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

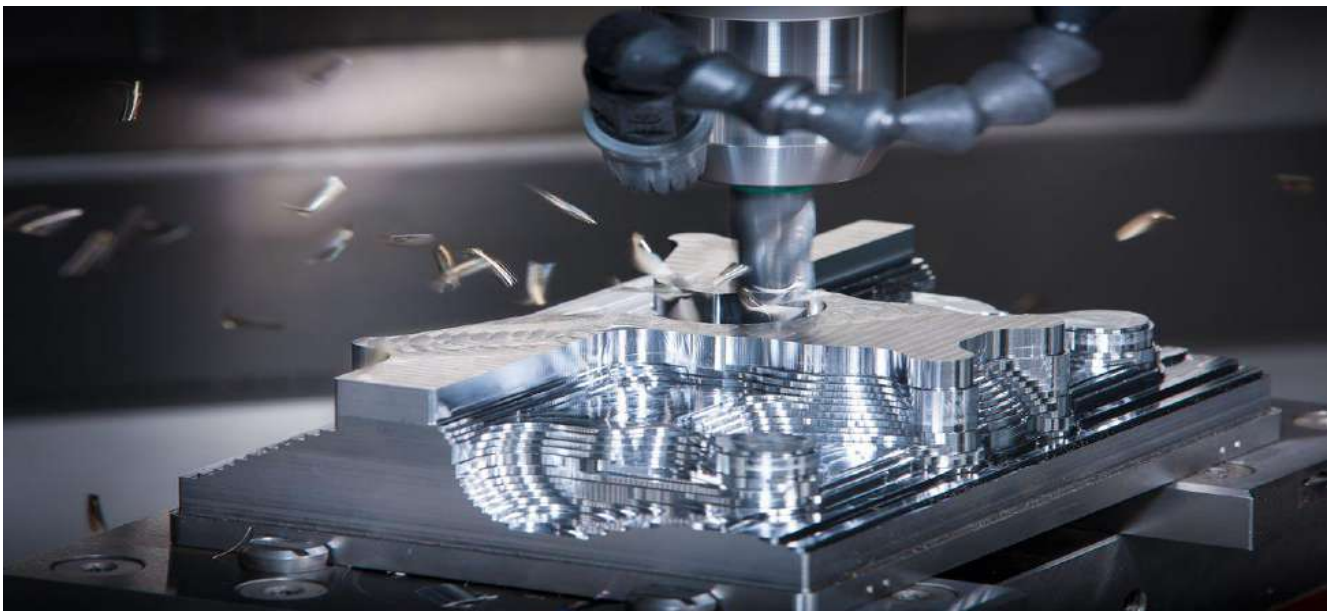
COMPETENCY BASED CURRICULUM

MACHINIST (OF)

(Duration: 1200 hrs.)

FLEXI MoU SCHEME

NSQF Level 4



Sector – Capital Goods & Manufacturing

कौशलं बलम्
Directorate General of Training

MACHINIST (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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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, Fitting, threading, turning, milling, Surface grinding, Gear cutting, measurement, CNC Turning and milling, 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

Machinist OF General; operates various types of power-driven metal cutting or grinding machines for cutting and grinding metal. Studies drawings or measures out sample with appropriate measuring instruments to note different dimensions and sequence of operations required. Selects metal piece and marks it or gets it marked for machining operations required. Fastens metal in chuck, jig or other fixture and respective tool or cutter, according to sequence of operation, on appropriate machine (lathe, shaper, milling, slotting, drilling, grinding). Checks machine setting or sets it for stipulated machine operations. Selects machine feed and speed and starts machine. Controls flow of coolant (cutting lubricant) and manipulates hand wheels or applies automatic controls to feed tool to metal or metal to tool. Observes cutting or grinding both from marking and machine readings, checks for dimensions as necessary and removes parts when machining is completed, checks completed part with measuring instruments and gauges to ensure prescribed accuracy. Makes adjustments if necessary and repeats operations, as required, on same or other machines. May assist in setting up machine for repetitive work, change tools, make simple adjustments, clean and oil machine. Does process planning, tool and cutting parameters selection, programming, setup and operation for cutting parts on CNC vertical machining center and CNC lathe.

Reference NCO:2015

7223.0500 – Mechanist, General/Machinist

4. GENERAL INFORMATION

Name of the Trade	**MACHINIST (OF)**
Trade Code	DGT/7014
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 Students)	20
Space Norms	130 Sq. m
Power Norms	20 KW
Instructors Qualification for	
1. Machinist (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 Engineering from AICTE /recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT. ***Note- Trainer should have minimum 3-4 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 a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

5.1 LEARNING OUTCOMES

1. Recognize & comply with 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 operation and check for dimensional accuracy [Basic fitting operation – marking, Hack sawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm].
3. Make different fit of components for assembling as per required tolerance observing principle of interchangeability and check for functionality [Different Fit – Sliding, 'T' fit and Square fit; Required tolerance: ±0.2 mm, angular tolerance: 1 degree.].
4. Produce components by different operations and check accuracy using appropriate measuring instruments.[Different Operations - Drilling, Reaming, Tapping, Dieing; Appropriate Measuring Instrument – Vernier, Screw Gauge, Micrometer]
5. 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, square, hexagonal]
6. 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, knurling.].
7. 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; Different machine parameters- Feed, speed, depth of cut.]
8. Set the different machining parameters to produce metric-v threaded components applying method/ technique and test for proper assembly of the components.
9. Set the different machining parameters and cutters to prepare job by performing different milling operation and indexing. [Different machining parameters – feed, speed and depth of cut. Different milling operations – plain, face, angular, form, gang, straddle milling]
10. Set the different machining parameters to produce "V'' threaded components applying method/ technique and test for proper assembly of the components.

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11. Produce components of high accuracy by different operations using grinding. [Different operations – surface grinding, cylindrical grinding with an accuracy of+/- 0.01 mm]
12. Set different machining parameters and cutters to prepare job by different milling machine operations. [Different machining parameters - feed, speed, depth of cut, different machining operation – facing, drilling, tapping, reaming, counter boring, counter sinking, spot facing, and boring slot cutting.]
13. Set the different machining parameters and cutters to prepare components by performing different milling operation and indexing. [Different machining parameters – feed, speed and depth of cut. Different components – Rack, Spur Gear, External Spline, Clutch]
14. Set (both job and tool) CNC turning centre and VMC (Vertical Machining Center) produce components as per drawing.

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
1. Recognize & comply with safe working practices, environment regulation and housekeeping.	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 operation and check for dimensional accuracy [Basic fitting operation – marking, Hack sawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm].	Plan & identify tools, instruments and equipment for marking and make this available for use in a timely manner.
	Select raw material and visual inspection 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. Make different fit of components for assembling as per required tolerance observing principle of	Plan and organize for fitting job.
	Select raw material, tools & equipment.
	Perform the work pieces for fitting according to tolerances and interchangeability.

interchangeability and check for functionality. [Different Fit – Sliding, 'T' fit and Square fit; Required tolerance: ±0.2 mm, angular tolerance: 1 degree.].	Check all dimensions and interchangeability in accordance with drawing and rectify if required.
4. Produce components by different operations and check accuracy using appropriate measuring instruments.[Different Operations - Drilling, Reaming, Tapping, Dieing; Appropriate Measuring Instrument – Vernier, Screw Gauge, Micrometer]	Plan and organize to produce different components.
	Select raw material, tools & equipment as per drawing.
	Execute/ perform different operations such as counter sinking counter boring and reaming, tapping, dieing etc.
	Check the work/ job using vernier, screw gauge micrometer and rectify if necessary.
5. 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, square, 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 standard operating practice.
	Observe safety procedure during above operation as per standard norms and company guidelines.
6. Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning operations. [Different cutting tool – V tool, side cutting,	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.

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, knurling.].	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.
7. 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; Different machine parameters- Feed, speed, depth of cut.]	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 measuring instruments for their functional requirement.
	Assemble the components to ascertain functionality.
8. Set the different machining parameters to produce metric-v threaded components applying method/ technique and test for proper assembly of the components.	Plan and select appropriate method to produce threaded components.
	Plan and prepare thread cutting tool in compliance with 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 parameters and cutters to prepare job by performing different milling operation	Identify different work and tool holding devices and acquaint with functional application of each device.
	Mount the work and tool holding devices with required alignment and check for its functional usage to perform

and indexing. [Different machining parameters – feed, speed and depth of cut. Different milling operations – plain, face, angular, form, gang, straddle milling]	milling operations.
	Observe safety procedure during mounting as per standard norms.
10. Set the different machining parameters to produce "V'' threaded components applying method/ technique and test for proper assembly of the components.	Plan and select appropriate method to produce components with different forms of thread.
	Plan and prepare thread cutting tool in compliance with 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.
11. Produce components of high accuracy by different operations using grinding. [Different operations – surface grinding, cylindrical grinding with an accuracy of+/- 0.01 mm]	Demonstrate Wheel balancing & truing, dressing of grinding wheel
	Grind surfaces as per accuracy specified in the drawing
	Grind external cylindrical surface as per accuracy specified in the drawing
	Check accuracy of job using measuring instruments
12. Set different machining parameters and cutters to prepare job by different milling machine operations. [Different machining parameters - feed, speed, depth of cut, different machining operation – facing, drilling, tapping, reaming, counter boring, counter sinking, spot facing, and boring slot cutting.]	Plan &select appropriate cutter according to standard of operation.
	Setting of cutter and machining parameters.
	Produce components by performing different milling operations/ indexing.
	Checking the accuracy/ correctness with instruments/ gauges and rectify if required.
13. Set the different machining	Select cutter as per specification of gear and plan to make

parameters and cutters to prepare components by performing different milling operation and indexing. [Different machining parameters – feed, speed and depth of cut. Different components – Rack, Spur Gear, External Spline, Clutch]	spur gear, rack & pinion as per drawing.
	Comply with safety rules when performing the above operations.
	Work out and apply indexing parameters as per different components to be produced to determine gear setting and set indexing head, milling machine.
	Set job and produce component following the standard operating procedure.
	Make components observing standard operating procedure.
	Measure with instruments/gauges as per drawing and check functionality of gear.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
14. Set (both job and tool) CNC turning centre and VMC (Vertical Machining Center) produce components as per drawing	Plan and prepare simple programme as per drawing, simulate for its correctness with appropriate software.
	Prepare tooling layout and select tools as required.
	Demonstrate possible solution within the team.
	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, drilling operations, etc.
	Set up the job and produce the component as per standard operating procedure involving face milling, contour milling with tool radius compensation, pocket milling, drilling, peck drilling, countersinking operations using canned cycle for hole operations.
	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.

7. TRADE SYLLABUS

MACHINIST (OF)			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skills – 45 Hrs Professional Knowledge – 10 Hrs	Recognize & comply with 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 Identification of 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 newcomers to become familiar with the working of Industrial Training Institute system including store's procedures. Soft skills, its importance and job area after completion of training. Importance of safety and general precautions observed in the industry/shop floor. Introduction of first aid. Operation of electrical mains and electrical safety. 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. Basic understanding on Hot work, confined space work and material handling equipment.

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Professional Skills – 85 Hrs **Professional Knowledge – 20 Hrs**	Plan and organize the work to make job as per specification applying different types of basic fitting operation and check for dimensional accuracy. [Basic fitting operation – marking, Hack sawing, Chiselling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]	Study the drawing to plan the job/ work Identification of tools & equipment as per desired specifications for marking, filing& sawing Visual inspection of raw material for rusting, scaling, corrosion etc Familiarisation of bench vice Filing- Flat and square (Rough finish) Marking with scriber and steel rule Filing practice, surface filing, marking of straight and parallel lines with odd leg calipers and steel rule Marking out lines, gripping suitably in vice jaws, hack sawing to given dimensions Sawing different types of metals of different sections Marking practice with dividers, odd leg callipers, scriber and steel rule (circles, arc, parallel lines) Grinding, centre punch, dot punch, chisel and scriber Marking off straight lines and arc using scribing block and dividers Marking, filing, filing square and check using try-square Marking according to	Linear measurements- its units, steel rule dividers, callipers – types and uses, Punch – types and uses. Uses of different types of hammers. Description, use and care of marking off table. Bench vice construction, types, uses, care & maintenance, vice clamps, hacksaw frames and blades, specification, description, types and their uses, method of using hacksaws. Files- elements, types, specification and their uses. Methods of filing. Care and maintenance of files. Measuring standards (English, Metric Units) Pedestal grinding machine: Use, care and safety aspect. Marking off and layout tools, scribing block, care & maintenance. Try square, ordinary depth gauge, Care & maintenance of cold chisels- materials, types, cutting angles. Combination set- its components, uses and cares. Marking media, Prussian blue, red lead, chalk and their special application, description. Surface plate and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types, uses, accuracy, care and maintenance. Drill, Tap, Die-types & application. Determination of tap drill size. Basic terminology related to

		drawing for locating, position of holes, scribing lines on chalked surfaces with marking tools Finding centre of round bar with the help of 'V' block and marking block Prepare mushroom head and round bar and bending metal plate by hammering Marking using scale, surface gauge and angle plate Chipping flat surfaces along a marked line Make a square from a round job by chipping upto 20mm length Slot, straight and angular chipping Mark off and drill through holes Drill and tap on MS flat Punch letter and number (letter punch and number punch)	screw thread. Reamer-material, types (Hand and machine reamer), parts and their uses, determining hole size for reaming, Reaming procedure. Vernier height gauge: construction, graduations, vernier setting & reading. Care and maintenance of Vernier height Gauge.

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Professional Skills – 70 Hrs **Professional Knowledge – 12 Hrs**	Make different fit of components for assembling as per required tolerance observing principle of interchangeability and check for functionality [Different Fit – Sliding, 'T' fit and Square fit; Required tolerance: ±0.2 mm, angular tolerance: 1 degree.].	Make Male & Female 'T' fitting with an accuracy +/- 02 mm and 1 degree Make male female square fit with accuracy +/- 01 mm Make Male & Female Hexagon fitting with accuracy +/- 06 mm	Interchangeability: Necessity in Engg, field, Limit- Definition, types, terminology of limits and fits-basic size, actual size, deviation, high and low limit, zero line, tolerance zone, allowances. Different standard systems of fits and limits. (British standard system & BIS system) Vernier calliper-its parts, principle, reading, uses & care. Outside micrometer- its parts, principle, reading, uses, Reading of Vernier Micrometer), care & maintenance. Dial test indicator-its parts, types, construction and uses.
Professional Skills – 40 Hrs **Professional Knowledge – 08 Hrs**	Produce components by different operations and check accuracy using appropriate measuring instruments.[Different Operations - Drilling, Reaming, Tapping, Dieing; Appropriate Measuring Instrument – Vernier, Screw Gauge, Micrometer]	Counter sinking, counter boring and reaming with accuracy +/- 04 mm Drill blind holes with an accuracy 04 mm Form internal threads with taps to standard size (blind holes) Prepare studs and bolt	Drilling machines-types &their application, construction of Pillar & Radial drilling machine. Countersunk, counter bore and spot facing-tools and nomenclature. Cutting Speed, feed, depth of cut and Drilling time calculations.

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Professional Skills – 30 Hrs **Professional Knowledge – 08 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, square, hexagonal]	Identify & function of different parts of lathe Practice on operation of lathe (dry/idle run) Setting lathe on different speed and feed Dismantling, assembling & truing of 3-jaw & 4-jaw chucks	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. Introduction to lathe- its types. Centre lathe construction, detail function of parts, specification. Safety points to be observed while working on a lathe.

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Professional Skills – 50 Hrs **Professional Knowledge – 16 Hrs**	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, knurling.]*	Grinding of RH & LH tools, V- tool, parting tool, Round nose tool Checking of angles with angle gauge/ bevel protractor Grinding of "V" tools for threading of Metric 60 degree threads Perform facing operation to correct length Centre drilling and drilling operation to required size Perform parallel turning and step turning operation Perform drilling, boring and undercut operation, parting, grooving, chamfering practice Measurement with steel rule and outside calliper with an accuracy of ± 05 mm Perform different Knurling operation in lathe with accuracy of ± 05mm Perform Drilling & boring of blind hole with an accuracy of ± 03mm	Lathe cutting tool-different types, material, shapes and different angles (clearance, rake etc.) and their effects, specification of lathe tools, grinding process of tools. Types of chips, chip breaker. Tool life, factors affecting tool life. Driving mechanism, speed and feed mechanism of Lathe. Chucks & different types of job holding devices on lathe and advantages of each type. Mounting and dismounting of chucks. Vernier Bevel Protractor – parts, reading and uses. Lathe operations-facing, turning, parting-off,grooving, chamfering, boring etc. Knurling-types, grade & its necessity.

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Professional Skills – 50 Hrs **Professional Knowledge – 10 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; Different machine parameters- Feed, speed, depth of cut.]*	Make taper turning by form tool with an accuracy of 1 degree Make taper turning by compound slide swivelling with an accuracy of ± 30 minute (20 hrs Make taper by off-setting tailstock with an accuracy of ± 30 minute Checking taper by Vernier Bevel Protractor and sine bar & slip gauge	Taper – different methods of expressing tapers, different standard tapers. Method of taper turning, important dimensions of taper. Taper turning by swiveling compound slide, its calculation. Calculations of taper turning by offsetting tail stock. Sine Bar – description & uses. Slip gauge –description and uses.
Professional Skills – 50 Hrs **Professional Knowledge – 10 Hrs**	Set the different machining parameters to produce metric-v threaded components applying method/ technique and test for proper assembly of the components.	Cutting V thread (external) in a lathe and check with Screw Pitch Gauge Cutting V thread (internal) in a lathe and check with Screw Pith Gauge Fitting of male & female threaded components	Different thread forms, their related dimensions and calculations of screw cutting in a lathe (Metric thread on English lathe and English thread on Metric lathe). Measurement of threads by three wire methods. Use of Screw Pitch Gauge.

Professional Skills – 100 Hrs **Professional Knowledge – 32 Hrs**	Set the different machining parameters and cutters to prepare job by performing different milling operation and indexing. [Different machining parameters – feed, speed and depth of cut. Different milling operations – plain, face, angular, form, gang, straddle milling]	Identification of milling machine Demonstrate working principle of Milling Machine Set vice & job on the table of Milling Machine Set arbor on the spindle of milling machine Set the cutter on arbour Safety points to be observed while working on a milling machine Demonstrate Up Milling and Down Milling Process Sequence of milling six faces of a solid block Check the accuracy with the help of try-square and vernier height gauge Perform Step milling using side and face cutter checking with depth micrometer Perform slot milling using side and face cutter Make "V" Block using Horizontal Milling Machine with accuracy +/- 02mm Make concave surfaces with an accuracy +/- 02mm Make convex surfaces with an accuracy +/- 02mm Straddle milling operation with an accuracy +/-02mm Gang milling operation with an accuracy +/- 02mm	Milling Machine: Introduction, types, parts, construction and specification. Driving and feed mechanism of Milling Machine. Different types of milling cutters & their use. Cutter nomenclature. Different milling operations - plain, face, angular, form, slot, gang and straddle milling etc. Up and down milling. Different types of milling attachments and their uses. **Jigs and Fixtures–** Introduction, principle, types, use, advantages & disadvantages. Properties of metals general idea of physical, mechanical properties of metals, colour, weight, hardness toughness, malleability, ductility their effect on machinability. Heat Treatment – Introduction, necessity, types, Purposes, different methods of Heat Treatment. Heat Treatment of Plain Carbon Steel. Indexing-introduction & types. Indexing head-types &constructional details, function of indexing plates and the sector arms. Calculation for simple indexing.

		Make Dovetail fitting (male & female) on Milling Machine with an accuracy +/-02mm Make T-Slot fitting (male & female) on Milling Machine with an accuracy +/-02mm Demonstrate indexing head Set and align indexing head with reference to job on milling machine Make square job by direct/ simple indexing method with an accuracy +/-02mm Make hexagonal job by simple indexing method with an accuracy +/-02mm	
Professional Skills – 40 Hrs **Professional Knowledge – 10 Hrs**	Set the different machining parameters to produce "V'' threaded components applying method/ technique and test for proper assembly of the components.	Checking of alignment of lathe centres and their adjustments Turning practice- between centres on mandrel (gear blank) with an accuracy +/-30 minute Taper turning by swivelling the cross slide	Turning of taper by taper turning attachment - advantages and disadvantages, taper calculations. Mandrel, Lathe centres, Lathe dog, catch plate/Driving plate, Face plate, Rests, their types & uses. Terms relating screw thread major/ minor diameter, pitch and lead of the screw, depth of thread. Simple gear train and compound gear train change gears for fractional pitches. Difference between single and multi start threads- their uses, merits and demerits.

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Professional Skills – 70 Hrs **Professional Knowledge – 16 Hrs**	Produce components of high accuracy by different operations using grinding. [Different operations – surface grinding, cylindrical grinding with an accuracy of+/- 0.01 mm]	Identification of different types of grinding machine Wheel balancing & truing Dressing of grinding wheel Grinding of block (six sides) by surface grinding machine with an accuracy of +/- 01mm Grinding of step block by surface grinding machine with an accuracy of +/- 01mm Grinding of slot block by surface grinding machine with an accuracy of +/- 01mm Set and perform angular grinding using universal vice/ sign vice to standard angle Make slide fit with an accuracy ± 01mm (male female) *Cylindrical grinding:* External Parallel cylindrical grinding (Both holding in chuck/ collet and in between centres	**Grinding –** Introduction, grinding wheel-abrasive, types, bond, grade, grid, structure, standard marking system of grinding wheel, selection of the grinding wheel. Dressing, types of dresser. Glazing and Loading of wheels – its causes and remedies. Roughness values and their symbols. Explain the importance and necessity of quality. **Surface Grinder –** Types, Parts, construction, use, methods of surface grinding, specification & safety. **Cylindrical grinder:** Introduction, parts, construction, types, specification, safety, different methods of cylindrical grinding. Cutting speed, feed, depth of cut, machining time calculation. Wet grinding and dry grinding, various types of grinding wheels and their application, grinding defects and remedies.

MACHINIST (OF)

Professional Skills – 50 Hrs **Professional Knowledge – 14Hrs**	Set different machining parameters and cutters to prepare job by different milling machine operations. *[Different machining parameters - feed, speed, depth of cut, different machining operation – facing, drilling, tapping, reaming, counter boring, counter sinking, spot facing, and boring slot cutting.]*	Practice of facing on milling Machine Drill on PCD on milling Machine with accuracy +/-02mm Perform Tapping and Reaming operation using milling Machine with an accuracy +/-02mm Perform spot facing operation using milling machine with accuracy +/-02mm Make slot on face of the job using milling Machine with an accuracy +/-02mm Make Internal Grooving using milling Machine with an accuracy +/-02mm.	Geometrical tolerances, definition, symbol and their application. Depth Micrometer – Parts, reading, uses and safety. Different types of micrometers and their uses. Inside Micrometer – its parts, reading and uses. Bore Dial Gauge – its parts, reading (both in Metric and English system) and uses. Telescopic gauge. Gauges – different types and their uses, difference between Gauges and Measuring Instruments. Gear introduction, use and type. Elements of a spur gear. Gear tooth of each forms types, merits and demerits of each.
Professional Skills – 60 Hrs **Professional Knowledge – 16 Hrs**	Set the different machining parameters and cutters to prepare components by performing different milling operation and indexing. *[Different machining parameters – feed, speed and depth of cut. Different components – Rack, Spur Gear, External Spline, Clutch]*	Make Straight Teeth Rack using Milling Machine with an accuracy 05mm Make spur gear using Simple indexing with an accuracy 05mm Perform Boring operation on Vertical Milling Machine with an accuracy 05mm	Rack – types, uses and calculations. Selection of gear cutter type and form & various methods of checking gear and its parts. Spur gear calculations, curves and their uses. Use of radius gauges and template. Vertical Milling Machine- its parts. Method of boring in Vertical milling. Difference between Horizontal and Vertical Milling Machine.

Professional Skills – 160 Hrs **Professional Knowledge – 38 Hrs**	Set (both job and tool) CNC turning centre and VMC (Vertical Machining Center) produce components as per drawing	Know rules of personal and CNC machine safety, safe handling of tools, safety switches and material handling equipment using CNC didactic/ simulation software and equipment Identify CNC lathe machine elements and their functions, on the machine Understand the working of parts of CNC lathe, explained using CNC didactic/ simulation software Identify machine over travel limits and emergency stop, on the machine Decide tool path for turning, facing, grooving, threading, drilling Identification of safety switches and interlocking of DIH modes Identify common tool holder and insert shapes by ISO nomenclature Select cutting tool and insert for each operation Fix inserts and tools in tool holders Decide cutting tool material for various applications Select cutting parameters from tool manufacturer's catalogue Write CNC programs for simple tool motions and parts using linear and	Personal safety, safe material handling, and safe machine operation on CNC turning centers. CNC technology basics, Comparison between CNC and conventional lathes. Concepts of positioning accuracy, repeatability. CNC lathe machine elements and their functions - bed, chuck, tailstock, turret, ball screws, guide ways, LM guides, coolant system, hydraulic system, chip conveyor, steady rest, console, spindle motor and drive, axes motors, tail stock, encoders, control switches. Feedback, CNC interpolation, open and close loop control systems. Machining operations and the tool paths in them – stock removal in turning and facing, grooving, face grooving, threading, drilling. Concept of Co-ordinate geometry, concept of machine coordinate axis, axes convention on CNC lathes, work zero, machine zero. Converting part diameters and lengths into co-ordinate system points. Absolute and incremental programming. Programming – sequence, formats, different codes and words. ISO G codes and M codes for

		circular interpolation, check on program verification/ simulation software Conduct a preliminary check of the readiness of the CNC lathe - cleanliness of machine, functioning of lubrication, coolant level, correct working of sub-systems, on the machine Starting the machine, do homing on CNC simulator Entering the CNC program in EDIT mode for an exercise on Simple turning & Facing (step turning) without using canned cycles, on CNC Mounting jaws to suit the part holding area on CNC machine Mounting tools on the turret according to part and process requirement, on CNC simulator &on CNC machine Perform Work and tool setting: Job zero/work coordinate system and tool setup and live tool setup Determining work and tool offsets using JOG, MDI, MPG modes, on CNC simulator Entering the tool offsets, tool nose radii and orientation for TNRC in offsets page, on CNC simulator	CNC turning. Describe CNC interpolation, open and close loop control systems. Co-ordinate systems and Points. Tool nose radius compensation (TNRC) and why it is necessary. Find the geometry page in CNC machine. Cutting tool materials, application of various materials. 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 catalogue for various operations. Collisions due to program errors, effects of collisions. Costs associated with collisions – tool breakage, machine damage, injuries. Program execution in different modes like MDI, single block and auto. Process planning & sequencing, tool layout& selection and cutting parameters selection. Work and tool offsets. Inputs value to the offset/ geometry page into machine. Turning in multiple setups, hard and soft jaws, soft jaw boring, use of tailstock and steady rest. Length to diameter (L/D) ratio and deciding work holding based on it. Machine operation

		Program checking in dry run, single block modes, on CNC simulator & CNC machine Prepare part program and cut the part in auto mode in CNC machine for the exercise on Simple turning & Facing (step turning), drilling. Identify CNC vertical machining center machine elements and their functions, on the machine Understand working of parts of CNC VMC, explained using CNC didactic/ simulation software (20 hrs Identify machine over travel limits and emergency stop, on the machine Decide tool path for Face milling, Side milling, Pocket milling, Drilling, Countersinking, Reaming, Rough boring, Finish boring, Spot facing Identify common tools, tool holders and inserts Select cutting tool, insert and holder for each operation Fix inserts and tools in tool holders Decide cutting tool material for various applications Select cutting parameters from tool manufacturer's catalog	modes – Jog, MDI, MPG, Edit, Memory. Entering and editing programs on machine console, entering offsets data in offsets page.

		Write CNC programs for simple parts using linear and circular interpolation, absolute and incremental modes, checkon program verification software Conduct a preliminary check of the readiness of the CNC VMC - cleanliness of machine, functioning of lubrication, coolant level, correct working of sub-systems on the machine. Starting the machine, do homing on CNC Entering the CNC program in EDIT mode for an exercise on face milling and drilling without using canned cycles, on CNC Mounting tools on the ATC according to part and process requirement, on CNC simulator& CNC machine Determining work and tool offsets using JOG, MDI, MPG modes, on CNC simulator& CNC machine Entering the work offset, tool length offsets, tool radii and, on CNC simulator Program checking in dry run, single block modes, on CNC simulator Prepare part programme, enter, edit and simulate Carryout tool path	

		simulation Machining part on CNC VMC with face milling, drilling Machining parts on CNC VMC with combination face milling, side milling with CRC, drilling, countersinking, Practical on Chamfer and counter-sink drilling	Safety aspects related to CNC VMC. Comparison between CNC VMC and conventional milling machines. Concepts of positioning accuracy, repeatability. CNC VMC machine elements and their functions - bed, chuck, Auto tool changer (ATC), ball screws, guide ways, LM guides, coolant system, hydraulic system, chip conveyor, rotary table, pallet changer, console, spindle motor and drive, axes motors, encoders, control switches. Feedback, CNC interpolation, open and close loop control systems. Machining operations and the tool paths in them - Face milling, Side milling, Pocket milling, Drilling, Countersinking, Rigid tapping, floating tapping Reaming, Rough boring, Finish boring, Spot facing. Concept of Co-ordinate geometry& polar coordinate points, concept of machine axis, axes convention on CNC VMC, work zero, machine zero. Converting part dimensions into coordinate system points. Absolute and incremental

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. No.	Syllabus	Time in 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.

MACHINIST (OF)

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	2

	• Item Reference on Drawing Sheet (Item list)	
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

MACHINIST			
LIST OF TOOLS AND EQUIPMENT (For batch of 20 candidates)			
S No.	**Name of the Tools & Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT			
1.	Steel rule	30 cm graduated both in English & Metric units	21 nos.
2.	Outside spring caliper	150 mm	15 nos.
3.	Inside spring caliper	150 mm	15 nos.
4.	Hermaphrodite caliper	150 mm	15 nos.
5.	Divider spring	150 mm	15 nos.
6.	Centre Punch	100 mm	15 nos.
7.	Hammer	B.P. 0.5 kg	15 nos.
8.	Cold chisel flat	25 x 200 mm	21 nos.
9.	File flat bastard	300 mm	21 nos.
10.	File flat	2nd cut 250 mm	21 nos.
11.	File flat smooth	200 mm	21 nos.
12.	Screw Driver	10 X 200 mm	21 nos.
13.	Combination Plier	150 mm	15 nos.
14.	Safety glasses		21 nos.
B. INSTRUMENTS AND GENERAL SHOP OUTFIT			
15.	Surface plate	400 mm x 400mm grade	1 no.
16.	Marking off table	1200 x 1200 x 600 mm high with stand	1 no.
17.	Scribing block universal	300 mm	2 nos.
18.	V- Block	100/7 – 80 – A	2 nos.
19.	Try square	300 mm	2 nos.
20.	Outside spring caliper	200 mm	2 nos.
21.	Divider spring	200 mm	2 nos.
22.	Inside spring caliper	200 mm	2 no.
23.	Straight edge steel	1 meter	1 no.
24.	Straight edge steel	500 mm	1 no.
25.	Steel tape	2 meter in case	1 no.
26.	Steel rule	60 cm graduated both in English & Metric units	2 nos.
27.	Sprit level	2V 250, 05 meter	1no.

28.	Hammer	B.P. 800 gms with handle	7 nos.
29.	Screw driver, heavy duty	300 mm with handle	7 nos.
30.	Hammer lead	1 kg.	2 nos.
31.	Spindle blade screw driver	100 mm	7 nos.
32.	Allen Hexagonal keys	2.5 to 12	2 sets
33.	Spanner D.E.	series 2 (set of 7 pieces)	10 sets
34.	Adjustable spanner	300 mm	2 nos.
35.	Reduction sleeve Morse	1-1, 3-1, 4-1, 4-2, 5-1, 5-2, 6-1,	2 nos. each
36.	Angle plate size	200 x 100 x 200 mm	2 nos.
37.	Angle plate adjustable	250 x 150 x 175 mm	2 nos.
38.	Solid parallels in pairs (different sizes) in Metric		20 pairs
39.	Oil Can pressure feed	500 mg	(assorted)
40.	Oil stone	150 x 50 x 25 mm	10 nos.
41.	Number drills H.S.S. (parallel shank)		2nos.
42.	Punch letter set.	3 mm	1 no.
43.	Punch number set	3 mm	1 no.
44.	Twist drills	3 mm to 13 mm in step of 0.5 mm (parallel shank)	1set
45.	Drill Chuck	0-13 mm with taper shank	2set
46.	Centre drill	A 1 to 5	1no.
47.	Grinding wheel dresser (diamond)		2set
48.	Grinding wheel dresser Huntington type		1no.
49.	Clamps C	100 mm	2 nos.
50.	Clamps C	200 mm	2nos.
51.	Tap and Die set in box metric pitch	(6 mm to 12 mm)	2nos.
52.	Drill H.S.S. taper shank	(6 mm to 12 mm in step of 0.5 mm)	1set
53.	File Half round	2nd cut 250 mm	7 nos.
54.	File triangular smooth	200 mm	7 nos.
55.	Needle file set		7 nos.
56.	File square	2nd cut 250 mm	1no.
57.	Reamer	6 mm to 25 mm by 1 mm	7 nos.
58.	Reamer adjustable	10 mm to 15 mm length 75 mm	1set
59.	Tool bits	H.S.S. 6 mm square	1 dozen
60.	Tool bits	H.S.S. 10 mm square	1 dozen
61.	Tool bits holder (Armstrong) L.H		1 dozen
62.	Tool bits holder (Armstrong) R.H.		7 nos.
63.	Assorted tools and bit holders for lathe in different shapes and sizes		4nos.as required

64.	Hacksaw frame adjustable	250-300 mm with blades	2nos.
65.	Table chuck	75 mm jaw swivel base	1no.
66.	Bench vice	100 mm jaw	2 nos.
67.	Machine vice	200 mm swivel base	4nos.
68.	Machine Vice	Swivel Base -150 mm	2nos.
69.	Hand vice	50 mm jaw	2nos.
70.	Radius turning attachment		1no.
71.	Angle turning attachment		1no.
72.	Compound angle vice (standard sine)		1no.
73.	Universal Machine Vice	100 mm	1no.
74.	Universal Table Angle Plate	150 X 150 X 150 mm	1no.
75.	Knurling tools	(set of 3) straight and diamond	1each
76.	Plier cutting	200 mm	2nos.
77.	Carbide tipped tools of different sizes and shapes (throw away tips)		2sets
78.	Hand hammer	1 kg With handle	2nos.
C. MILLING CUTTERS			
79.	Milling Cutter - Cylindrical Cutter	Ø 63 mm, 90 mm Length and 27 mm Bore Diameter	3nos.
80.	Milling Cutter - Cylindrical Cutter	Ø 80 mm, 90 mm Length and 27 mm Bore Diameter	3 nos.
81.	Milling Cutter	Side and face cutter dia 100 X 10 X 27 mm	2 nos.
82.	Milling Cutter	Side and face cutter dia 100 X 12 X 27 mm	3 nos.
83.	Milling Cutter	Side and face cutter dia 160 X 10 X 27 mm	2 nos.
84.	Milling Cutter	Side and face cutter dia 160 X 16 X 27 mm	2 nos.
85.	Milling Cutter - Side and face cutter	dia 200 X 20 X 27 mm	3 nos.
86.	Milling Cutter - Side and face cutter	dia 80 X 8 X 27 mm	2 nos.
87.	Milling Cutter - Equal Angle Cutter	45˚/100 mm x 27 mm bore dia	2 nos.
88.	Milling Cutter - Equal Angle Cutter	60˚/100 mm x 27 mm bore dia	2 nos.
89.	Milling Cutter - Equal Angle Cutter	90˚/100 mm 27 mm bore dia	2 nos.
90.	Milling Cutter - Double Angle Unequal	Cutter 50 X 12 X 27 mm bore dia55˚	2 nos.
91.	Milling Cutter - Double Angle Unequal	Cutter 50 X 12 X 27 mm bore dia 60˚	2 nos.
92.	Milling Cutter - Double Angle Unequal	Cutter 63 X 18 X 27 mm bore dia 70˚	2 nos.
93.	Milling Cutter - Double Angle Unequal	Cutter 63 X 18 X 27 mm bore dia 75˚	1 no.
94.	Milling Cutter - Single Angle	Cutter 63 x 18 x 45˚ RH 27 mm bore dia	1 no.

95.	Milling Cutter - Single Angle	Cutter 63 x 18 x 45˚LH 27 mm bore dia	1 no.
96.	Milling Cutter - Single Angle	Cutter 63 x 18 x 60˚ LH 27 mm bore dia	1 no.
97.	Milling Cutter - Single Angle	Cutter 63 x 18 x 60˚RH 27 mm bore dia	1 no.
98.	Milling Cutter - Slitting Saw Cutter	Ø 75 x 3 X Ø 27 mm	2 nos.
99.	Milling Cutter - Slitting Saw Cutter	Ø 100 x 6 X Ø 27 mm	2 nos.
100.	Milling Cutter - Shell End Mill	Ø 50 x 36 x 27 mm, Preferably Inserted Tip Type	2 nos.
101.	Milling Cutter - Shell End Mill	Ø 75 mm x 50 x 27 mm, Preferably Inserted Tip Type	2 nos.
102.	Milling Cutter - Parallel Shank end mills	Ø 6, Ø 10 and Ø 16 are (double fluted), Ø 20 mm & Ø 25mm (four fluted)	4 nos. each
103.	Milling Cutter - T Slot Cutter with Parallel Shank	Ø 17.5 x 8 mm Width x Diameter of shank 8 mm	2 nos.
104.	Milling Cutter - Concave	Ø 63 x 6 radius x 27 mm Bore Diameter	1 nos.
105.	Milling Cutter - Convex	Ø 63 x 6 radius x 27 mm Bore Diameter	1 nos.
106.	Milling Cutter - Disc type form	(involutes form - 2 module, 20° pressure angle)	1 set
D. MEASURING INSTRUMENTS			
107.	Micrometer outside	0-25 mm Reading 0.01 mm with NABL Accredited lab. Certificate	4 nos.
108.	Micrometer outside	25-50 mm Reading 0.01 mm with NABL Accredited lab. Certificate	2 nos.
109.	Micrometer outside	50-75 mm Reading 0.01 mm with NABL Accredited lab. Certificate	1 no.
110.	Micrometer outside	75-100 mm Reading 0.01 mm with NABL Accredited lab. Certificate	1 no.
111.	Micrometer depth gauge	0-200 mm Reading 0.01 mm with NABL Accredited lab. Certificate	1no.
112.	Digital micrometer	0-25 mm Reading 0.01 mm with NABL Accredited lab. Certificate	1 no.
113.	Vernier Caliper	Depth 200 mm /8 inches with metric & inch scale (L.C. = 0.02mm) with NABL Accredited lab. Certificate	11 nos.
114.	Direct reading vernier caliper	0- 300 (direct reading with dial)	1no.
115.	Digital vernier caliper	0- 300 mm	1 no.

116.	Vernier height gauge	250 mm	1 no.
117.	Vernier gear tooth caliper		1no.
118.	Combination set	with 300 mm rule	2 sets
119.	Vernier bevel protractor	with 150 m blade	1 no.
120.	Bevel gauge	200 mm	1 no.
121.	Telescopic Gauge	8 mm to 150 mm	1set
122.	Sine Bar	200 mm	1 no.
123.	Universal Dial Test Indicator	Plunger Type - Range 0 - 10 mm, Graduation 0.01 mm complete with Clamping Devices and Magnetic Stand	1 no.
124.	Centre Gauge com.	60°, 55° and 29°	1 no.
125.	Gauge Slip Box	Metric - 87 Pieces Set	1 set
126.	Gauge Screw Pitch	Metric -0.25 to 6 mm	2 sets
127.	Gauge - Radius Set	1 mm to 25 mm by 0.5 mm	1 set
128.	Limit plug gauges	5 mm to 25 mm by 2.5 mm	1 set
129.	Ring gauges	5 mm to 25 m by 2.5 mm (GO & NO GO)	1 set
130.	Taper gauge	M.T. No. 1, 2, 3, 4 & 5	1 set
131.	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 no.
132.	Planer gauge standard size		1 no.
133.	Magnifying glass	75 mm	2nos.
E. FURNITURE			
134.	Steel lockers for 14 trainees		1no.
135.	Steel chair for Instructor		1 no.
136.	Steel table for Instructor		1 no.
137.	Work bench	2400 x 1200 x 900 mm	1no.
138.	Steel cup board	180 x 90 x 45 mm	1 no.
139.	Steel cup board	120 x 60 x 45 cm	1no.
140.	Black board with easel		1 no.
141.	First Aid Box		1 no.
F. GENERAL MACHINERY SHOP OUTFIT			
142.	SS and SC centre lathe (all geared) with specification as:	Centre height 150 mm and centre distance 1000 mm along with 4 jaw chuck, Taper turning attachment, steadies, auto feed system, safety guard, motorized coolant system, with lighting arrangement and set	3 nos.

		of lathe tools, Motor Capacity - 5.5 KW	
143.	Drilling machine pillar	20 mm capacity with drill chuck & key, 0.75 KW	1 no.
144.	Radial drill	1200 mm area motorized with tapping attachment, 3.6KW	1no.
145.	Silicon carbide grinder for carbide tipped tools		1 no.
146.	Double ended Pedestal Grinder	with 178 mm wheels(one fine and one rough wheel), 0.75 KW	1 no.
147.	Universal Milling machine with minimum specification as:	Table Length x width 1200 x 300 mm having motorized up & down movement along with auto feed arrangement and with Motor Capacity - 7.5KW following attachments such as:	2 nos.
		a. Vertical head	
		b. Slotting attachment	
		c. Rack cutting attachment	
		d. Rotary table	
		e. Dividing head	
		f. Adaptors, arbors and collects etc. for holding straight shank drills and cutters from 3 mm to 25 mm.	
148.	Horizontal Milling Machine with minimum specification as:	Table Length x width 1200 x 300 mm having motorized up & down movement along with auto feed arrangement and 150mm Universal vice, Motor Capacity - 7.5KW	1no.
149.	Vertical Milling Machine with minimum specification as:	Table Length x width 1200 x 300 mm having motorized up & down movement along with auto feed arrangement along with 150mm universal vice, Motor Capacity - 5.5KW	1 no.

MACHINIST (OF)

150.	Surface Grinding Machine with minimum specification as:	Grinding machine plain surface, wheel dia. 175 mm (or near) with reciprocating table having longitudinal table traverse 200 mm (or near) fully automatic and fitted with adjustable traverse stops, machine to be fully motorized and fitted with ace guards and pumps, tank and pump fittings and also to be supplied with magnetic chuck 250 x 112 mm. Diamond tool holder, set of spanners, grease gun, oil-can and spare grinding wheel for general purpose grinding, Motor Capacity - 3.0 KW	1 no.
151.	Cylindrical grinder	Max. grinding length – 300 mm Height of centre – 130 mm Max. distance between centers – 340 mm	1 no.
152.	CNC lathe/CNC turn Centre	[specification as per Annex-A & A (I)]	As per Annex-A & A (I)
153.	CNC Vertical Machining Centre	[specification as per Annex-A &A (II)]	As per Annex-A &A (II)
154.	a) Simulator b) Desktop Computers	[specification as per Annex-A &A (II)]	As per Annex-A &A (II)
155.	CNC milling tools	[specification as per Annex-A &A (II)]	As per Annex-A &A (II)
156.	CNC hole machining tools	[specification as per Annex-A &A (II)]	As per Annex-A &A (II)
157.	LCD projector/ large screen TV		1 no.

NOTE:

1. All tools must be hardened, toughened and grounded.
2. Institute having centralized computer lab may use the existing infrastructure to impart simulation training.
3. Internet facility is desired to be provided in the class room.

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						
S.N.	**Name of Item**	**Category**	**Quantity**		**Unit**	**Remark**
			4 (2+2) units & Above	**Below 4 (2+2) units**		
1	CNC turn Centre [specification as per Annex-A (I)]	Machine	1	NIL	No.	Refer Instructions
2	CNC Vertical Machining Centre [specification as per Annex-A (II)]	Machine	1	NIL	No.	Refer Instructions
3	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	
4	Desktop Computers compatible to run simulation software with LAN facility	Machine	10	10	No.	
5	Printer - (Laser/ Inkjet)	Machine	1	1	No.	Optional
6	Air Conditioner - Split - 2.0 Ton	Machine	1	1	No.	Optional

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7	UPS - 2 KVA	Machine	1	1	No.	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 net weight	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	Ty^eo^{u} 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 output	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	As required	
	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**
a)	External turning holder, insert type, MWLNL	2	4	WNMG	20	40
b)	External turning holder, insert type, MVJNL	2	4	VNMG	10	20
c)	External turning holder, insert type, PDJNR	2	4	DNMG	10	20
d)	Threading Holder - External, LH	2	4	0.5 to 2	10	30
e)	Threading Holder - Internal, LH	2	4	0.5 to 2	10	30
f)	Grooving Holder External, LH	2	4	3 mm	10	30
g)	Grooving Holder Internal, LH	2	4	3 mm	10	30
h)	Parting off Holder for insert width 2 mm, LH	2	4	2 mm	10	30
i)	Boring holder SCLCL for minimum bore dia. 12 mm	2	4	WCMT	20	60
j)	Boring holder SCLCL for minimum bore dia. 16 mm	2	4	CCMT	20	60
k)	Internal grooving holder LH, for minimum bore dia. 12 mm.	2	4	2 mm	10	30

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l)	Internal threading holder LH, for minimum bore dia. 12 mm	2	4	w mm	10	30
m)	Insert drill 12.7 mm	2	4	Suitable	10 sets	30 sets
n)	Reducing sleeves for internal holders - Dia 12 and 16 mm	1 set	2 sets			
o)	Centre drill HSS A 2.5 x 6.3	2	6			
p)	Twist drill HSS straight shank, dia 6,8,10,12 mm	2 Sets	6 sets			
q)	Collets suitable for the above drills	1 Set	2 sets			
r)	Collet Holder	2	4			
s)	Boring bar holder	3	3			

ANNEXURE-A (II)

Detailed specification for CNC Vertical Machining Centre			
1.	**MACHINE CAPACITY**	**Units**	**Size**
a	Table size	mm	500x250 or higher
b	Max. load on table	Kg	150 or higher
c	T slot dimension (N x W x P)	mm	3 x 14 x 100 or higher
d	Table height from floor	mm	800 ~ 900
e	Cast Iron grade for bed and saddle		Grade 25 or equivalent
f	Machine net weight	kg	1500 or higher
2.	**SPINDLE**		
a	Spindle nose		BT30 / BT40
b	Minimum distance (spindle nose to table)	mm	100 - 150
d	Maximum spindle speed	RPM	6000 or higher
e	Spindle power, continuous	kW	3.7 or higher
f	Type of drive		AC servo spindle motor (digital)
g	Spindle bearing class		P4
h	Front Bearing Dia. (ID)	mm	50 or higher
3.	**AXES**		
a	X - axis Travel	mm	300 or higher
b	Y - axis Travel	mm	250 or higher
c	Z - axis Travel	mm	250 or higher
d	Rapid traverse - X/Y/Z	m/min	20/20/20 or higher
e	Minimum programmable command- X/Y/ Z	mm	0.001
f	Programmable feed range - X, Y & Z axes	mm/min	10 - 10000
g	Type of drive		AC servo motor
h	Motor Torque - X & Y axes	Nm	3 or higher
i	Motor torque - Z axis	Nm	6 or higher with brake
j	Ball screw - X, Y & Z axes (diameter x pitch)	mm	25 x 10 or higher
k	Ball screw finish - X, Y & Z axes		Ground and hardened
l	Ball screw class - X, Y & Z axes		Pre-loaded with C3 or better
m	Guideways - X, Y & Z axes		Antifriction linear motion guideway
n	Guideways size - X, Y & Z axes	mm	25 or higher
o	Guideway precision - X, Y, & Z axes		P Class
4.	**AUTOMATIC TOOL CHANGER**		
a	Number of tool pockets	Nos	8 or higher
b	Max tool diameter	mm	80 or higher
c	Tool selection		Bi-directional

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d	Tool shank type	BT30 / BT40	
e	Tool weight max	kg	2.5 for BT30 / 6 for BT40
f	Tool length max	mm	100 ~150 for BT30 / 150~200 for BT40
g	Tool change time (chip to chip)	sec	5 or lower
h	Tool clamp & unclamp	Disc Spring & Hydro-Pneumatic	
5.	**ACCURACY as per ISO 230-2**		
a	Positioning accuracy for X,Y& Z axes	mm	0.012
b	Repeatability for X,Y& Z axes	mm	±0.007
c	Geometrical Alignment		ISO 10791-Part 1
d	Accuracy of finish test piece		ISO 10791-Part 7
6.	**CNC SYSTEM**		
a	Control System	FANUC/Siemens	
b	Motors & Drives	Compatible with CNC controllers as mentioned above	
c	System resolution	0.001 mm	
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	
7.	**COOLANT/LUBRICATION**		
a	Coolant tank Capacity	Litres	100 or higher
b	Coolant pump motor	kW	0.37
c	Coolant pump output	lpm	20 or higher
d	Lubrication type		Automatic centralized lubrication
e	Lubrication tank capacity	Litres	3 or higher
8.	**AIR COMPRESSOR FOR TOOL UNCLAMP**		
a	Compressor Type		Screw type with dryer, filter & air receiver
b	Tank capacity	litres	200 or higher
c	Air Flow	CFM	10 or higher
d	Pressure	bar	7 max.
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.	
c	Backup CD for PLC Ladder Logic	1 no.	
d	Machine lightning	1 no.	
e	Leveling pads and jacking screws	4 nos.	
f	Operation manual	1 no.	
g	Maintenance manual	1 no.	
h	Installation kit	1 no.	
i	Maintenance tool kit	1 no.	
j	6 rack tool trolley (Size 25"x22"x45") with lock	1 no.	
h	Machine guarding with safety compliance	1 no.	
11.	**MAKES OF CRITICAL COMPONENTS**		
a	LM guideways	HIWIN/THK/PMI/STAR	
b	Ball Screws	HIWIN/THK/TSUBAKI/PMI/STAR/HMT/NSK	
c	Spindle Bearings	RHP/NSK/FAG/SKF/NRB	
d	ATC	PRAGATI/GIFU	
e	Panel AC	WERNER FINLEY/RITTAL/LEXTECNOID	
f	Stabilizer	NEEL/SE RVOMAX/CONSUL/FARMAX	
g	Lubrication	CENLUBE/DROPCO	
h	Coolant Pump	RAJAMANE/GRU NDFOS	
i	Cutting tools and holders	SANDVIK/TAEGUTEC/KEN NAMETAL/SECO/MITSUBISHI	
j	Air compressor (capacity: 6 kg/cm2 - 300 lpm min.)	GODREJ/ELGI/KAESER/ATLASCOPCO	

12.	**Cutting Tools & Tool Holders (for BT30 or BT40 as per machine supplied)**					
S No.	**Item**	**Quantity**		**Inserts**	**Quantity**	
		1 year	**3 years**		**1 year**	**3yrs**
a.	Face mill 45 degree 63 mm., insert type	2	4	Suitable inserts	5 sets	15
b.	Face mill square shoulder 50 mm., insert type	2	4	Suitable inserts	5 sets	15
c.	Twist drill HSS straight shank 6, 6.7, 8.5, 9.7	2	4		20	60
d.	Spot drill Carbide, dia. 8 mm X 90°	2	4		20	60
e.	Drill insert type - 16 mm.	2	4	Suitable inserts	10	30
f.	Solid carbide Twist drill straight shank - 8 mm	2	4			
g.	Solid carbide End mill straight shank - 10, 12 mm dia.	2	4			
h.	End mill insert type straight shank - 16 mm dia.	2	4	Suitable inserts	10	30

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i.	Machine Taps HSS - M8, M10	2	4		10	30
j.	Solid carbide Reamer straight shank - 10 mm	2	4		10	30
k.	Finish boring bar dia. 20 to 25 mm	1	3	Suitable inserts	10	30
l.	Holder for face mills (Adapter)	2	4		20	60
m.	Collets for above drills, reamers, end mills	2 sets	4 sets			
n.	Collet holder suitable for collets	4	4			
o.	Side lock holder for 16 mm insert drill	1	2			
p.	Machine vice 0-150 mm range - Mechanical type	1	1			
q.	C spanner for tightening tools in holder	1	2			
r.	Magnetic dial stand	1	2			
s.	Mallet	2	4			
t.	Tap wrench	1	2			
u.	Hands tools set (spanners, Allen keys, etc.)	1 box				
v.	T Nuts, Strap clamps, Clamping Nuts and studs	1 set				
w.	Tap wrench	1	2			
x.	Hands tools set (spanners, Allen keys, etc.)	1 box				
y.	T Nuts, Strap clamps, Clamping Nuts and studs	1 set				

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