



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

COMPETENCY BASED CURRICULUM

TURNER

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 5



SECTOR –CAPITAL GOODS AND MANUFACTURING



Directorate General of Training

TURNER

(Engineering Trade)

(Revised in 2019)

Version: 1.2

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 5

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

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SYLLABUS FOR TURNER TRADE			
FIRST YEAR			
Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 175 Hrs.;	Plan and organize the work to make job as per specification applying different types of basic fitting operations & check for dimensional accuracy following safety precautions. <i>[Basic Fitting Operation – Marking, Hack sawing, filing, drilling, tapping etc.]</i>	1. Importance of trade training, List of tools & Machinery used in the trade. (1 hr.)	All necessary guidance to be provided to the newcomers 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. (07 Hrs.)
Professional Knowledge 49 Hrs.		2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (5 hrs.) 3. First Aid Method and basic training. (2 hrs.) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (2 hrs.) 5. Hazard identification and avoidance. (2 hrs.) 6. Safety signs for Danger, Warning, caution & personal safety message. (1 hr.) 7. Preventive measures for electrical accidents & steps to be taken in such accidents. (2 hrs.) 8. Use of Fire extinguishers. (7 hrs.) 9. Practice and understand precautions to be followed while working in fitting jobs.	

		(2 hrs.) 10. Safe use of tools and equipments used in the trade. (1 hr.)	
		11. Identification of tools & equipments as per desired specifications for marking & sawing (Hand tools, Fitting tools & Measuring tools) (2 hrs.) 12. Selection of material as per application Visual inspection of raw material for rusting, scaling, corrosion etc. (1 hr.) 13. Marking out lines, gripping suitably in vice jaws, hack sawing to given dimensions, sawing different types of metals of different sections. (16 hrs.) 14. Practice on hammering, marking out, chipping, chisel grinding. (6 hrs.)	Measurement, line standard and end standard, steel rule-different types, graduation and limitation. Hammer and chisel-materials, types and uses. Prick punch and scriber. (07 Hrs.)
		15. Filing practice on plain surfaces, right angle by filing. (45 hrs.) 16. Use of calipers and scale measurement. (5 hrs.)	Vice – types and uses, Files-different types of uses, cut, grade, shape, materials etc. Try square-different types, parts, material used etc. Calipers-types and uses (firm joint). (14Hrs.)
		17. Filing at right angle, marking & hack sawing. (25 hrs.)	Vee – block, scribing block, straight edge and its uses. Hacksaw-their types & uses. (07 Hrs.)
		18. Marking operation on flat & round job. (10 hrs.) 19. Drilling operation: Drill on flat, square bar and round	Center punch- materials, construction & material uses. Drill machine-different parts. Hacksaw blades- sizes, different

		bar of different material (Sensitive drill machine). (15 hrs.)	Parts. Hacksaw blades-sizes, different pitch for different materials. Nomenclature of drill. (07 Hrs.)
		20. Different threading (BSW, BSP, BA, Metric, UNC, UNF) with the help of taps and dies both external & internal (including pipes) using collet chuck. (19 hrs.) 21. Extraction of broken tap. (6 hrs.)	Surface plate its necessity and use. Tap - different types (Taper 2 nd and bottoming) care while tapping. Dies different types and uses. Calculation involved to find Out drill size (Metric and Inch). (07 Hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.	Set different shaped jobs on different chuck and demonstrate conventional lathe machine operation observing standard operation practice. <i>[Different chucks: - 3 jaws & 4 jaws, different shaped jobs: - round, hexagonal, square]</i>	22. Identify & function of different parts of lathe. Practice on operation of lathe (dry/idle run). (20 hrs.) 23. Setting lathe on different speed and feed. (5 hrs.)	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. (07 Hrs.)
		24. Mounting of chuck on machine spindle and unloading –3-jaw chuck & 4-jaw chuck. (15 hrs.) 25. Setting practice on round & square/ hexagonal bar. (3 hrs.) 26. Dismantling and assembling of 3 jaw and 4 jaw chucks. (7 hrs.)	Classification of lathe in Function and construction of different parts of Lathe. (07 Hrs.)
Professional Skill 250Hrs.; Professional Knowledge 70Hrs.	Prepare different cutting tool to produce jobs to appropriate accuracy by performing	27. Turning of round stock and square/hexagonal as per availability on 4-jaw independent chuck. (15hrs.) 28. Turning of round stock on 3-jaw self centering chuck.	Types of lathe drivers, merit and demerit. Description in details-head stock- cone pulley type- all geared type-construction & function. Tumbler gear set.

<p>different turning operations. <i>[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.</i></p>	(10hrs.)	Reducing speed-necessary & uses. Back Gear Unit –its construction use. (07Hrs.)
	29. Grinding of R.H. and L.H., V-tool, side cutting tools, parting tool. (15 hrs.)	Lathe cutting tool-different types, shapes and different angles (clearances and rake), specification of lathe tools. (07 Hrs.)
	30. Checking of angles with angle gauge / bevel protractor. (1 hr.)	
	31. Grinding of “V” tools for threading of Metric 60-degree threads. (9 hrs.)	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. (07Hrs.)
	32. Facing operation to correct length (10hrs.)	
	33. Centre drilling and drilling operation to required size. (05hrs.)	
34. Make square block by turning using 4-jaw chuck and perform drilling, boring and grooving operation. (10hrs.)	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. (14 Hrs.)	
35. Parallel turning, step turning, parting, grooving, chamfering practice. (48 hrs.)		
36. Measurement with scale and outside caliper to ± 0.5 mm. accuracy. (2 hrs.)	Different types of micrometer, Outside micrometer. Vernier scale graduation and reading. Sources of error with	
37. Step turning within ± 0.06 mm with different shoulder, U/cut on outside diameter. (15 hrs.)		

		38. Drilling on Lathe-step drilling, drill grinding practice. (10 hrs.)	micrometer & how to avoid them. Use of digital measuring instruments. (07Hrs.)
		39. Boring practice-Plain. Counter& step, internal recessing. (20 hrs.) 40. Reaming in lathe using solid and adjustable reamer. (15 hrs.) 41. Make bore by trepanning (10 hrs.) 42. Drill grinding. (5 hrs.)	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. (14 Hrs.)
		43. Turning practice-between centres on mandrel (Gear blanks). (20 hrs.) 44. Fitting of dissimilar materials- M.S. in brass, aluminium, in cast iron etc. (20 hrs.) 45. Knurling practice in lathe (Diamond, straight, helical & square). (10 hrs.)	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. (14 Hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Test the alignment of lathe by checking different parameters and adjust the tool post. <i>[Different parameters – Axial slip of main spindle, true running of head stock, parallelism of main</i>	46. 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. (20 hrs.) 47. Adjustment of tool post. (3 hrs.) 48. Mounting job in between	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. (07 Hrs.)

	<i>spindle, alignment of both the centres.]</i>	centres. (2 hrs.)	
Professional Skill 75 Hrs.;	Set different components of machine & parameters to produce taper/angular components and ensure proper assembly of the components. <i>[Different component of machine: - Form tool, Compound slide, tail stock offset, taper turning attachment. Different machine parameters- Feed, speed, depth of cut.]</i>	49. Make taper turning by form tool and compound slide swivelling. (25 hrs.)	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. (07 Hrs.)
Professional Knowledge 21 Hrs.		50. Male and female taper turning by taper turning attachment, offsetting tail stock. (22 hrs.)	Bevel protector & Vernier bevel protractor-its function & reading.
		51. Matching by Prussian Blue. (2 hrs.) 52. Checking taper by bevel protector and sine bar. (1 hr.) 53. Make MT3 lathe dead centre and check with female part. (Proof machining) (25 hrs.)	Method of taper angle measurement. Sine bar-types and use. Slip gauges-types, uses and selection. (14 Hrs.)
Professional Skill 75 Hrs.;	Set the different machining parameter & tools to prepare job by performing different boring operations. <i>[Different machine parameter- Feed, speed & depth of cut; Different boring operation – Plain, stepped & eccentric]</i>	54. Turning and boring practice on CI (preferable) or steel. (23 hrs.)	Method of brazing solder, flux used for tip tools.
Professional Knowledge 21 Hrs.		55. Tip brazing on shank. (2 hrs.)	Basic process of soldering, welding and brazing. (07 Hrs.)
		56. Eccentric marking practice. (2 hrs.)	Vernier height gauge, function, description & uses, templates-its function and construction.
		57. Perform eccentric turning. (18 hrs.) 58. Use of Vernier height Gauge and V-block. (1 hr.) 59. Perform eccentric boring. (18 hrs.) 60. Make a simple eccentric with dia. of 22mm and throw/offset of 5mm. (11	Screw thread-definition, purpose & its different elements. Driving plate and lathe carrier and their usage. Fundamentals of thread cutting on lathe. Combination set-square head. Center head, protractor head-

		hrs.)	its function construction and uses. (14 Hrs.)
Professional Skill 250Hrs.;	Set the different machining parameters to produce different threaded components applying method/ technique and test for proper assembly of the components. <i>[Different thread: - BSW, Metric, Square, ACME, Buttress.]</i>	61. Screw thread cutting (B.S.W) external (including angular approach method) R/H & L/H, checking of thread by using screw thread gauge and thread plug gauge. (16hrs.)	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 threads. Calculation involved in finding core dia., gear train (simple gearing) calculation. Calculations involving driver-driven, lead screw pitch and thread to be cut. (14Hrs.)
Professional Knowledge 70Hrs.		62. Screw thread cutting (B.S.W) internal R/H & L/H, checking of thread by using screw thread gauge and thread ring gauge. (16hrs.)	
		63. Fitting of male & female threaded components (BSW) (4hrs.)	
		64. Prepare stud with nut (standard size). (14hrs.)	
		65. Grinding of "V" tools for threading of Metric 60-degree threads and check with gauge. (3 hrs.)	Thread chasing dial function, construction and use. Calculation involving pitch related to ISO profile.
		66. Screw thread cutting (External) metric thread-tool grinding. (15 hrs.)	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. (14Hrs.)
		67. Screw thread (Internal) metric & threading tool grinding. (16 hrs.)	
		68. Fitting of male and female thread components (Metric) (2 hrs.)	
		69. Make hexagonal bolt and nut (metric) and assemble. (14 hrs.)	
		70. Cutting metric threads on inch lead screw and inch threads on Metric Lead Screw. (25 hrs.)	Calculation involving gear ratios metric threads cutting on inch L/S Lathe and vice-versa. (07 Hrs.)

		71. Practice of negative rake tool on non-ferrous metal and thread cutting along with fitting with ferrous metal. (25 hrs.)	Tool life, negative top rake-its application and performance with respect to positive top rake (07 Hrs.)
		72. Cutting Square thread (External) (16 hrs.) 73. Cutting Square thread (Internal). (18 hrs.) 74. Fitting of male and female Square threaded components. (2 hrs.) 75. Tool grinding for Square thread (both External & Internal). (2 hrs.) 76. Make square thread for screw jack (standard) for minimum 100mm length bar. (12 hrs.)	Calculation involving tool Thickness, core dia., pitch proportion, depth of cut etc. of sq. thread. (14 Hrs.)
		77. Acme threads cutting (male & female) & tool grinding. (08 hrs.) 78. Fitting of male and female threaded components.(7 hrs.) 79. Cut Acme thread over 25 mm dia. rod and within length of 100mm. (10 hrs.)	Calculation involved – depth, core dia., pitch proportion etc. of Acme thread. Calculation involved depth, core dia., pitch proportion, use of buttress thread. (07 Hrs.)
		80. Buttress threads cutting (male & female) & tool grinding. (13hrs.) 81. Fitting of male & female threaded components. (2 hrs.) 82. Make carpentry vice lead screw.(10hrs.)	Buttress thread cutting (male & female) & tool grinding(07Hrs.)
Professional	Set the different machining	83. Make job using different lathe accessories viz.,	Different lathe accessories, their use and care. (14 Hrs.)

<p>Skill 50 Hrs.; Professional Knowledge 14 Hrs.</p>	<p>parameter & lathe accessories to produce components applying techniques and rules and check the accuracy. <i>[Different machining parameters: - Speed, feed & depth of cut; Different lathe accessories: - Driving Plate, Steady rest, dog carrier and different centres.]</i></p>	<p>driving plate, steady rest, dog carrier and different centres. (30hrs.) 84. Make test mandrel (L=200mm) and counter bore at the end. (20 hrs.)</p>	
<p>Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.</p>	<p>Plan and perform basic maintenance of lathe & grinding machine and examine their functionality.</p>	<p>85. Balancing, mounting & dressing of grinding wheel (Pedestal). (10hrs.) 86. Periodical lubrication procedure on lathe. (20 hrs.) 87. Preventive maintenance of lathe. (20 hrs.)</p>	<p>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. (14 Hrs.)</p>
<p>In-plant training / Project work Broad area:</p> <ul style="list-style-type: none"> a) Drill extension socket b) conical brush c) V-belt pulley d) Tail Stock Centre (MT – 3) e) Taper ring gauge f) Sprocket g) Socket spanner 			

SYLLABUS FOR TURNER TRADE

SECOND YEAR

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 125 Hrs.; Professional Knowledge 45Hrs.	Plan & set the machine parameter to produce precision engineering component to appropriate accuracy by performing different turning operation. <i>[Appropriate accuracy - $\pm 0.02\text{mm}/(MT - 3)$ (proof turning); Different turning operation – Plain turning, taper turning, boring, threading, knurling, grooving, chamfering etc.]</i>	88. Form turning practice by hand. (8 hrs.)	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 (09 hrs.)
		89. Re-sharpening of form tools using bench grinder. (2 hrs.)	
		90. Tool machine handle turning by combination feed. (15 hrs.)	
		91. Turn Morse taper plug (different number) and check with ring gauge / suitable MT sleeve. (25 hrs.)	
		92. Make revolving tail stock centre- Bush type (C-40). (Proof machining) (25 hrs.)	Cutting tool material-H.C.S., HSS, Tungsten. Carbide, Ceramic etc, - Constituents and their percentage. Tool life, quality of a cutting material. (18 hrs.)
		93. Make Morse taper sleeve and check by taper plug gauge. (25 hrs.)	Checking of taper with sin bar and roller-calculation involved (09 hrs.)
		94. Make mandrel/ plug gauge with an accuracy of $\pm 0.02\text{mm}$ using tungsten carbide tools including throw-away tips. (25 hrs.)	Cutting speed, feed, turning time, depth of cut calculation, cutting speed chart (tungsten carbide tool) etc. Basic classification of tungsten carbide tips. (09 hrs.)

Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Set & Produce components on irregular shaped job using different lathe accessories. <i>[Different Lathe accessories: - Face plate, angle plate]</i>	95. Setting and turning operation involving face and angle plate (25 hrs.) 96. Make angle plate using face plate. (25 hrs.)	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. (18 hrs.)
Professional Skill 125 Hrs.; Professional Knowledge 45 Hrs.	Plan and set the machine using lathe attachment to produce different utility component/ item as per drawing. <i>[Different utility component/ item – Crank shaft (single throw), stub arbour with accessories etc.]</i>	97. Holding and truing of Crankshaft – single throw (Desirable). (50 hrs.)	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. (18 hrs.)
		98. Turning of long shaft using steady rest (within 0.1 mm). (25 hrs.)	Roller and revolving steadies, Necessary, construction, uses etc. (09 hrs.)
		99. Use of attachments on lathe for different operations. (25 hrs.) 100. Turning standard stub arbor with accessories collar, tie rod, lock nut. (25 hrs.)	Different types of attachments used in lathe. Various procedures of thread measurement thread screw pitch gauge. Screw thread micrometer, microscope etc. (18 hrs.)
Professional Skill 100 Hrs.; Professional Knowledge 36 Hrs.	Set the machining parameters and produce & assemble components by performing different boring operations with an appropriate accuracy. <i>[Different</i>	101. Perform eccentric boring and make male & female eccentric fitting. (15 hrs.)	Tool maker’s button and its parts, construction and uses, telescopic gauge its construction and uses. (09 hrs.)
		102. Position boring using tool maker’s button. (10 hrs.)	
		103. Boring and stepped boring (within ± 0.05 mm) (15 hrs.) 104. Cutting of helical grooves in bearing and bushes (Oil	Inside micrometer principle, construction graduation, reading, use etc. (Metric & Inch.) (09 hrs.)

	<i>boring operation – eccentric boring, stepped boring; appropriate accuracy – ±0.05mm]</i>	groove) (10 hrs.)	
		105. Turning & boring of split bearing – (using boring bar and fixture)(50 hrs.)	Care for holding split bearing. Fixture and its use in turning. (18 hrs.)
Professional Skill 125 Hrs.;	Calculate to set machine setting to produce different complex threaded component and check for functionality. <i>[Different complex threaded component- Half nut, multi start threads (BSW, Metric & Square)]</i>	106. Cutting thread of 8 and 11 TPI. (25 hrs.)	Calculation involving fractional threads. Odd & even threads. (09 hrs.)
Professional Knowledge 45 Hrs.		107. Multi start thread cutting (B.S.W.) external & internal. (25 hrs.)	Multiple thread function, use, different between pitch & lead, formulate to find out start, pitch, lead. Gear ratio etc. (09 hrs.)
		108. Multi start thread cutting (Metric) (External & internal). (25 hrs.)	Indexing of start - different methods tool shape for multi-start thread. Setting of a lathe calculation for required change wheel (09 hrs.)
		109. Multi-start thread cutting, square form (Male & Female). (25 hrs.)	Calculation involving shape of tool, change wheel, core dia etc. Calculation involving shape, size pitch, core dia. Etc. (09 hrs.)
		110. Make half nut as per standard lead screw. (25 hrs.)	Helix angle, leading angle & following angles. Thread dimensions-tool shape, gear, gear calculation, pitch, depth, lead etc. (09 hrs.)
Professional Skill 250Hrs.;	Set (both job and tool) CNC turn centre and produce components as per drawing by preparing part programme.	111. Personal and CNC machine Safety: Safe handling of tools, equipment and CNC machine. (2 hrs.)	CNC technology basics: Difference between CNC and conventional lathes. Advantages and disadvantages of CNC machines over conventional machines. Machine model, control system and specification.
Professional Knowledge 90Hrs.		112. Identify CNC machine, CNC console. (5 hrs.)	
		113. Demonstration of CNC lathe machine and its parts - bed, spindle motor and	

		<p>drive, chuck, tailstock, turret, axes motor and ball screws, guide ways, LM guides, console, control switches, coolant system, hydraulic system, chip conveyor, steady rest. (10 hrs.)</p> <p>114. Working of parts explained using Multimedia based simulator for CNC parts shown on machine. (6 hrs.)</p> <p>115. Identify machine over travel limits and emergency stop. (2 hrs.)</p>	<p>Axes convention of CNC machine - Machine axes identification for CNC turn centre.</p> <p>Importance of feedback devices for CNC control.</p> <p>Concept of Co-ordinate geometry, concept of machine axis. (09 hrs.)</p>
		<p>116. 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. (2 hrs.)</p> <p>117. Identification of safety switches and interlocking of DIH modes. (1 hr.)</p> <p>118. Machine starting & operating in Reference Point, JOG and Incremental Modes. (10hrs.)</p> <p>119. Check CNC part programming with simple exercises and using various programming codes and words. (09hrs.)</p> <p>120. Check the programme</p>	<p>Programming – sequence, formats, different codes and words.</p> <p>Co-ordinate system points and simulations.</p> <p>Workpiece zero points and ISO/DIN G and M codes for CNC.</p> <p>Different types of programming techniques of CNC machine.</p> <p>Describe the stock removal cycle in CNC turning for OD / ID operation.</p> <p>L/H and R/H tool relation on speed.</p> <p>Describe CNC interpolation, open and close loop control systems. Co-ordinate systems and Points.</p> <p>Program execution in different modes like manual, single block and auto.</p>

		<p>simulation on machine OR practice in simulation software in respective control system. (09hrs.)</p> <p>121. Absolute and incremental programming assignments and simulations. (09hrs.)</p> <p>122. Linear interpolation, and Circular interpolation assignments and simulations on software. (10hrs.)</p>	<p>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. Process planning & sequencing, tool layout & selection and cutting parameters selection. Tool path study of machining operations Prepare various programs as per drawing. (18hrs.)</p>
		<p>123. Perform Work and tool setting: - Job zero/work coordinate system and tool setup and live tool setup. (15hrs.)</p> <p>124. Carryout jaw adjustment according to Diameter and tooling setup on Turret. (15hrs.)</p> <p>125. CNC turning centre operation in various modes: JOG, EDIT, MDI, SINGLE BLOCK, AUTO. (15hrs.)</p> <p>126. Program entry. (2hrs.)</p> <p>127. Set the tool offsets, entry of tool nose radius and orientation. (15hrs.)</p> <p>128. Conduct work off set measurement, Tool off set measurement and entry in</p>	<p>Tool Nose Radius Compensation (G41/42) and its importance (TNRC). Cutting tool materials, cutting tool geometry – insert types, holder types, insert cutting edge geometry.</p> <ul style="list-style-type: none"> - 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

		<p>CNC Control. (10hrs.)</p> <p>129. Make Tool nose radius and tool orientation entry in CNC control. (8hrs.)</p> <p>130. Jaw removal and mounting on CNC Lathe. (8hrs.)</p> <p>131. Manual Data Input (MDI) and MPG mode operations and checking of zero offsets and tool offsets. (12hrs.)</p>	<p>grooving, threading, drilling. (36 hrs.)</p>
		<p>132. Program checking in dry run, single block modes. (6 hrs.)</p> <p>133. Checking finish size by oversizing through tool offsets. (9 hrs.)</p> <p>134. Part program preparation, Simulation & Automatic Mode Execution for the exercise on Simple turning & Facing (step turning) (10 hrs.)</p> <p>135. Part program preparation, Simulation & Automatic Mode Execution for the exercise on Turning with Radius / chamfer with TNRC. (10 hrs.)</p> <p>136. Part program preparation, Simulation & Automatic Mode Execution of CNC Machine for the exercise on Blueprint programming contours with TNRC. (10 hrs.)</p> <p>137. Machining parts on CNC lathe with parallel, taper, step, radius turning,</p>	<p>Prepare various part programs as per drawing & check using CNC simulator.</p> <p>Processes and Tool selection related to grooving, drilling, boring & threading. (27 hrs.)</p>

		<p>grooving & threading. (15 hrs.)</p> <p>138. Carryout Drilling /Boring cycles in CNC Turning. (15 hrs.) <i>(First 60 % of the practice is on CNC machine simulator, followed by 40 % on machine.)</i></p>	
		<p>139. Geometry Wear Correction. Geometry and wear offset correction. (10 hrs.)</p> <p>140. Produce components on CNC Machine involving different turning operations viz.,</p> <ul style="list-style-type: none"> • Stock removal cycle OD • Drilling / boring cycles • Stock removal cycle ID • Carryout threading in different pitches. (18 hrs.) <p>141. Produce components by involving turning operation and part programme exercises of CNC turning viz.,</p> <ul style="list-style-type: none"> • Grooving and thread cutting OD • Grooving and thread cutting ID • Threading cycle OD • Sub programs with repetition • Using Sub Programs & Cycles in the Main Program. (18 hrs.) 	<ul style="list-style-type: none"> - Describe Tapping on CNC turning. - Programming for Grooving/Threading on OD/ID in CNC Turning. - Trouble shooting in CNC lathe machine - Identify Factors affecting turned part quality/productivity. - Parting off operation explanation. - Bar feeding system through bar feeder. - Input and Output of Data. - DNC system. Interlacing with PC. - Use of CAM Programme. (Optional) (27 hrs.)

		<p>142. Part off: Part Prog. (4 hrs.)</p> <p>143. Produce job involving profile turning, threading on taper, boring, etc. operations. (22 hrs.)</p> <p>144. Demo on M/C on bar feeding system. (simulation/ video) (1 hr.)</p> <p>145. DNC system setup. (Optional)</p> <p>146. Run the machine on DNC mode.(Optional)</p> <p>147. CAM programme execution. (Optional)</p> <p>148. Data Input-Output on CNC machine. (2 hrs.)</p>	
Professional Skill 100 Hrs.;	<p>Manufacture and assemble components to produce utility items by performing different operations & observing principle of interchangeability and check functionality.</p> <p><i>[Utility item: - screw jack/ vice spindle/ Box nut, marking block, drill chuck, collet chuck etc.; different operations: - threading (Square, BSW, ACME, Metric), Thread on</i></p>	149. Thread on taper surface (Vee form). (50 hrs.)	<p>Setting of tools for taper threads-calculation of taper setting and thread depth.</p> <p>Heat treatment – meaning & procedure hardening, tempering, carbonizing etc.</p> <p>Different types of metal used in engineering application. (18 hrs.)</p>
Professional Knowledge 36 Hrs.		150. Manufacturing & Assembly of Screw jack/vice/Box nut by performing different lathe operation. (To use earlier produce screw jack). (25 hrs.)	Interchangeability meaning, procedure for adoption, quality control procedure for quality production. (09hrs.)
		151. Prepare different types of documentation as per industrial need by different methods of recording information. (4 hrs.)	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
		152. Turn Bevel gear blank. (21	

	<i>taper, different boring (Plain, stepped)]</i>	hrs.)	time, productivity reports, job cards. (09 hrs.)
Professional Skill 125 Hrs.;	Make a process plan to produce components by performing special operations on lathe and check for accuracy. [Accuracy - $\pm 0.02\text{mm}$ or proof machining & $\pm 0.05\text{mm}$ bore; Special operation – Worm shaft cutting (shaft) boring, threading etc.]	153. Read a part drawing, make a process plan for turning operation and make arbor with clamping nut (hexagonal). (50hrs.)	Terms used in part drawings and interpretation of drawings – tolerances, geometrical symbols - cylindricity, parallelism. etc. (18 hrs.)
Professional Knowledge 45 Hrs.		154. Practice of special operations on lathes - worm gear cutting. (Shaft) (25 hrs.)	Automatic lathe-its main parts, types diff. Tools used-circular tool etc. (09 hrs.)
		155. Boring on lathe using soft jaws to make bush with collar (standard) on nonferrous metal and check with dial bore gauge to accuracy of ± 0.05 mm. (30hrs.)	Related theory and calculation. (18 hrs.)
		156. Make Arbor support bush. (Proof Machining) (20hrs.)	
In-plant training/ Project work (Any Project to be done on CNC machine)			
<ul style="list-style-type: none"> a) Taper Sunk b) Socket with Split Collet c) Screw Jack d) Spindle with Hub e) Morse Taper Eccentric f) Crank Shaft with Taper Sleeve 			

SYLLABUS FOR CORE SKILLS

1. Workshop Calculation & Science (Common for two years courses) (80Hrs. + 80 Hrs.)
2. Engineering Drawing (Common for Group-I (Mechanical Trade Group)) (80Hrs. + 80 Hrs.)
3. Employability Skills (Common for all CTS trades) (160Hrs. + 80 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in