

7. TRADE SYLLABUS

SYLLABUS FOR MACHINIST TRADE

FIRST YEAR

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 100 Hrs.; Professional Knowledge 20Hrs.	Plan and organize the work to make job as per specification applying different types of basic fitting operation and check for dimensional accuracy following safety precautions. [Basic fitting operation – marking, Hack sawing, Chiselling,	<ol style="list-style-type: none"> 1. Importance of trade training, List of tools & Machinery used in the trade.(02hr.) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (05hrs.) 3. First Aid Method and basic training.(03hrs.) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (02hrs.) 	<p>All necessary guidance to be provided to the newcomers to become familiar with the working of Industrial Training Institute system including store's procedures.</p> <p>Soft skills, its importance and job area after completion of training.</p> <p>Importance of safety and general precautions observed in the industry/shop floor.</p> <p>Introduction of first aid. Operation</p>

<p>Filing, Drilling, Taping and Grinding etc. Accuracy: $\pm 0.25\text{mm}$ CSC/N0304</p>	<p>5. Hazard identification and avoidance. (02hrs.)</p> <p>6. Identification of safety signs for Danger, Warning, caution & personal safety message.(02 hrs.)</p> <p>7. Preventive measures for electrical accidents & steps to be taken in such accidents.(03hrs.)</p> <p>8. Use of fire extinguishers.(04hrs.)</p> <p>9. Practice and understand precautions to be followed while working in fitting jobs. (02hrs.)</p> <p>10. Safe use of tools and equipments used in the trade. (02 hr)</p>	<p>of electrical mains and electrical safety. Introduction of PPEs.</p> <p>Response to emergencies e.g. power failure, fire, and system failure.</p> <p>Importance of housekeeping & good shop floor practices.</p> <p>Introduction to 5S concept & its application.</p> <p>Occupational Safety & Health: Health, Safety and Environment guidelines, legislations & regulations as applicable.</p> <p>Basic understanding on Hot work, confined space work and material handling equipment. (04 hrs.)</p>
	<p>11. Study the drawing to plan the job/ work. Identification of tools & equipments as per desired specifications for marking, filing & sawing. (03hrs.)</p> <p>12. Familiarisation of bench vice. (02 hr)</p> <p>13. Filing- Flat and square (Rough finish). (06 hrs.)</p> <p>14. Marking with scriber and steel rule.(03hrs.)</p> <p>15. Filing practice, surface filing, marking of straight and parallel lines with odd leg calipers and steel rule. (06hrs.)</p>	<p>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. (03hrs.)</p>
	<p>16. Marking out lines, gripping suitably in vice jaws, hack sawing to given dimensions.</p>	<p>Bench vice construction, types, uses, care & maintenance, vice clamps, hacksaw frames and</p>

		<p>(05hrs.) 17. Sawing different types of metals of different sections. (06hrs.) 18. Marking practice with dividers, odd leg callipers, scribe and steel rule (circles, arc, parallel lines). (06hrs.)</p>	<p>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) (04 hrs.)</p>
		<p>19. Grinding, centre punch, dot punch, chisel and scribe.(07hrs.) 20. Marking, filing, filing square and check using try-square. (10 hrs.)</p>	<p>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. (05 hrs)</p>
		<p>21. Marking according to drawing for locating, position of holes, scribing lines on chalked surfaces with marking tools. (04hrs.) 22. Finding centre of round bar with the help of 'V' block and marking block. (04hrs.) 23. Prepare mushroom head and round bar and bending metal plate by hammering. (05hrs.) 24. Marking using scale, surface gauge and angle plate. (06 hrs.)</p>	<p>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. (04 hrs.)</p>
<p>Professional Skill 39 Hrs; Professional Knowledge</p>	<p>Produce components by different operations and check accuracy using appropriate measuring</p>	<p>25. <i>Chipping flat surfaces along a marked line. (07hrs.)</i> 26. <i>Make a square from a round job by chipping upto 20mm length. (3 hrs)</i></p>	<p>Drill, Tap,Die-types & application. Determination of tap drill size. Basic terminology related to screw thread. Reamer- material, types (Hand</p>

<p>08 Hrs.</p>	<p>instruments. [Different Operations - Drilling, Reaming, Tapping, Dieing; Appropriate Measuring Instrument – Vernier, Screw Gauge, Micrometre] CSC/N9405</p>	<p>27. Slot straight and angular chipping. (2 hrs) 28. Mark off and drill through holes. (03hrs.) 29. Drill and tap on M.S. flat. (02hrs.) 30. Cutting external thread on M.S. rod using Die.(03hrs.) 31. Punch letter and number (letter punch and number punch). (03hrs.) 32. Counter sinking, counter boring and reaming with accuracy +/- 0.04 mm.(05 hrs.) 33. Drill blind holes with an accuracy 0.04 mm.(02 hrs.) 34. Form internal threads with taps to standard size (blind holes).(03 hrs.) 35. Prepare studs and bolt.(06hrs.)</p>	<p>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. (04 hrs.) 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. (04 hrs.)</p>
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<p>Professional Skill 90 Hrs.;</p> <p>Professional Knowledge 12 Hrs.</p>	<p>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.] CSC/N0304</p>	<p>36. Make Male & Female ‘T’ fitting with an accuracy ± 0.2 mm and 1 degree. (25hrs.)</p> <p>37. Make male female square fit with accuracy ± 0.1 mm. (25hrs.)</p> <p>38. Make Male & Female Hexagon fitting with accuracy ± 0.06 mm. (40 hrs.)</p>	<p>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) (06 hrs)</p> <p>Vernier calliper-its parts, principle, reading, uses & care.</p> <p>Outside micrometre- its parts, principle, reading, uses, Reading of Vernier Micrometre), care & maintenance.</p> <p>Dial test indicator-its parts, types, construction and uses. (06 hrs.)</p>
<p>Professional Skill 20 Hrs.;</p> <p>Professional Knowledge 05 Hrs.</p>	<p>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] CSC/N0110</p>	<p>39. Identify & function of different parts of lathe. Practice on operation of lathe (dry/idle run). (07 hrs.)</p> <p>40. Setting lathe on different speed and feed. (04 hrs.)</p> <p>41. Dismantling, assembling & truing of 3-jaw & 4-jaw chucks. (09hrs.)</p>	<p>Getting to know the lathe with its main components, lever positions and various lubrication points as well.</p> <p>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. (05 hrs.)</p>
<p>Professional Skill 112 Hrs.;</p> <p>Professional Knowledge</p>	<p>Prepare different cutting tool to produce jobs to appropriate accuracy by performing different turning</p>	<p>42. Grinding of R.H. and L.H. tools, V- tool, parting tool, Round nose tool. (15 hrs.)</p> <p>43. Checking of angles with angle gauge/ bevel protractor. (02</p>	<p>Lathe cutting tool-different types, material, shapes and different angles (clearance, rake etc.) and their effects, specification of lathe</p>

16 Hrs.	operations. <i>[Different cutting tool – V tool, side cutting, parting, thread cutting (both LH& RH), Appropriate accuracy: $\pm 0.06\text{mm}$, Different turning operation – Plain, facing, drilling, boring (counter & stepped), grooving, Parallel Turning, Step Turning, parting, chamfering, U-cut, Reaming, knurling.]</i> CSC/N0110	hrs.) 44. Grinding of “V” tools for threading of Metric 60-degree threads. (08 hrs.)	tools, grinding process of tools. Types of chips, chip breaker. Tool life, factors affecting tool life. (04 hrs.)
		45. Perform facing operation to correct length. (05 hrs.) 46. Centre drilling and drilling operation to required size. (05 hrs.) 47. Perform parallel turning and step turning operation. (12 hrs.)	Driving mechanism, speed and feed mechanism of Lathe. (03 hrs)
		48. Perform drilling, boring and undercut operation, parting, grooving, chamfering practice, Drilling and Boring in blind holes. (55 hrs.) 49. Measurement with steel rule and outside calliper with an accuracy of $\pm 0.5\text{ mm}$. (02 hrs.)	Concept of Orthogonal and Oblique Cutting. 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. (06hrs)
		50. Perform different Knurling operation in lathe with accuracy of $\pm 0.5\text{ mm}$ (8 hrs.)	Lathe operations-facing, turning, parting-off, grooving, chamfering, boring etc. Knurling-types, grade & its necessity. (03 hrs)
Professional Skill 45 Hrs.; Professional Knowledge 06 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</i>	51. Make taper turning by form tool with an accuracy of 1 degree. (05 hrs.) 52. Make taper turning by compound slide swivelling with an accuracy of ± 30 minute (15 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. (03 hrs.)
		53. Make taper by off-setting tailstock with an accuracy of ± 30 minute. (20hrs.) 54. Checking taper by Vernier	Calculations of taper turning by off-setting tail stock. Sine Bar – description & uses. Slip gauge –description and uses.

	<i>stock offset; Different machine parameters- Feed, speed, depth of cut.] CSC/N0110</i>	Bevel Protractor and sine bar & slip gauge. (05 hrs.)	(03 hrs.)
Professional Skill 40 Hrs.; Professional Knowledge 07 Hrs.	Set the different machining parameters to produce metric-v threaded components applying method/ technique and test for proper assembly of the components. CSC/N0110	55. Cutting V thread (external) in a lathe and check with Screw Pitch Gauge. (18 hrs.) 56. Cutting V thread (internal) in a lathe and check with Screw Pith Gauge. (19 hrs.) 57. Fitting of male & female threaded components. (03 hrs.)	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. (07hrs.)
Professional Skill 71 Hrs.; Professional Knowledge 15 Hrs.	Set the different machining parameters and cutting tool to prepare job by performing different slotting operation. <i>[Different machining parameters – feed, speed and depth of cut. Different slotting operations –concave & convex surface, internal key ways, profiling, making internal sprocket with an accuracy of +/- 0.04 mm] CSC/N9406</i>	58. Identification of slotting machine parts & its construction, use of rotary table. (10 hrs.) 59. Practice on slotting key ways on pulley with accuracy +/- 0.04 mm (15 hrs.)	Slotter– Classification, principle, construction, Safety precaution. Introduction and their indexing process on a Slotter by its Rotary table graduations. Driving mechanisms, quick return motion and speed ratio. Safety points to be observed while working on a Slotter. (06 hrs.)
		60. Slotting a double ended spanner with accuracy +/- 0.1 mm. (25 hrs.)	Job holding devices-vice, clamps, V-block, parallel block etc. Slotting tools- types, tool angles. (04 hrs)
		61. Cutting internal spline on slotting machine with accuracy +/-0.04 mm. (21 hrs.)	Spline – types and uses. Coolant & lubricant – Introduction, types, properties, application & applying methods. (05hrs)
Professional	Set the different	62. Identification of milling	Milling Machine: Introduction,

<p>Skill 138 Hrs.; Professional Knowledge 25 Hrs.</p>	<p>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] CSC/N9407</p>	<p>machine. (02 hrs.) 63. Demonstrate working principle of Milling Machine. (04hrs.) 64. Set vice & job on the table of Milling Machine. (04 hrs.) 65. Set arbor on the spindle of milling machine. (06hrs.) 66. Set the cutter on arbour. (04 hrs.) 67. Safety points to be observed while working on a milling machine. (02 hrs.)</p>	<p>types, parts, construction and specification. Driving and feed mechanism of Milling Machine. (04 hrs)</p>
		<p>68. Demonstrate Up Milling and Down Milling Process. (05hrs.) 69. Sequence of milling six faces of a solid block. (08 hrs.) 70. Check the accuracy with the help of try-square and Vernier height gauge. (02hrs.) 71. Perform Step milling using side and face cutter checking with depth micrometer. (05hrs.) 72. Perform slot milling using side and face cutter. (05hrs.)</p>	<p>Different types of milling cutters & their use. Cutter nomenclature. (03 hrs)</p>
		<p>73. Make “V” Block using Horizontal Milling Machine with accuracy +/-0.02 mm. (20hrs.)</p>	<p>Different milling operations - plain, face, angular, form, slot, gang and straddle milling etc. Up and down milling. (03 hrs)</p>
		<p>74. Make concave surfaces with an accuracy +/-0.02 mm. (03 hrs.) 75. Make convex surfaces with an accuracy +/-0.02 mm. (03 hrs.) 76. Straddle milling operation with an accuracy +/-0.02 mm. (07 hrs.) 77. Gang milling operation with an accuracy +/-0.02 mm. (07hrs.)</p>	<p>Different types of milling attachments and their uses. (03 hrs)</p>

		78. Make Dovetail fitting (male & female) on Milling Machine with an accuracy ± 0.02 mm. (12hrs.)	Jigs and Fixtures– Introduction, principle, types, use, advantages & disadvantages. (03 hrs)
		79. Make T-Slot fitting (male & female) on Milling Machine with an accuracy ± 0.02 mm. (18hrs.)	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. (05 hrs)
		80. Demonstrate indexing head. (04hrs.) 81. Set and align indexing head with reference to job on milling machine.(04hrs.) 82. Make square job by direct/simple indexing method with an accuracy ± 0.02 mm. (05hrs.) 83. Make hexagonal job by simple indexing method with an accuracy ± 0.02 mm. (08hrs.)	Indexing-introduction & types. Indexing head-types & constructional details, function of indexing plates and the sector arms. Calculation for direct and simple indexing. (04 hrs)
Professional Skill 60 Hrs.;	Set the different machining parameters to produce square & “V” threaded components applying method/ technique and test for proper assembly of the components. CSC/N0110	84. Checking of alignment of lathe centres and their adjustments. (03 hrs.)	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. (04 hrs)
Professional Knowledge 13 Hrs.		85. Turning practice-between centres on mandrel (gear blank) with an accuracy ± 30 minute. (07hrs.) 86. Taper turning by swivelling the cross slide. (03 hrs.)	
		87. Make square thread (external) on a lathe with an accuracy \pm	Terms relating screw thread major/ minor diameter, pitch and

		<p>0.02 mm. (10hrs.)</p> <p>88. Make square thread (internal) on a lathe with an accuracy +/- 0.02 mm. (14hrs.)</p> <p>89. Check with thread gauge – grinding of tool & setting in correct position. (04hrs.)</p> <p>90. Fitting of male & Female Square threaded components. (02hrs.)</p> <p>91. Make multi-start V thread on lathe with Screw Pitch gauge.(10 hrs.)</p> <p>92. Perform eccentric turning with an accuracy +/-0.02mm. (07hrs..)</p>	<p>lead of the screw, depth of thread. Simple gear train and compound gear train change gears for fractional pitches.</p> <p>Square thread and its form and calculation of depth, core dia, pitch dia.</p> <p>Difference between single and multi-start threads- their uses, merits and demerits. (9 hrs.)</p>
<p>Professional Skill 125 Hrs.;</p> <p>Professional Knowledge 35 Hrs.</p>	<p>Produce components of high accuracy by different operations using grinding.</p> <p><i>[Different operations – surface grinding, cylindrical grinding with an accuracy of +/- 0.01 mm]</i> CSC/N0109</p>	<p>93. Identification of different types of grinding machine. (02 hrs.)</p> <p>94. Wheel balancing & truing. (06 hrs.)</p> <p>95. Dressing of grinding wheel. (02 hrs.)</p> <p>96. Grinding of block (six sides) by surface grinding machine with an accuracy of +/- 0.01 mm. (15 hrs.)</p>	<p>Grinding –</p> <p>Introduction, grinding wheel- abrasive, types, bond, grade, grid, structure, standard marking system of grinding wheel, selection of the grinding wheel. (06 hrs.)</p>
		<p>97. Grinding of step block by surface grinding machine with an accuracy of +/- 0.01 mm. (10hrs.)</p> <p>98. Grinding of slot block by surface grinding machine with an accuracy of +/- 0.01 mm. (08hrs.)</p>	<p>Dressing, types of dresser.</p> <p>Glazing and Loading of wheels – its causes and remedies.</p> <p>Roughness values and their symbols.</p> <p>Explain the importance and necessity of quality. (06 hrs.)</p>
		<p>99. Set and perform angular grinding using universal vice/ sign vice to standard angle. (05 hrs.)</p>	<p>Surface Grinder –</p> <p>Types, Parts, construction, use, methods of surface grinding, specification & safety. (06 hrs.)</p>

		<p>100. Make slide fit with an accuracy $\pm 0.01\text{mm}$ (male female) (05hrs.)</p> <p>101. Perform form grinding (05 hrs.)</p> <p>102. Make dovetail fitting with an accuracy $\pm 0.01\text{mm}$ (male & female) (08 hrs.)</p>	
		<p>Cylindrical grinding:</p> <p>103. External parallel cylindrical grinding (Both holding in chuck/ collet and in between centers. (10 hrs.)</p> <p>104. Plunge grinding (08hrs.)</p>	<p>Cylindrical grinder: Introduction, parts, construction, types, specification, safety, different methods of cylindrical grinding. (06 hrs.)</p>
		<p>105. Perform straight bore grinding (05hrs.)</p> <p>106. Perform step bore grinding (05hrs.)</p> <p>107. Internal taper bore grinding (05hrs.)</p> <p>108. Make male female fitting with an accuracy of $\pm 0.01\text{ mm}$ (08hrs.)</p>	<p>Cutting speed, feed, depth of cut, machining time calculation. (06 hrs.)</p>
		<p>109. External step cylindrical grinding with an accuracy of $\pm 0.01\text{ mm}$ (10hrs.)</p> <p>110. External taper Cylindrical grinding with an accuracy of $\pm 0.01\text{ mm}$. (08hrs.)</p>	<p>Wet grinding and dry grinding, various types of grinding wheels and their application, grinding defects and remedies. (05 hrs.)</p>
Engineering Drawing: 40 Hrs.			
Professional Knowledge ED- 40 Hrs	Read and apply engineering drawing for different application in the field of work. CSC/N9401	<p><u>Engineering Drawing:</u></p> <p>Introduction to Engineering Drawing and Drawing Instruments –</p> <ul style="list-style-type: none"> • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument <p>Lines- Types and applications in drawing Free hand drawing of –</p> <ul style="list-style-type: none"> • Geometrical figures and blocks with dimension 	

		<ul style="list-style-type: none"> • Transferring measurement from the given object to the free hand sketches. • Free hand drawing offhand tools and measuring tools. <p>Drawing of Geometrical figures:</p> <ul style="list-style-type: none"> • Angle, Triangle, Circle, Rectangle, square, Parallelogram. • Lettering & Numbering- Single Stroke. <p>Dimensioning</p> <ul style="list-style-type: none"> • Types of arrow head • Leader line with text • Position of dimensioning(Unidirectional, Aligned) <p>Symbolic representation–</p> <ul style="list-style-type: none"> • Different symbol used in the related trades. <p>Concept and reading of Drawing in</p> <ul style="list-style-type: none"> • Concept of axes plane and quadrant • Concept of Orthographic and ISO metric projections • Method of first angle and third angle projections (definition and difference) <p>Reading of Job drawing of related trades.</p>
Workshop Calculation & Science: 38 Hrs.		
<p>Professional Knowledge WCS- 38 Hrs.</p>	<p>Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402</p>	<p><u>WORKSHOP CALCULATION & SCIENCE:</u></p> <p>Unit, Fractions Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, subtraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication & division Solving problems by using calculator</p> <p>Square root, Ratio and Proportions, Percentage Square and square root Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction</p> <p>Mass, Weight, Volume and Density Mass, volume, density, weight and specific gravity Related problems for mass, volume, density, weight and specific gravity</p> <p>Speed and Velocity, Work, Power and Energy Work, power, energy, HP, IHP, BHP and efficiency</p> <p>Heat & Temperature and Pressure Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals</p>

		<p>and non-metals</p> <p>Concept of pressure - Units of pressure, atmospheric pressure, absolute pressure, gauge pressure and gauges used for measuring pressure</p> <p>Basic Electricity</p> <p>Introduction and uses of electricity, electric current AC,DC their comparison, voltage, resistance and their units</p> <p>Mensuration</p> <p>Area and perimeter of square, rectangle and parallelogram</p> <p>Area and perimeter of Triangles</p> <p>Area and perimeter of circle, semi-circle, circular ring, sector of circle, hexagon and ellipse</p> <p>Surface area and volume of solids - cube, cuboid, cylinder, sphere and hollow cylinder</p> <p>Finding the lateral surface area, total surface area and capacity in litres of hexagonal, conical and cylindrical shaped vessels</p> <p>Levers and Simple machines</p> <p>Simple machines - Effort and load, mechanical advantage, velocity ratio, efficiency of machine, relationship between efficiency, velocity ratio and mechanical advantage</p> <p>Trigonometry</p> <p>Measurement of angles</p> <p>Trigonometrical ratios</p> <p>Trigonometrical tables</p>
<p>In-plant training/ Project work</p> <p>Broad area:</p> <ul style="list-style-type: none"> a) Drill extension socket b) V-belt pulley c) Tail Stock Centre (MT – 3) d) Taper ring gauge e) Taper plug gauge. (Morse taper – 3) 		

SYLLABUS FOR MACHINIST TRADE

SECOND YEAR

Duration	Reference Learning Outcome	Professional Skills (Trade Practical) With Indicative Hours	Professional Knowledge (Trade Theory)
Professional Skill 60 Hrs.; Professional Knowledge 15 Hrs.	Re-sharpen different single & multipoint cutting tool. [Different single point tools, slab milling cutter, side & face milling cutter, end mill cutter and shell end mill cutter.] CSC/N0109	111. Demonstrate and practice of grinding of different single point tools. (18 hrs.)	Tool & cutter grinder- Introduction, parts, construction, use and specification, different types of tool rest & their application. (05 hrs.)
		112. Demonstrate and practice of grinding of slab milling cutter. (10 hrs.)	Various methods of cutter grinding. (05 hrs.)
		113. Re-sharpening side and face milling cutter. (12 hrs.)	
		114. Demonstrate and practice of grinding of end mill cutter. (10 hrs.) 115. Re-sharpening of shell end mill cutter. (10 hrs.)	Various cutter grinding attachments and their uses. (05 hrs.)
Professional Skill 60 Hrs; Professional Knowledge 15 Hrs.	Set different machining parameters and cutters to prepare job by different milling machine operations. <i>[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.]</i> CSC/N9407	116. Practice of facing on milling Machine. (08 hrs.)	Geometrical tolerances, definition, symbol and their application. Depth Micrometer – Parts, reading, uses and safety. (05 hrs.)
		117. Drill on P.C.D on milling Machine with accuracy +/- 0.02 mm. (10 hrs.)	
		118. Perform Tapping and Reaming operation using milling Machine with an accuracy +/- 0.02 mm.(08hrs.) 119. Perform spot facing operation using milling machine with accuracy +/-0.02 mm. (10 hrs.)	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. (05hrs.)
		120. Make slot on face of the job using milling Machine with an accuracy +/-0.02 mm. (10 hrs.) 121. Make Internal Grooving using milling Machine with an accuracy 0.02 mm. (14 hrs.)	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. (5 hrs.)

<p>Professional Skill 87Hrs.;</p> <p>Professional Knowledge 24Hrs.</p>	<p>Set the different machining parameters and cutters to prepare components by performing different milling operation and indexing. <i>[Different machining parameters – feed, speed and depth of cut. Different components – Rack, Spur Gear, External Spline, Steel Rule, Clutch, Helical Gear]</i> CSC/N9407</p>	<p>122. Make Straight Teeth Rack using Milling Machine with an accuracy 0.05 mm. (08 hrs.)</p> <p>123. Make Helical Teeth Rack using Milling Machine with an accuracy 0.05 mm one straight rack. (08 hrs.)</p> <p>124. Measurement of teeth by Vernier Gear Tooth Caliper. (03 hrs.)</p> <p>125. Make spur gear using Simple indexing with an accuracy 0.05 mm. (08 hrs.)</p> <p>126. Make spur gear using differential indexing with an accuracy 0.05 mm. (08 hrs.)</p> <p>127. Perform Boring operation on Vertical Milling Machine with an accuracy 0.05 mm. (16 hrs.)</p> <p>128. Make helical gear on milling machine with an accuracy 0.05 mm. (18 hrs.)</p> <p>129. Make straight flute milling on Milling Machine with an accuracy 0.05 mm. (10 hrs.)</p> <p>130. Make helical flute on Milling Machine with an accuracy 0.02 mm. (08 hrs.)</p>	<p>Rack – types, uses and calculations.</p> <p>Selection of gear cutter type and form & various methods of checking gear and its parts.</p> <p>Vernier gear tooth caliper - its construction and application in checking gear tooth. (07hrs.)</p> <p>Spur gear calculations, curves and their uses.</p> <p>Use of radius gauges and template. (04hrs.)</p> <p>Vertical Milling Machine- its parts. Method of boring in Vertical milling. Difference between Horizontal and Vertical Milling Machine. (04hrs.)</p> <p>Helix and Spiral introduction, types and elements. Difference between helix & spiral. Difference between R.H. and L.H. helix.</p> <p>Helical gear- elements, application. Calculations for cutting helical gear. (05hrs.)</p> <p>Reamer – types, elements and uses. Calculations for cutting Reamer.</p> <p>Twist drill-nomenclature, cutter selection. Calculations for cutting twist drill. (04hrs.)</p>
<p>Professional Skill 200Hrs.;</p> <p>Professional Knowledge 40Hrs.</p>	<p>Set (both job and tool) CNC turning centre and produce components as per drawing by preparing part programme. CSC/NO115</p>	<p>131. 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. (03 hrs.)</p> <p>132. Identify CNC lathe machine</p>	<p>Personal safety, safe material handling, and safe machine operation on CNC turning centers.</p> <p>CNC technology basics, Comparison between CNC and conventional lathes. Concepts of positioning accuracy, repeatability.</p> <p>CNC lathe machine elements and their functions - bed, chuck,</p>

		<p>elements and their functions, on the machine. (07 hrs.)</p> <p>133. Understand the working of parts of CNC lathe, explained using CNC didactic/ simulation software. (09 hrs.)</p> <p>134. Identify machine over travel limits and emergency stop, on the machine. (01 hr)</p> <p>135. Decide tool path for turning, facing, grooving, threading, drilling. (04hrs.)</p> <p>136. Identification of safety switches and interlocking of DIH modes. (01 hr)</p>	<p>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.</p> <p>Feedback, CNC interpolation, open and close loop control systems.</p> <p>Machining operations and the tool paths in them – stock removal in turning and facing, grooving, face grooving, threading, drilling. (05hrs.)</p>
		<p>137. Identify common tool holder and insert shapes by ISO nomenclature. (05hrs.)</p> <p>138. Select cutting tool and insert for each operation. (03hrs.)</p> <p>139. Fix inserts and tools in tool holders. (02hrs.)</p> <p>140. Decide cutting tool material for various applications. (03hrs.)</p> <p>141. Select cutting parameters from tool manufacturer's catalogue. (02hrs.)</p> <p>142. Write CNC programs for simple tool motions and parts using linear and circular interpolation, check on program verification/ simulation software. (10hrs.)</p> <p>143. Write CNC part programs using canned cycles for stock removal, grooving, threading operations, with drilling and finish turning. Use TNRC commands for finish turning. Check simulation on program verification/ simulation software. (18hrs.)</p> <p>144. Avoiding collisions caused by</p>	<p>Concept of Co-ordinate geometry, concept of machine coordinate axis, axes convention on CNC lathes, work zero, machine zero.</p> <p>Converting part diameters and lengths into co-ordinate system points. Absolute and incremental programming.</p> <p>Programming – sequence, formats, different codes and words.</p> <p>ISO G codes and M codes for CNC turning.</p> <p>Describe CNC interpolation, open and close loop control systems. Co-ordinate systems and Points.</p> <p>Program execution in different modes like MDI, single block and auto.</p> <p>Canned cycles for stock removal (turning/facing), grooving, threading, for external and internal operations.</p> <p>Tool nose radius compensation (TNRC) and why it is necessary. Find the geometry page in CNC machine.</p> <p>Cutting tool materials, application of various materials.</p> <p>Cutting tool geometry for internal</p>

		<p>program errors. Knowing causes and effects of collisions due to program errors, by making deliberate program errors and simulation on program verification/ simulation software. (06 hrs.)</p>	<p>and external turning, grooving, threading, face grooving, drilling. Insert holding methods for each. Insert cutting edge geometry. ISO nomenclature for turning tool holders, boring tool holders, Indexable inserts. 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. Writing part programs as per drawing & checking using CNC program verification/ simulation software. Process planning, work holding, tool and cutting parameters selection according to the part geometry and dimensions. Collisions due to program errors, effects of collisions. Costs associated with collisions – tool breakage, machine damage, injuries. (10hrs.)</p>
		<p>145. 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. (05 hrs.)</p> <p>146. Starting the machine, do homing on CNC simulator. (02 hrs.)</p> <p>147. Entering the CNC program in EDIT mode for an exercise on Simple turning & Facing (step turning) without using canned cycles, on CNC simulator. (15</p>	<p>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 modes – Jog,</p>

		<p>hrs.)</p> <p>148. Mounting jaws to suit the part holding area on CNC machine (03hrs.)</p> <p>149. Mounting tools on the turret according to part and process requirement, on CNC simulator & on CNC machine. (08hrs.)</p> <p>150. Perform Work and tool setting: Job zero/work coordinate system and tool setup and live tool setup. (08hrs.)</p> <p>151. Determining work and tool offsets using JOG, MDI, MPG modes, on CNC simulator. (08hrs.)</p> <p>152. Entering the tool offsets, tool nose radii and orientation for TNRC in offsets page, on CNC simulator. (05hrs.)</p>	<p>MDI, MPG, Edit, Memory.</p> <p>Entering and editing programs on machine console, entering offsets data in offsets page.</p> <p>Use of Emergency stop, Reset, Feed rate override, spindle speed override, edits lock on/off buttons and keys. (10hrs.)</p>
		<p>153. Program checking in dry run, single block modes, on CNC simulator & CNC machine. (01hr)</p> <p>154. Absolute and incremental programming assignments and simulation. (04 hrs.)</p> <p>155. Checking finish size by over sizing through tool offsets, on CNC simulator. (02hrs.)</p> <p>156. Prepare part program and cut the part in auto mode in CNC machine for the exercise on Simple turning & Facing (step turning) (08 hrs.)</p> <p>157. Recovering from axes over travel, on CNC simulator (01 hr)</p> <p>158. Part program writing, setup, checking and Automatic Mode Execution for exercise on Turning with Radius/ chamfer</p>	<p>First part checking: Program checking in single block and dry run modes – necessity and method.</p> <p>Tool offsets adjustment on first part for close tolerance dimensions, by over sizing (for outside dimensions) or under sizing (for inside dimensions) the dimension to prevent part rejection.</p> <p>Wear offset setting – necessity, relationship with tool wear, entering in offsets page.</p> <p>Process and tool selection related to grooving, drilling, boring and threading. Axes over travel, recovering from over travel.</p> <p>Collisions due to improper machine setup and operation – causes and effects. Recovering from collisions.</p>

		<p>with TNRC on CNC machine (10hrs.)</p> <p>159. Part program writing, setup, checking and Automatic Mode Execution for exercise on Turning with TNRC, grooving and threading, on CNC simulator & on CNC machine (12hrs.)</p> <p>160. Checking finish size by over sizing through tool offsets, on the machine. (02 hrs.)</p> <p>161. Machining parts on CNC lathe with combination step, taper, radius turning, grooving & threading, with external and internal operations, first and second operation, on the machine. (10 hrs.)</p> <p>162. Machining long part on CNC lathe held in chuck and tailstock (between centers). (04 hrs.)</p> <p>163. Starting from interruption due to power shutdown, tool breakage. (01hr)</p> <p>164. Changing wear offsets to take into account tool wear. (02hrs.)</p> <p>165. Part program preparation, Simulation & Automatic Mode Execution of CNC Machine for the exercise on Blue print programming contours with TNRC. (07 hrs.)</p> <p>166. Carryout Drilling/Boring cycles in CNC Turning. (08 hrs.) <i>(First 60% of the practice is on CNC machine simulator, followed by 40% on machine.)</i></p>	<p>Find out alarm codes and meaning of those codes. (15hrs.)</p>
<p>Professional Skill 313Hrs.;</p> <p>Professional</p>	<p>Set CNC VMC (vertical machining center) and produce components as per</p>	<p>181. Identify CNC vertical machining center machine elements and their functions, on the machine. (10hrs.)</p>	<p>Safety aspects related to CNC VMC.CNC technology basics, Comparison between CNC VMC and conventional milling</p>

<p>Knowledge 98Hrs.</p>	<p>drawing by preparing part program. CSC/N9408</p>	<p>182. Understand working of parts of CNC VMC, explained using CNC didactic/ simulation software (20 hrs.)</p> <p>183. Identify machine over travel limits and emergency stop, on the machine. (05hrs.)</p> <p>184. Decide tool path for Face milling, Side milling, Pocket milling, Drilling, Counter sinking, tapping, Reaming, Rough boring, Finish boring, Spot facing. (03hrs.)</p>	<p>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. (15 hrs)</p>
		<p>185. Identify common tools, tool holders and inserts. (05 hrs.)</p> <p>186. Select cutting tool, insert and holder for each operation. (05 hrs.)</p> <p>187. Fix inserts and tools in tool holders. (03 hrs)</p> <p>188. Decide cutting tool material for various applications. (04 hrs.)</p> <p>189. Select cutting parameters from tool manufacturer's catalog. (02 hrs)</p> <p>190. Write CNC programs for simple parts using linear and circular interpolation, absolute and incremental modes, checkon program verification software. (15 hrs.)</p> <p>191. Write CNC part programs for parts with face milling, pocket milling with subprograms. Check on program verification</p>	<p>Concept of Co-ordinate geometry& polar coordinate points, concept of machine axis, axes convention on CNC lathes, work zero, machine zero. Converting part dimensions into coordinate system points. Absolute and incremental programming. Programming - sequence, formats, different codes and words. ISO G and M codes for CNC milling. Canned cycles for drilling, peck drilling, reaming, tapping, finish boring. Subprograms. Cutter radius compensation (CRC)and why it is necessary. Cutting tool materials, application of various materials. Cutting tool geometry for face mill, end mill, drill, countersink, tap, finish bore, reamer. Insert holding methods face mill, insert type end</p>

		<p>software. (11hrs.)</p> <p>192. Write CNC part programs for pocket milling, drilling with canned cycle, countersinking with canned cycle, tapping with canned cycle. Check on program verification software. (10hrs.)</p> <p>193. Avoiding collisions caused by program errors. Knowing causes and effects of collisions due to program errors, by making deliberate program errors and simulation on program verification software. (06 hrs.)</p>	<p>mill and insert type drill. Insert cutting edge geometry. Cutting parameters- cutting speed, feed rate, depth of cut. 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. Writing part programs as per drawing & check using CNC program verification software. Process planning, work holding, tool and cutting parameters selection according to the part geometry and dimensions. Collisions due to program errors, effects of collisions. Costs associated with collisions - tool breakage, machine damage, injuries. (20hrs.)</p>
		<p>194. 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. (03 hrs.)</p> <p>195. Starting the machine, do homing on CNC simulator. (03 hrs.)</p> <p>196. Entering the CNC program in EDIT mode for an exercise on face milling and drilling without using canned cycles, on CNC simulator. (12 hrs.)</p> <p>197. Mounting tools on the ATC according to part and process requirement, on CNC simulator & CNC machine. (08hrs.)</p> <p>198. Determining work and tool offsets using JOG, MDI, MPG</p>	<p>Program execution in different modes like manual, single block and auto. Process planning & sequencing, tool layout & selection and cutting parameters selection. Work offset, tool length offset, tool radius offset. Work holding with temporary holding and fixtures. Truing of part and fixture. Machine operation modes - Jog, MDI, MPG, Edit, Memory. Entering and editing programs on machine console, entering offsets data in offsets page. Use of Emergency stop, Reset, Feed rate override, spindle speed override, edit lock on/off buttons and keys. (15hrs.)</p>

		<p>modes, on CNC simulator & CNC machine. (07hrs.)</p> <p>199. Tool change in CNC milling and JOG, MDI, MPG mode operation. (06 hrs.)</p>	
		<p>200. Program checking in dry run, single block modes, on CNC simulator. (04 hrs.)</p> <p>201. Checking finish size by over or under sizing through tool offsets, on CNC simulator. (05 hrs.)</p> <p>202. Prepare part programme, enter, edit and simulate. (04 hrs.)</p> <p>203. Carryout tool path simulation. (04 hrs.)</p> <p>204. Recovering from axes over travel, on virtual machine simulator (03 hrs.)</p> <p>205. Part program writing, setup, checking and Automatic Mode Execution for exercise on side milling with CRC, on CNC simulator & CNC machine. (15 hrs.)</p> <p>206. Part program writing, setup, checking and Automatic Mode Execution for exercise on face milling, drilling, countersinking, tapping using canned cycle, on CNC simulator & CNC machine (20 hrs.)</p> <p>207. Automatic mode execution of CNC Machine Exercises with Block Search and restart. (12 hrs.)</p> <p>208. Mounting clamps, locators, supports, truing part and fixture. (8 hrs.)</p>	<p>First part checking: Program checking in single block and dry run modes -necessity and method.</p> <p>Tool offsets adjustment on first part for close tolerance dimensions, by oversizing (for outside dimensions) or under sizing (for inside dimensions) the dimension to prevent part rejection.</p> <p>Axes over travel, recovering from over travel.</p> <p>Collisions due to improper machine setup and operation - causes and effects.</p> <p>Recovering from collisions.</p> <p>State the importance of Helical inter-polar and thread milling, advantage and limitation in CNC machine. (20hrs.)</p>
		<p>209. Machining part on CNC VMC with face milling, drilling. (05 hrs.)</p>	<p>Tool wear and necessity for wear offsets change, entering wear offsets in offsets page.</p>

		<p>210. Machining parts on CNC VMC with combination face milling, side milling with CRC, drilling, countersinking, tapping. Use canned cycles and subprograms wherever possible. (05 hrs.)</p> <p>211. Machining of part with closely controlled slot dimension using CRC. (05hrs.)</p> <p>212. Machining of part with pockets. (02 hrs.)</p> <p>213. End milling with polar coordinates. (04 hrs.)</p> <p>214. Part programs & Simulation Automatic Mode Execution of CNC Machine for the exercise on End milling with polar coordinates and practical on Simple drilling-G 81. (06 hrs.)</p> <p>215. Determining and entering wear offsets. (03 hrs.)</p> <p>216. Restarting machine from power shutdown or sudden stoppage. (01hr)</p> <p>217. Program transfer to machine through electronic media – USB and flash drive. (01 hr)</p> <p>218. Merging the work zero with program zero point, geometry and wear offset correction. (02 hrs.)</p> <p>219. Practical on Chamfer and counter-sink drilling. (02 hrs.)</p> <p>220. Carryout Deep hole drilling G 83. (03 hrs.)</p> <p>221. Perform Threading and tapping G 84. (06 hrs.)</p> <p>222. Carryout Boring cycles G 85 - G 89. (08 hrs.)</p> <p>223. Preparations of part programs for thread cutting/thread milling for CNC machining centres.(06 hrs.)</p>	<p>Effects of sudden machine stoppage due to power shutdown or use of emergency stop. Restarting machine from sudden stoppage.</p> <p>Means of program transfer through electronic media.</p> <p>Productivity concepts, cycle time, machine down time, causes of down time - breaks, machine breakdown, inspection, part loading and unloading, chip cleaning. Effect of down time on profitability, reducing down time.</p> <p>Machine hour rate, components of machine hour rate - principal repayment, interest, overheads (power, tooling, space, salaries, indirect expenses). Calculation of machining cost, cost of down time. (20hrs.)</p>
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		<p>228. Prepare different types of documentation as per industrial need by different methods of recording information. (25 hrs.)</p>	<p>Machine productivity concepts – cycle time, down time, cycle time estimation.</p> <p>Costing - machine hour rate, machining cost, tool cost, cost of down time.</p> <p>Importance of Technical English terms used in industry. Technical forms, process sheet, activity log, job card, in industry-standard formats.(08hrs.)</p>
Professional Skill 45 Hrs.;	Plan and perform simple repair, overhauling of different machines and check for functionality. <i>[Different Machines - Drilling Machine, milling machine and Lathe] CSC/N9403</i>	<p>229. Perform Periodic Lubrication system on Machines. (10 hrs.)</p> <p>230. Perform simple repair work.(10hrs.)</p>	Lubricating system-types and importance. (05hrs.)
Professional Knowledge 12Hrs.		<p>231. Perform the routine maintenance with check list. (05hrs.)</p> <p>232. Inspection of Machine tools such as alignment, leveling etc. (10 hrs.)</p> <p>233. Accuracy testing of machine tools such as geometrical parameters.(10 hrs.)</p>	<p>Maintenance: Definition, types and its necessity.</p> <p>System of symbol and colour coding. Possible causes for failure and remedies. (07hrs.)</p>
Professional Skill 75Hrs;	Set the different machining parameters and cutters to prepare components by	<p>234. Cutting teeth on helical slab/ cylindrical cutter and end mill cutter with an accuracy of +/- 0.05 mm. (15hrs.)</p>	<p>Calculations for cutting helical slab/ cylindrical cutter.</p> <p>Calculations for cutting End Mill cutter. (06hrs.)</p>
Professional Knowledge		<p>235. Cutting bevel gears on a</p>	<p>Bevel gear-elements, types,</p>

28Hrs.	performing different milling operation and indexing. <i>[Different machining parameters - feed, speed and depth of cut. Different components - end mill, bevel gear, cam, worm & worm wheel]</i> CSC/N9407	milling machine with an accuracy of +/-0.05 mm. (15 hrs.)	application, calculation for cutting bevel gear. (06 hrs.)
		236. Cutting a plate cam with angular setting in milling machine with an accuracy of +/-0.05 mm. (15 hrs.)	Cam-types, elements & application, Plate cam-manufacturing & calculations. Drum cam- its calculation, advantages, types of follower & its purposes. (06hrs.)
		237. Cutting worm wheel on a milling machine with an accuracy of +/- 0.05 mm. (15 hrs.)	Worm wheel-application, elements & calculation, Worm-calculation.(05hrs.)
		238. Cutting worm thread on a milling machine with an accuracy of +/- 0.05 mm. (15 hrs.)	Types of Keys and their uses. Variation - types and causes. Testing of Gear and error. (05hrs.)
Engineering Drawing: 40 hrs.			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work. CSC/N9401	Engineering Drawing: <ul style="list-style-type: none"> • Reading of drawing of nuts, bolt, screw thread, different types of locking devices e.g., Double nut, Castle nut, Pin, etc. • Reading of foundation drawing • Reading of Rivets and rivetted joints, welded joints, welded joints • Reading of drawing of pipe and pipe joints • Reading of Job Drawing, Sectional View & Assembly view. 	
Workshop Calculation & Science: 28 hrs.			

<p>Professional Knowledge WCS- 28 Hrs.</p>	<p>Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. CSC/N9402</p>	<p><u>WORKSHOP CALCULATION & SCIENCE:</u></p> <p>Friction Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice</p> <p>Centre of Gravity Centre of gravity - Centre of gravity and its practical application</p> <p>Area of cut out regular surfaces and area of irregular surfaces Area of cut out regular surfaces - circle, segment and sector of circle Related problems of area of cut out regular surfaces - circle, segment and sector of circle Area of irregular surfaces and application related to shop problems</p> <p>Elasticity Elasticity - Elastic, plastic materials, stress, strain and their units and young's modulus Elasticity - Ultimate stress and working stress</p> <p>Heat Treatment Heat treatment and advantages Heat treatment - Different heat treatment process – Hardening, tempering, annealing, normalising and case hardening</p> <p>Estimation and Costing Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing</p>
<p>In-plant training/ Project work (Any Project to be done involving CNC machine also)</p> <p>Broad area:</p> <ol style="list-style-type: none"> Socket with Split Collet Screw Jack Crank Shaft with Taper Sleeve Crank and slotted link mechanism Stub arbor with collet and nuts Compound gear train 		