM and Problems	
III.	**Material Science**	**4**
1	Types of metals	
2	Physical and Mechanical Properties of metals	
3	Types of ferrous and non-ferrous metals	
IV.	**Mass, Weight, Volume, and Density**	**4**
1	Mass, volume, density, weight & specific gravity	
2	Related problems for mass, volume, density, weight & specific gravity	
V.	**Speed and Velocity, Work Power and Energy**	**6**
1	Rest, motion, speed, velocity, difference between speed and velocity, acceleration and retardation	
2	Related problems on speed and velocity	
VI.	**Heat &Temperature and Pressure**	**4**
1	Concept of heat and temperature, effects of heat, difference between heat and temperature	
2	Scales of temperature, Celsius, Farenhieght,Kelvin and Conversion between scales of temperature	
VII.	**Basic Electricity**	**6**
1	Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC, DC and their comparison, voltage , resistance and their units	
2	Conductor, Insulator, types of connections- Series and Parallel,	
	Ohm's Law, relation between VIR & related problems	
3	Electrical power, energy and their units, calculation with assignments	
VIII.	**Mensuration**	**6**
1	Area and perimeter of square, rectangle and parallelogram	
2	Area an Perimeter of Triangle	
3	Area and Perimeter of Circle, Semi-circle , circular ring, sector of circle, hexagon and ellipse	
X.	**Trigonometry**	**6**
1	Measurement of Angle, Trigonometrical Ratios, Trigonometric Table	
2	Trigonometry-Application in calculating height and distance (Simple Applications)	
	Total	**40**

Engineering Drawing

LEARNING OUTCOME WITH ASSESSMENT CRITERIA

ENGINEERING DRAWING	
LEARNING OUTCOME	**ASSESSMENT CRITERIA**
1. Read and apply engineering drawing for different application in the field of work.	Read & interpret the information on drawings and apply in executing practical work.
	Read & analyse the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.

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Sl. No.	Topic	Time in hrs.
1.	Engineering Drawing – Introduction Introduction to Engineering Drawing and Drawing Instruments – • Conventions • Viewing of engineering drawing sheets. • Method of Folding of printed Drawing sheet as per BIS SP: 46-2003	1
2.	Drawing Instrument • Drawing board, T-square, Drafter (Drafting M/c), Set squares, Protector, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), pencils of different grades, Drawing pins/ Clips.	1
3.	Free hand drawing of – • Lines, polygons, ellipse etc. • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Solid objects – Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone with dimensions.	6
4.	Lines • Definition, types and applications in drawing as per BIS: 46-2003 • Classification of lines (Hidden, centre, construction, extension, Dimension, Section) • Drawing lines of given length (Straight, curved) • Drawing of parallel lines, perpendicular line	2
5.	Drawing of Geometrical figures: Definition, nomenclature and practice of – • Angle: Measurement and its types, method of bisecting. • Triangle: different types • Rectangle, Square, Rhombus, Parallelogram. • Circle and its elements	4
6.	Dimensioning and its Practice • Definition, types and methods of dimensioning (functional, non-functional and auxiliary) • Position of dimensioning (Unidirectional, Aligned) • Types of arrowhead	4
7.	Sizes and layout of drawing sheets • Selection of sizes • Title Block, its position and content • Item Reference on Drawing Sheet (Item list)	2

8.	Method of presentation of Engg. Drawing • Pictorial View • Orthographic View • Isometric View	2
9.	Symbolic representation – different symbols used in the trades • Fastener (Rivets, Bolts and Nuts) • Bars and profile sections • Weld, Brazed and soldered joints • Electrical and electronics element • Piping joints and fitting	6
10.	Projections • Concept of axes plane and quadrant • Orthographic projections • Method of first angle and third angle projections (definition and difference) • Symbol of 1st angle and 3rd angle projection in 3rd angle.	8
11.	Reading of fabrication drawing	4
Total		**40**

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate

ANNEXURE-I

TURNER			
LIST OF TOOLS AND EQUIPMENT (For batch of 20 candidates)			
S No.	**Name of the Tool & Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-10 is required additionally)			
1	Caliper outside spring joint	150 mm	(20 +1) nos.
2	Caliper inside spring joint	150 mm	(20 +1) nos.
3	Caliper odd-leg firm joint	150 mm	(20 +1) nos.
4	Steel Rule	150 mm, Graduated both in Metric and English Unit	(20 +1) nos.
5	Scriber	150mm x 3 mm	(20 +1) nos.
6	Hammer ball peen	250 gm with handle	(20 +1) nos.
7	Centre punch	100 mm	(20 +1) nos.
8	Prick punch	100 mm	(20 +1) nos.
9	Divider spring joint	150 mm	(20 +1) nos.
10	Safety goggles clear glass (Good quality)		(20 +1) nos.
B. INSTRUMENTS AND GENERAL SHOP OUTFIT			
11	Surface Plate - Granite	1000 x 1000 mm with Stand and Cover	1 no.
12	Work bench	240 x 120x 90cm high	1 no.
13	Marking table (CI)	120 x 120 cm	1 no
14	Bench vice	125 mm jaw	6 nos.
15	V-Block	150X100X100 mm with Clamp (Hardened & Ground)	1 pair each
16	Universal Surface gauge	250 mm arm	2 nos.
17	Hammer ball peen	750 gm with handle	6 nos.
18	Chisel cold flat	20 x 150 mm	6 nos.
19	Hammer copper/brass	500 gm with handle	12 nos.
20	Hacksaw fixed	200 mm (Pistol grip)	6 nos.
21	File flat	300 mm rough	6 nos.
22	File flat	250 mm 2nd cut	6 nos.
23	File flat	250 mm smooth	6 nos.
24	File half round	250 mm 2nd cut	6 nos.
25	File round	250 mm smooth	6 nos.
26	File half round	150 mm smooth	2 Sets

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27	Knurling tool revolving head	(Rough, med, fine) diamond and straight	2 Sets
28	Combination set	300 mm (Complete Set)	6 nos.
29	Screwdriver	10 X 200 mm	1 set
30	Spanner double ended	6 mm to 21 mm	2 nos.
31	Spanner adjustable	200 mm	---
32	Pliers flat nose	150 mm side cutting	15 nos.
33	Caliper transfer inside	150 mm	3 nos.
34	Micrometer Outside	0 to 25 mm, Least Count 0.01 mm with NABL Accredited lab. Certificate	2 sets
35	Micrometer Outside	25 to 50 mm, Least Count 0.01 mm with NABL Accredited lab. Certificate	2 nos.
36	Micrometer Outside	50to 75 mm, Least Count 0.01 mm with NABL Accredited lab. Certificate	2 sets
37	Micrometer Inside	up to 25 mm, Least Count 0.01 mm with NABL Accredited lab. Certificate	2 nos.
38	Micrometer Inside	up to 25 to 50 mm, Least Count 0.01 mm with NABL Accredited lab. Certificate	2 nos.
39	Depth Gauge Micrometer	0 to 150 mm, Least Count 0.01 mm with NABL Accredited lab. Certificate	2 nos.
40	Vernier Caliper Outside, Inside and Depth	200 mm /8 inches with metric & inch scale (L.C. = 0.02mm) with NABL Accredited lab. Certificate	6 nos.
41	Dial Vernier Caliper with metric	200 mm, Least Count 0.05 mm with NABL Accredited lab. Certificate	6 nos.
42	Vernier Bevel Protractor	300 mm blade with NABL Accredited lab. Certificate	6 nos.
43	Vernier Micrometer	0 - 25 mm o/s LC 0.001mm with NABL Accredited lab. Certificate	2 nos.

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44	Vernier Micrometer	25 - 50 mm, outside Least Count 0.001mm with NABL Accredited lab. Certificate	2 sets
45	Vernier Micrometer	0 inch to 1 inch.Outside Least Count 0.001 inch with NABL Accredited lab. Certificate	2 nos.
46	Gauge Feeler	Thickness - 0.05 mm to 0.3 mm by 0.05 **and** 0.4 mm to 1 mm by 0.1 mm - 13 leaves	1 each
47	Gauge - Radius Set	1 mm to 25 mm by 0.5 mm	6 nos.
48	Centre Gauge	com. 60°, 55° and 29°	2 sets
49	Screw Pitch Gauge	Whitworth & Metric each (0.25 to 6mm)	2 sets
50	Drill Angle Gauge		2 sets
51	Universal Dial Test Indicator - Plunger Type	Range 0 - 10 mm, Graduation 0.01 mm complete with Clamping Devices and Magnetic Stand	2 sets
52	Vernier Height Gauge	0 - 300 mm, LC = 0.02 mm with NABL Accredited lab. Certificate	1 set
53	Try Square	150 blades	4 nos.
54	Magnifying Glass	75 mm with magnifying factor 10X	4 nos.
55	Plain Ring and Plug Gauge	(12,16,20,25,30,32,36,40,45,50 mm)	1 set each
56	Wheel Dresser Hunting on-type with star cutter		1 No.
57	Wheel Dresser Diamond	(inserted-0.75 or 1 Carat)	2 nos.
58	Screw Thread micrometer interchangeable	(0-25 mm)	1 no.
59	Morse Taper Plug & Ring Gauge	No. 0 to 7 MT	1 set
60	Sine Bar with centers	200 mm	2 nos.
61	Slip Gauge metric set	(87 pieces in a Box) with workshop grade	2 nos.
62	Morse Taper	Sleeves No. 0-1, 1-2, 2-3, 3-4, 4-5.	1 set
63	Drill Drift		1 Set.

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64	Twist Drill	straight shank 3 to 12 mm by 1 mm	1 No.
65	Drill Twist Set	Taper Shank - 14 mm to 20 mm by 1 mm	1 set (Box)
66	Drill Chuck	12 mm cap with key	2 Sets.
67	Tap & Die	B.A. No. 0 to 10 in a box	2 nos.
68	Tap and Die Set	Metric - 3 to 24 mm	2 Sets
69	Tap & Die	B.S.F. up to 1 inch	2 Sets.
70	Tap & Die	B.S.W. up to 1 inch	2 Sets.
71	Reamer machine	straight flute 6 to 25 mm	1 Set.
72	Reamer Adjustable	10 to 20 mm	1 set.
73	Tool Holder RH & straight for mm square tool bit		1 no.
74	Parting Tool Holder with H.S.S. blade		12 nos.
75	Tool Bits	12 X 150 mm sq. assorted shaped	15 nos.
76	Boring Tool holder	6 mm sq. tool bit	15 nos.
77	Steel Rule	300 mm with Metric and Inch	15 nos.
78	Oil Can	½ pint (pressure feed system)	06 nos.
79	Dog Carrier	25, 50 and 75 mm	12 nos.
80	Angle Plate	Adjustable - 150 X 175 X 250 mm	02 nos.
81	Spirit Level	0.05 mm / 200 mm	2 nos.
82	Tool Maker's button		1 set
83	Combination Drill / Centre Drill	A3, A4 & A5	1 set
84	Oil Stone	12 mm sq. x 100 long fine	12 nos.
85	Tap Wrench (adjustable)		09 nos.
86	Die Handle		2 nos.
87	Tool Bit assorted sizes on holder		10 nos.
88	Machine Vice - Swivel Base	100 mm	01 no.
89	Chalk Board on mobile stand		1 no.
90	Spare Grinding Wheel Ajax type for carbide tool		1 no.
91	Almirah	1980x 910 x 480 mm	2 no.
92	St. Locker with drawer (Pigeonholes)		1 no.
93	Desk		1 no.
94	Stool		4 nos.
95	Angle Gauge for tool grinding		6 nos.

98	Revolving Center (to suit Lathe tailstock)		6 nos.
99	Tool Cemented carbide assorted shaped (External) for steel turning	set of 12 nos.	1 No.
100	Thread Plug Gauge	M-20 & M-21	1 set
101	Thread Ring Gauge	M-20 & M-21	1 no.
103	Coventry Die head		2 nos.
104	Gauge Drill Grinding		1 No.
105	Magnetic Chuck	150 mm dia.(Circulartype)	1 set.
106	Lathe Mandrels (Diff. Types)		1 no.
107	Coventry Type Die Head (Self-opening)		1 no.
108	Collapsible Tap with attachment		2 nos.
109	Fire Extinguisher and buckets		2 nos. each
110	Bore dial gauge stems	12 to 35 mm, 35 to 65 mm., dial gauge indicator of 0.01 accuracy.	1 set each
C : MACHINERIES AND EQUIPMENTS			
111.	Lathe S.S. & S.C. (All geared head stock) with minimum specification as:	150 mm center height, to admit 750 mm between centers. Machine to be motorized and supplied with coolant installation, 4-jaw Independent chuck 150 mm, 3-jaw self-centering chuck 150 mm, fixed steady, traveling steady, face plate, driving plate, 4-way tool post, quick change gear box for Metric or British threads, live and dead centers with taper attachments, Motor Capacity - 5.5 KW	5 nos.

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112.	Lathe S.S & S.C.(all geared type) with minimum specification as:	150 mm. Center height, 1000 mm between centers, gap bed machine to be motorized and supplied with coolant installation, 4-jaw independent chuck 250 mm , 3-jaw self-centering chuck 200 mm fixed steady, face plate, driving plate, 4-way tool post, quick change gear box for Metric/British threads, live and dead centers with taper attachments, Motor Capacity - 5.5 KW	1 no.
113.	Lathe tool room S.S. & S.C. (all geared type) with minimum specification as:	150 mm center height, 1000 mm between centers. Machine to be motorized and supplied with coolant installation, 4-jaw independent chuck 250 mm, 3-jaw self-centering chuck 150 mm fixed steady, traveling steady, face plate, driving plate, 1-way tool post, draw in type collets set up to 25 mm, 0.5 mm, relieving attachments, Motor Capacity -5.5 KW	1 no.
114.	Grinding machine pedestal type	D.E. 200 mm dia. Wheel with wheel guard and vision, Motor Capacity -0.75 KW	1 no.
115.	Drill machine pillar type-motorized	up to 12 mm. Cap, Motor Capacity -0.75 KW	1 no.
116.	Power saw machine – hydraulic feed system	400 mm. Blade size, Motor Capacity -0.75 KW	1 no.
D: LIST OF ADDITIONAL MACHINES, TOOLS & EQUIPMENT FOR CNC TURN CENTRE:			
117.	CNC lathe/CNC turn Centre	[specification as per Annex-A & A (I)]	As per Annex-A & A (I)
118.	a) Simulator b) Desktop Computers	[specification as per Annex-A & A (I)]	As per Annex-A & A (I)

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119.	Tool holders	[specification as per Annex-A & A (I)]	As per Annex-A & A (I)
120.	LCD projector / large screen TV		1 no.
121.	Digimatic Electronic VernierCaliper	inch and mm 8"/200 mm. LCM 0.005"/0.001 mm	2 nos.
122.	Digimatic electronic outside Micrometer	(0 to 25 mm & 25 to 50 mm) LC 0.001 mm.	1 no. each

NOTE: -

1. *Institute having centralized computer lab may use the existing infrastructure to impart simulationtraining.*
2. *Preferably all tools must be hardened, toughened and grounded.*
3. *Internet facility is desired to be provided in the classroom.*

Annexure – A

CNC Lab						
Space and Power Requirement						
1	Space Required (in Sq. Meter):	40 (For below 8(4+4) units) 65 (For above 8(4+4) units)				
2	Power Required (in KW):	6 (For below 4(2+2) units) 12.5(For 4(2+2) & above units)				
CNC Lab Infrastructure						
SNo.	**Name of Item**	**Category**	**Quantity**		**Unit**	**Remark**
			4 (2+2) units & Above	**Below 4 (2+2) units**		
3	CNC turn Centre [specification as per Annex-A (I)]	Machine	1	NIL	Number	**Refer Instructions**
4	Multimedia based simulator for CNC technology and interactive CNC part programming software for turning & milling with virtual machine operation and simulation using popular operation control system such as Fanuc, Siemens, etc. (Web-based or licensed based) (12 trainees + 1faculty) ***With help of this software the trainees should be able to Write, Edit, Verify & Simulate***	Software	10	10.	users	
5	Desktop Computers compatible to run simulation software with LAN facility	Machine	10	10	Number	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. RAM:-4 GB DDR-III or Higher, Wi-Fi Enabled. Network Card: Integrated

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						Gigabit Ethernet, with USB Mouse, USB Keyboard and Monitor (Min. 17 Inch.) Licensed Operating System and Antivirus compatible with trade related software.
6	Printer - (Laser/ Inkjet)	Machine	1	1	Number	Optional
7	Air Conditioner	Machine	As required	As required	Number	Optional
8	UPS	Machine	As required	As required	Number	Optional

Annexure –A (I)

Detailed specification for 2 axis CNC Lathe / Turning centre			
1	**MACHINE CAPACITY**	**Units**	**Size**
a	Swing over bed	mm	350 or higher
b	Turning diameter	mm	135 or higher
c	Distance between centres	mm	250 or higher
d	Maximum Turning Length	mm	200 or higher
e	Slant angle (bed or saddle)	degrees	30 to horizontal or higher
f	Cast Iron grade for bed and saddle		Grade 25 or equivalent
g	Machine weight net	kg	1500 or higher
2	**SPINDLE**		
a	Spindle nose		A2-4 / A2-5
b	Bore through Spindle	mm	35 or higher
c	Maximum spindle speed	RPM	4000 or higher
d	Spindle power, continuous	kW	3.7 or higher
e	Minimum spindle speed @ full power	RPM	1200 or lower
f	Type of drive		AC servo spindle motor (digital)
g	Chuck size	mm	135 or higher
h	Chuck type		3-jaw hydraulic, Hydraulic Power operated
i	Spindle bearing class		P4 class
j	Front Bearing Dia. (ID)	mm	60 or higher
3	**AXES**		
a	X - axis Travel	mm	100 or higher
b	Z - axis Travel	mm	200 or higher
c	Programmable feed rate- X & Z	mm/min	10 - 10000
d	Minimum programmable command - X & Z	mm	0.001
e	Rapid traverse - X & Z	m/min	20 or higher
f	Type of drive - X & Z		AC servo motor
g	Motor torque - Z axis	Nm	3 or higher
h	Motor torque - X axis	Nm	3 or higher with brake
i	Ball screw - Z & X axes (diameter x pitch)	mm	25 x 10 or higher
j	Ball screw finish - Z & X axes		Hardened and Ground
k	Ball screw class- Z & X axes		Pre-loaded with C3 or better
l	Guideway type - Z & X axes		Antifriction linear motion guideway
m	Guideway size - Z & X axes	mm	25 or higher
n	Guideway precision - Z & X axes		P class
4	**TURRET**		

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a	Bi-Directional Tool Turret	Electromechanical/Servo/Hydraulic	
b	No. of Tools	Nos.	8 or higher
c	Tool shank size	mm	20 x 20 or higher
d	Maximum boring bar diameter	mm	25 or higher
5	**TAIL STOCK**		
a	Quill Diameter	mm	65 or higher
b	Quill Stroke	mm	70 or higher
c	Quill Taper	MT-4 or higher	
d	Quill actuation	Hydraulic	
e	Tail stock base travel manual	mm	150 or higher
f	Thrust (Adjustable)	Kgf	300 or higher
6	**COOLANT/LUBRICATION/HYDRAULIC**		
a	Coolant tank Capacity	Litres	100 or higher
b	Coolant pump motor	kW	0.37
c	Coolant pump out put	LPM	20 or higher
d	Lubrication type	Automatic centralized lubrication	
e	Lubrication tank capacity	Litres	3 or higher
f	Hydraulic pump discharge	LPM	8 or higher
g	Hydraulic tank capacity	Litres	30 or higher
h	Hydraulic system pressure maximum	Bar	30 or higher
7	**ACCURACY as per ISO 230-2**		
a	Positioning accuracy X & Z axes	mm	0.012
b	Repeatability X & Z axes	mm	± 0.007
c	Geometrical Alignment	ISO 13041-Part 1	
d	Accuracy of finish test piece	ISO 13041-Part 6	
8	**CNC SYSTEM**		
a	Control System	FANUC /Siemens	
b	System resolution	0.001 mm	
c	Motors & Drives	Compatible with CNC controllers mentioned above	
d	Tool number display	On machine operator panel	
e	Machine control panel	Feed rate, spindle speed override knob	
f	MPG (Manual pulse generator)	On machine operator panel	
g	CNC features	Graphic Simulation, Programming help, Tool Offsets, MDI,	
		Absolute/ Incremental Positioning, Pitch error compensation	
9	**POWER SOURCE**		
a	Mains supply (± 10 %)	415 V, 3 Ph., 50Hz	
b	Total connected load requirement	Approx. 15 kVA	
10	**STANDARD EQUIPMENT**		
a	Voltage Stabilizer	15 kVA	
b	Air conditioning unit for electrical cabinet	1 No.	

	Backup CD for PLC Ladder Logic	1 No.	
d	Machine lighting	1 No.	
e	Levelling pads and jacking screws	4 No.	
f	Operation manual	1 No.	
g	Maintenance manual	1 No.	
h	Installation kit	1 No.	
i	Maintenance tool kit	1 No.	
j	6 rack trolley (Size 25"x22"x45”) with lock	1 No.	
k	Machine guarding with safety compliance	1 No.	
11	**MAKES OF CRITICAL MACHINE TOOL COMPONENTS**		
a	Linear Motion Guideways	HIWIN/THK/PMI/STAR	
b	Ball Screws	HIWIN/THK/TSUBAKI/PMI/STAR/HMT/NSK	
c	Spindle Bearings	RHP/NSK/FAG/SKF/NRB	
d	Turret	PRAGATI/BARUFFALDI/SAUTER/DUPLOMATIC	
e	Hydraulic Chuck & Cylinder	GMT/KITAGAWA/AIRTECH/PRAGATI/ROHM	
f	Hydraulic Power Pack	YUKEN/FLUID/REXROTH	
g	Panel AC	WERNER FINLEY/RITTAL/LEXTECNOID	
h	Stabilizer	NEEL/SERVOMAX/CONSUL/FARMAX/EQUIVALENT	
i	Lubrication	CENLUBE/DROPCO/EQUIVALENT	
j	Coolant Pump	RAJAMANE/GRUNDFOS	
k	Cutting tools and holders	SANDVIK/TAEGUTEC/KENNAMETAL/SECO/ISCAR/MITSUBISHI	

12 Cutting tools & tool holders	**Quantity**		**Inserts**	**Quantity**	
	1 year	**3 years**		**1 year**	**3 years**
1. External turning holder, insert type, MWLNL	2	4	WNMG	20	40
2. External turning holder, insert type, MVJNL	2	4	VNMG	10	20
3. External turning holder, insert type, PDJNR	2	4	DNMG	10	20
4. Threading Holder - External, LH	2	4	0.5 to 2	10	30
5. Threading Holder - Internal, LH	2	4	0.5 to 2	10	30
6. Grooving Holder External, LH	2	4	3 mm	10	30
7. Grooving Holder Internal, LH	2	4	3 mm	10	30
8. Parting off Holder for insert width 2 mm, LH	2	4	2 mm	10	30
9. Boring holder SCLCL for minimum bore dia. 12 mm	2	4	WCMT	20	60
10. Boring holder SCLCL for minimum bore dia. 16 mm	2	4	CCMT	20	60
11. Internal grooving holder LH, for minimum bore dia. 12 mm.	2	4	2 mm	10	30
12. Internal threading holder LH, for minimum bore dia. 12 mm	2	4	w mm	10	30
13. Insert drill 12.7 mm	2	4	Suitable	10 sets	30 sets

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14. Reducing sleeves for internal holders - Dia 12 and 16 mm	1 set	2 sets			
15. Centre drill HSS A 2.5 x 6.3	2	6			
16. Twist drill HSS straight shank, dia 6,8,10,12 mm	2 Sets	6 sets			
17. Collets suitable for the above drills	1 Set	2 sets			
18. Collet Holder	2	4			
19. Boring bar holder	3	3			


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