

**MEMBERS OF THE TRADE COMMITTEE FOR THE TRADE OF  
“TOOL AND DIE MAKER – PRESS TOOLS, JIGS & FIXTURES “**

**CHAIRMAN**

SHRI V. M. RAGHAVAN, DIRECTOR  
CENTRAL INSTRUCTIONAL MEDIA INSTITUTE,  
GUINDY, MADRAS – 600 032

<b>MEMBER SECRETARY</b> SHRI K. SAMBANDAM DY. DIRECTOR		CIMI, GUINDY MADRAS – 600 032
<b>MEMBERS</b>		<b>NIIF</b>
1.	SHRI B.N. BALAJI SINGH Gen. Manager of Trg.	23/24 Peenya Industrial Area, Bangalore- 560 058
2.	SHRI S. M. HOSURKAR Asst. Manager	Govt. Tool Room and Training Centre, Rajaji Nagar, Bangalore – 560 044
3.	SHRI V. SWAMINATHAN Manager	Ashok Leyland Ltd. Ennore, Madras – 600 057
4.	SHRI JAGANNATHA RAO Training Manager	Ashok Leyland Ltd. Ennore, Madras-600 057
5.	SHRI S.FERDRICK MOSES Manager	CIPET, Guindy, Madras-600 032
6.	SHRI F.M.LAWRENCE Superintendent	English Electric Co. Ltd. Pallavaram, Madras-600 043
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10.	SHRI G. ETHIRAJ Asst. Director	DET, Govt. of Tamil Nadu, Chepauk, Madras – 600 005
11.	SHRI G.O.R.NAMBLAR Dy. Director	ATI, Guindy, Madras – 600 032
12.	SHRI H.S.N.MURTHY RAO Director(Rtd.)	ATI, Guindy, Madras – 600 032
13.	SHRI M.K.VENUGOPAL Training Officer (Rtd.)	CIMI, Guindy, Madras – 600 032
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15.	SHRI M.V.RANGASWAMY Jt. Director	CIMI, Guindy, Madras – 600 032
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	Dy. Director	Madras – 600 032
17.	SHRI WILFRED JOSEPH Asst. Director	CIMI, Guindy, Madras – 600 032
18.	SHRI V.R.S.MANI Training officer	CIMI, Guindy, Madras – 600 032
<b>Special Invitees over and above the Trade Committee Members Who have attended the Review Meeting</b>		
1.	Shri A.K.MITRA Director	CIMI, Guindy, Madras – 600 032
2.	Shri P.KANDASAMY Principal	CTI, Guindy, Madras – 600 032
3.	Shri D. VASUDEVALU Manager (Trg.)	HAL, Bangalore
4.	Shri k.PONNUSAMY Jt. Director	DET, Govt. of Tamil Nadu, Chepauk, Madras – 600 005
5.	Shri S.Y.KULKARNI Principal	Industrial Training Institute, 374, Sene Guruji Marg, Bombay – 400 011
6.	Shri V.SRINIVASAN Special officer/cd Cell	DET, Govt. of Tamil Nadu, Chepauk, Madras – 600 005
7.	Shri P.T.GANGASUDHAN Training officer	CIMI, Guindy, Madras – 600 032
<b>GENERAL INFORMATION</b>		
1.	Name of the Trade	- Tool and Die Maker (Press Tools, Jigs and Fixtures/Dies and Moulds)
2.	N.C.O. Code No.	- 833.10,833.40
3.	Duration of Craftsman Training	- 3 years
4.	Duration of	- 4 years including Basic Training for 3 years
5.	Entry Qualification	- Passed 10 <sup>th</sup> class with Science and Mathematics under 10 + 2 system of Education or its equivalent
6.	Rebate allowed towards Apprenticeship Training For Ex-ITI trainees	
	(a) Tool and Die Maker	Full (3 years)
	(b) Fitter	1 year
	(c) Turner	1 year
	(d) Machinist	1 year
	(e) Machinist (Grinder)	1 year
7.	Ratio of Apprentice to worker	1:2
<b>Note :</b>		
I.	Common one year Training for both Press Tool, Jigs and Fixtures and Dies and Moulds followed by six months Training in which the trainees will prepare the elements of the tools which are to be prepared during the remaining period of one and half years.	
II.	During the remaining period of one and a half years of training under CTS, the trainee will undergo training either in Press Tools, Jigs and Fixtures or in	

	Dies and Moulds.
III.	The course contents for Entrepreneurship Training and Social Studies being common for all the trades are not incorporated separately in this syllabus.

MODIFIED SYLLABUS FOR THE TRADE OF "TOOL AND DIE MAKER , PRESS TOOLS , JIGS AND FIXTURES"

A. FOR THE FIRST 18 MONTHS (78 WEEKS)

WEEK No.	PRADE PRACTICAL	TRADE THEORY	ENGINEERING DRAWING	WORKSHOP CALCULATION AND SCIENCE
1		3	4	5
1	Familiarisation with the craftsman training and scheme and the institute. Manufacturing ess as a means of converting natural resources into useful products with respect to the trade of tool and die making. Safety rules to be observed in the shop floor.	Need for skill training in a developed country. Importance of tool and die making in mass production of interchangeable components. Brief outline of various subjects to be revealed. Disciplinary rules of the institute, training and other facilities available. Apprenticeship Training scope for employment.	Introduction to Engineering drawing and its importance.	Revision problems in fractions. Decimals, average percentage ratio and proportion and square roots.
2.	Bench Work: Filing surfaces flat and checking with try-square. Filing angles at 90 with try-square accuracy. Measuring with steel rule. Hammering practice.	-do-	Types of lines- their meaning and application as per IS -696	-do-
3.	-do-	Introduction to SI system of units. Conversion from MKS to SI. Brief description of CGS and FPS system.	-do-	Revision on problems in fractions- decimals –Average, percentage ratio and proportion and square roots.
4.	Filing surfaces flat	Steel rule, uses of	Simple	-do-

	and parallel within +/- 0.5 mm accuracy. Marking and punching. Chip ping practice.	calipers and types of calipers. Introduction to surface plate, surface gauge and its uses. Description and uses of scribes, dot punch and hammer and marking media (marking media).	conventional symbols for materials and parts as per IS – 696.	
5.	-do-	Types of vices, care of vices types of files and care of files. Methods of filing. Description uses of bevel gauge and bevel protractor.	-do-	-do-
6.	Number and latter punching. Marking parallel lines on cylindrical surfaces using 'V' Block and scribing Block. Hacksawing practice. Filing chamfer at 45°. setting bevel protractor. Checking angles using bevel gauge.	Hacksaw, selection of blades, precautions while hacksawing. Principles of various gauges. measurement of angles, construction of various types of caliper.		
7.	-do-	Chisels: Types of chisels process: Types of hammers and their us/s.	Free hand sketching of straight lines. rectangles, circles, squares, polygons ellipse.	-do-
8	Filing and finishing angles with in +/-1°. .filing external gauge.	Venier caliper- principle - construction – graduations – readings – uses and care.	-do-	-do-
9	Introduction to drilling machine. Drilling through	Introduction to drilling machines. Types of drilling		

	holes. Chain drilling and parting off. Hacksawing along a given ling. Measuring jobs with vernier caliper of least count 0.02mm and surface roughness N9. drilling blind holes. Countersinking. Tapping, Die passing.	machines. description of twist drill. Counterboring tool countersinking tool. Selection of cutting speed for different materials and operations. Calculation of rotation per minute (rpm). Determination of drilling time.		
10.	-do-	-do-	-do-	-do-
11.	-do-	-do-	-do-	-do-
12.	File surface within + /-0.1mm and surface roughness N8. Drill holes with =/-0.2mm accuracy between centres. Reaming operation (hand ) further practice on drilling and tapping.	Description and uses of taps, dies and reamers. Care to be taken while using taps, dies and reamers.	-do-	-do-
13.	-do-	-do-	Orthographic projections I & III angle (simple figures)	Simple equations-shop problems involving the application of simple equations.
14.	Introduction to lathe and pedestal grinding machine. Grinding single point turning tools. Mounting of jobs on the lathe chuck, and setting of cutting operations to +/- 0.5mm.	Description of pedestal grinders and description of single point cutting tool. Tool angles and its importance. Effect of tool setting and tool angles.	-do-	-do-
15.	-do-	-do-	-do -	-do-
16.	Ste) turning and shoulder turning checking squareness on the shoulder.	Lathe accessories and attachments. Types of chucks, face plates, lathe dogs, lathe centres	-do-	Simultaneous equations with 2 unknowns.

	Measuring chamfer. Checking of fillets and radii of shoulder with gauges. Turning jobs between centres to +/- 0.2mm. undercutting and forming square shoulder.	and lathe steady.		
17.	-do-	Different lathe operations: Speed feed and depth of cut as applied to turning, time calculation. Parallel or straight turning, step turning, grooving, reradius, drilling and boring.	-do-	-do-
18.	Shaping : Introduction to the shaping machine. Grinding single point tool for shaping operations. Shaping rectangular blocks to +/-0.2mm accuracy.	Calculation of taper: TAPER TURNING METHODS, Form tool, Taper turning attachment.	-do-	-do-
19.	-do-	Thread cutting methods: lathe tool materials, Coolants and lubricants.	-do-	Logarithm- multiplication division powers roots by using log.
20.	Filing : Measuring jobs using micrometer. Filing jobs to an accuracy of +/- 0.05mm. filing concave and convex radii. Sharpening of twist drills. Drilling holes with centre distances within an accuracy of +/- +/-0.6 mm	Description of shaping machine: work holding methods. Types of tools those can be used on shaper. Calculation of cutting speed.	-do-	-do-

	marking angular open fit. Use of dial indicator for flatness checking.			
21.	-do-	-do-	Drawing Isometric views out of orthographic views.	-do-
22.	-do-	Construction of micrometer. Determination of least count of micrometer. Mechanical properties of materials.	-do-	-do-
23.	-do-	Brief description of production of steel. Types of steels, effects of alloying elements on the properties of steel.	-do-	-do-
24.	Fitting exercises with different shapes of mating surfaces.	Types of steels used in tool making and their specifications, Cast iron: Types and applications.	-do-	-do-
25.	Scrap and finish surface with 3plate method.	Test	-do-	-do-
26.	Turning: Boring holes to an accuracy of +/- 0.2mm. Use of 4-jaw chuck – setting using dial indicator. Reaming with machine reamer. Checking with plug gauge. Drilling deep through holes.	Description, construction and uses of gauges, plug gauge, radius gauge, fillet gauge, template gauge feeler gauge. Types of milling machines.	-do-	-do-
27.	Internal recessing, step boring. Milling: Introduction to	Principal parts of milling machine.	Missing lines and views	Calculation of areas of plane figures formed by the combination of

	milling machine. Fixing cutter. Milling block within an accuracy of +/-0.2mm. Milling step block +/-0.2mm.			standard figures.
28.	Step milling +/- mm. Milling key ways or splines on bores using of slotting attachment on milling machine. Angular block milling within +/- 1.	-do-	-do-	-do-
29.	-do-	Specification and parts of milling machine.	-do-	-do-
30.	Test.	Work holding devices.	-do-	Calculation of volumes of standard solids prisms, cylinder, spheres cone, pyramid, frustrum of cone and pyramids.
31.	Shaping: shaping angular surfaces. Checking with bevel protractor.	Cutter holding devices.	Sectional views – Half sections and full sections.	-do-
32.	Turning : Form turning, checking with template. Taper turning using compound slide. Checking of taper using sine bar, slip gauges and dial indicator.	Milling machine attachments.	-do-	-do-
33.	-do-	-do-	-do-	-do-
34.	Taper turning by tailstock setover method. Taper turning by taper turning attachment.	Types of Milling cutters.	-do-	Simple machine-pulley, lever, wheel and axle. (Weston differenatial) problems on calculation of MA, VR and efficiency.
35.	Turning to an accuracy of +/-	Nomenclature of milling cutter.	Exercise involving	-do-



	0.05mm. Forming threads by die passing.		different types of sectional views.	
36.	Milling using simple indexing. Milling internal splines.	Influence of tooth angles of cutter performance. Milling cutter material. Sharpening of milling cutters.	-do-	-do-
37.	Dovetail Milling. Measuring dovetails with rollers. Milling 'v' block.	Milling process. Conventional milling and down milling, face milling & end milling. Milling machine operations.	-do-	-do-
38.	Milling jobs using differential indexing. Use of rotary table. Milling convex and concave surfaces. Helical milling.	Simple dividing head and universal dividing head.	Sketching of standard elements like bolts, nuts, screws, dowels, rivets, joints and keys.	Trigonometrical ratios –use of trigonometrical tables.
39.	-do-	-do-	-do-	Shop problems involving the solution of right angled triangles.
40.	Grinding: Introduction to surface grinding machine. Setting of job. Setting of machine. Wheel balancing, grinding of parallel and perpendicular surfaces (+/-0.2 mm ) using magnetic chucks and C-clamp.	Indexing methods. Direct indexing simple indexing, Compound indexing. Differential indexing.	-do-	-do-
41.	Using depth micrometer. Grinding of steps within +/-0/02mm. Grinding angular surfaces with – in	-do-	-do-	Trigonometrical ratios- height and distance problems.

	an accuracy of +/- 5" using universal vice.			
42.	Introduction to cylindrical grinding machine. Setting of hole. Setting of machine. Wheel selection. Grinding cylindrical surface between centers within an accuracy of +/- 0.002.	Calculation of cutting speed and feed.	Screw threads and their representation.	-do-
43.	Grinding steps on cylindrical surfaces within +/- 0.02mm. grinding taper holes on cylindrical grinding machine. Internal grinding within +/-0.02mm	Description of construction and use of slip gauges, dial indicators. Different types of dowels, their applications and principles of doweling.	-do-	-do-
44.	Grinding internal steps within an accuracy of +/- 0.01 mm. Grinding internal taper within accuracy of +/-5 min.using4-jaw chuck.	Description of construction and uses of depth micrometers, universal bevel protractor,bore in dicators.	Sketching bolts and nuts, screws and other screwed members.	SI Units and its comparison with metric units.
45.	-do-	Description of grinding operation, types of grinding machines.	-do-	-do-
46.	Cylindrical grinding holes using collets.	Description of cylindrical grinding machine and surface grinding machine,Centreless grinding.	Engg. drawing of pipe joints shafts couplings, shaft bearings, pulleys, etc.	Speed, velocity and acceleration-simple problems.
47.	Introduction to gas welding equipments. Introduction to are welding	-do-	-do-	-do-

	equipment. Welding of simple holes. Practice on brazing .			
48	Bench Work : filing within an accuracy of +/- 0.02 mm. Fitting exercises.	Description of tool and cutter grinder. Specification of grinding wheels.	Reading of drawing, blueprints of various tools and die assemblies.	-do-
49.	-do-	Grinding Wheels. Specification of grinding wheels. Types of grinding wheels. Selection of grinding wheels.	-do-	-do-
50.	Fitting exercises	Mounting of grinding wheels. Balancing of grinding wheels. Dressing and turning of grinding wheels.	-do-	Mass, weight and their units definition of force compressive tensile and shear force- graphical representation of force.
51.	filing drill point gauge and angle gauge.	-do-	-do-	-do-
52.	Test	Test	Test	Test
53.	Filing straight edge (to be finished by milling and grinding )	Determination of cutting speed and work-speed. Calculation of machining time.	Limits, fits and tolerances. Dimensioning and sectional views.	Concept of the term resultant force- Resultant of forces in the same line and two forces meeting at a point by analytical and vector methods.
54.	Filing bevel edge try square (to be finished by milling and lapping )	Explanation of gas welding and arc welding techniques. Description of welding equipment. Types of welded joints.	-do-	-do-
55.	Turning	Rivets and riveted joints. Different types of threaded fasteners, locking devices, keys, cotter taper pin	Classification of Eng. Drgs. Difference between assembly drawing and	-do-

		and split pins. Self holding and self riveting tapers.	working drawing.	
56.	Eccentric turning (internal and external)	-do-	Working drawing, points to be incorporated, symbols and abbreviations (tolerance – geometrical tolerance.)	Concept of term-equilibrium and equilibrant. Law of triangle of forces, Lamis theorem.
57.	Further exercises on turning and matching.	-do-	Assembly drawing of a machine element such as tailstock, clapper box, tool post, beaming, etc.	-do-
58.	Milling, Exercises on milling to an accuracy of +/-0.1 mm.	Properties and uses of non-ferrous metals and their alloys.	Working drawing of the above assembly.	Moment of a force. Problems with respect to levers of all the three orders.
59.	Milling and matching profiles.	-do-	-do-	-do-
60.	Further exercises in Milling straight, angular and profiles.	Difference between thermoplastics and thermoset plastics. Types of plastics and their applications.	Assembly drawing of a machine element such as tailstock, clapper box, tool post, beaming etc.	-do-
61.	-do-	-do-	Working drawing of the above assembly. Views.	Moment of a force in problems with respect of levers of all the three orders.
62.	-do-	Limits fits and tolerances as per IS 919.	-do-	-do-
63.	-do-	Brief description of the microstructure of steel.	Assembly drawing a machine element such as tailstock, clapper box, tool post, beaming etc.	-do-
64.	Practice on heat treatment.	Change in the structure of steel during heating.	Working drawing of the above assembly	-do-
65.	Grinding :	-do-	-do-	Calculation of work

	Grinding External and internal parallel jobs and matching.Grinding external and internal taper jobs and matching.			done by force-unit of work in SI units shop problem in calculation of work done.
66.	-do-	Heat treatment process. Purpose and its effects on the properties of steel. Annealing, nitriding, hardening and tempering.	Assembly drawing of a machine element such as tailstock, clapper box, tool post, beaming, etc.	-do-
67.	Further practice on surface grinding machine. Convex and concave form grinding.	-do-	Working drawing of the above assembly.	-do-
68.	-do-	Case hardening, surface hardening, carburising, cyaniding nitriding, flame hardening and induction hardening.	-do-	-do-
69.	Practice on Tool and cutter grinding.	-do-	Assembly drawing of a machine element such as tailstock, clapper box, tools post, beaming etc,	Meaning of the term power and units of power in SI system shop problems in calculation of HP for drilling turning etc.
70.	EDM work observation on EDM machine (spark and wire cut)	Precautions to be observed during heat treatment of tools. Furnaces used for heat treatment	Working drawing of the above assembly.	Meaning of the term power and units of power in SI system-shop problems in calculation of HP and power required for drilling turning etc.
71.	Pantograph : Die sinking practice-engraving sunk and raised letters.	Enlarging and reducing- selection of cutters and ratio- method of removing material	-do-	-do-

		for diesinking form master and template		
72.	Bench Work : Marking and cutting of sheet metal. Bending, profile bending and soldering.	Jig boring, purpose, parts, and function of the parts, accessories, Accuracy achievable. Jiggrinding - purpose parts and ,function of the parts, accuracies, Accuracy achievable.	Assembly drawing of a machine element such as tailstock, clapper box, tool post, beaming, etc.	Meaning if HP, IHP, BHP and applied problems.
73.	-do-	-do-	Working drawing of the above assembly.	-do-
74.	Simple project work-tool makers clamp.	-do-	-do-	-do-
75.	-do-	EDM- Principle and functions	Assembly drawing of a machine element such as tailstock, clapper box, tool post, beaming, etc.	Revision
76.	Simple project work – Assembly fit.	Pantograph: Principle and function and types.	Working drawing of the above assembly.	-do-
77.	-do-	Revision	-do-	-do-
78.	Test	Test	Test	Revision
<p><b>Note :</b> skills listed under trade practical from week Nos 53 to 78 will be achieved by Preparing the elenients of the actual tools which are expected to be manufactured during The remaining period of 18 months.</p>				

MODIFIED SYLLABUS FOR THE TRADE OF "TOOL AND DIE MAKER , PRESS TOOLS , JIGS AND FIXTURES"  
 B. FOR THE FIRST 18 MONTHS (78 WEEKS)

WEEK NO	TRADE PRACTICAL	TRADE THEORY	ENGINEERING DRAWING	WORK SHOP CALCULATION AND SCIENCE
79.	Project work-manufacture of simple blanking tool.	Introduction to tooling: brief description of press tools, moulds for plastics, die casting dies and jigs and fixtures.	Blue prints reading of various Engg. Drawing, assembly drawing and detail drawings press tool.	Revision of first year Topics.
80.	-do-	Shearing theory, stages of shearing.	-do-	-do-
81.	-do-	Description of the following press tool.	"Guide plate tool" drawing and detail drawing. Single stage rectangular punching tool.	Heat and temperature. Coefficient of linear expn. Problems.
82.	-do-	Operations	-do-	-do-
83.	-do-	Blanking, piercing, cuff off, parting off, Perforating, progressive tool compound tool, Trimming, notching, shaving, lancing Diesinking, broaching, Planishing, Embossing, coining, drawing, fiaring curling, bulging swaging.	Drawing of a dovetail gauge.	-do-
84.	Assembly tryout and rectification of simple blanking tool.	Cutting clearance	-do-	Concept of terms latent heat of fusion, evaporation. Simple problems.
85.	-do-	The importance of cutting clearance. Effect on the component of optimum, insufficient and excessive cutting	-do-	-do-

		clearance. Misalignment between punch and die burrside, relation between piece part size. Calculation of cutting clearance.		
86.	Project work- manufacture of piercing tool.	-do-	-do-	Meaning of the terms stress and strain-tensile and compressive, shear stress, ultimate stress and yield point.
87.	-do-	Land and angular clearance.	-do-	-do-
88.	-do-	-do-	Drawing of a dovetail straight edge gauge.	-do-
89.	-do-	Guiding parts and function of a guide plate tool.	-do-	-do-
90.	-do-	Calculation of cutting force. Selection of press, methods adopted to reduce press force.	-do-	-do-
91.	-do-	Stock materials, their materials. Choosing material for the required press operation. Difference between stock strip and unit stock.	Drawing of a snap gauge.	-do-
92.	Assembly tryout and rectification of piercing tool.	Strip layout. It's importance in tool designs, percentage of utilization of strip. Determining the most economical strip layout.	-do-	-do-
93.	-do-	-do-	Drawing of precision try-square.	-do-
94.	-do-	Cutting and rear cutting punches.	-do-	-do-



		Different types of punches. Types of loads coming on a punch. Determining the use of a punch that can withstand the force. ( diameters, length restriction)		
95.	Project work – manufacture of ‘v’block grinding fixture	-do-	Drawing of a plug gauge.	-do-
96.	-do-	Difference between solid die and split die. Factors for selecting split die. Nesting and nesting methods.	-do-	Problems of ultimate stress and factors of safety Poisson’s Ratio Modulus of rigidity.
97.	-do-	-do-	Drawing of a ring gauge.	-do-
98.	Manufacture of supporting tools.	Function of stopper in a press tool. Difference between strip position and registering positions. Functions of primary and secondary stoppers, side acting and end acting trigger stoppers. Function of a stripper, constructional features of traveling stripper.	Drawing of jig bushes, pins, feet. Standard elements.	-do-
99.	-do-	-do-	-do-	-do-
100.	-do-	-do-	Drawing of a plate jig.	-do-
101.	-do-	Function of gauges in a press tool nest gauges.	-do-	Elementary of magnetism, magnetic fields, Laws of attraction and repulsion.

102.	-do-	Test	-do-	-do-
103.	Project work	Explanation of piloting, principles of piloting different types of pilots. Direct piloting and indirect piloting. Function of side cutter, advantages of side cutter. Requirement of fasteners and dowels used in a press tool.	Drawing of a clamping fixture.	-do-
104.	Manufacture of plate jig.	-do-	-do-	-do-
105.	-do-	-do-	Drawing of a quick clamping fixture	Forms of energy Description of the terms potential, Kinetic, energy examples and application.
106.	Project work	Function of shank in a press tool.	-do-	-do-
107.	Precision Clamp	Different types of shanks. Importance of locating the shank in the correct position.	-do-	-do-
108.	-do-	Advantages of die set, die set materials, die set components. Type of die sets. Standard die sets.	-do-	Simple problems on potential and Kinetic energy.
109.	Project Work- Manufacture of 'V' Bending tool	Functions of elements of blanking tool and piecing tool.	Drawing of an equilibrising clamp.	-do-
110.	-do-	Function of ejectors and shedders in a press tool, direct knockouts and indirect knockouts.	-do-	Description of Heat Energy and simple problems and applications.
111.	-do-	Construction of progressive tools. Function of the	-do-	-do-

		elements of a progressive tool.		
112.	-do-	-do-	-do-	-do-
113.	-do-	Construction of a compound tool. Function of the elements of a compound tool. Advantages and disadvantages of compound tool over progressive tool.	Drawing of a drill jig. Laws of attraction and repulsion.	-do-
114.	Assembly, Tryout and rectification of Bending tool.	-do-	-do-	-do-
115.	-do-	Shaving process, purpose of shaving. Punch and die size for shaving, allowance for shaving. Determination of blank size before shaving.	-do-	Centre of gravity of solids. Simple problems on determination of CG.
116.	Project Work – Manufacture of progressive tool.	Principles of bending, deformation process during bending, different bend elements.	Drawing of blanking and detail drawing simple components.	-do-
117.	-do-	-do-	-do-	-do-
118.	-do-	Distinguishing between V-bending and U-bending.	Irregular components blanking tool.	-do-
119.	Assembly tryout and rectification of progressive tool.	-do-	-do-	Electrical terms- Voltage, Current, Resistance, Ohm's Law.
120.	-do-	Centre fibre and neutral fibre. Calculations of the length of neutral fibre. Calculating the blank length of bend components.	Drawing of bending tools, simple V-bending and U-bending.	-do-
121.	-do-	Calculation of maximum bending	-do-	Calculation of current using Ohm's

		stress, minimum and maximum bend radius.		Law in simple circuit.
122.	-do-	Bending force for V-bending. Operations and bending force U-bending.	Multidirectional bending tools.	-do-
123.	-do-	Spring back in U-bending and V-bending.	Detail drawing of bending tools.	-do-
124.	-do-	-do-	Drawing of lancing tool and detail drawing.	-do-
125.	-do-	Methods of stripping bend components, effect of burr side on bending, precaution to be taken while bending in proximity to the pierced hole, materials used for bending.	Drawing of progressive tool-two stage with pilot mounted punch.	-do-
126.	-do-	-do-	-do-	Meaning of terms conductors, insulators, Fuse, Magnetic effect of electric current.
127.	Test	Constructional features of V-bending tool.	Multistage progressive tool.	-do-
128.	Project Work – Manufacture of Drill jig.	Revision	-do-	Heating effect of Elec-current application.
129.	-do-	Test	Drawing of progressive tools with automatic stoppers. Side acting and end acting.	-do-
130.	-do-	Functions of jig and fixtures, difference between jig and fixtures, determining the economy in use of	-do-	-do-

		a jig and fixture.		
131.	-do-	-do-	Drawing of progressive tool with side cutter multistage.	Determination of electrical energy consumption in simple circuits.
132.	-do-	Possible direction of movement. Materials of restricting the possible movements, Locating methods. Functions of nest in a jig or a fixture. Importance of tool proofing in a jig or fixture.	-do-	-do-
133.	-do-	-do-	Drawing of progressive tool with side cutter with traveling stripper.	-do-
134.	Project Work – Manufacture of Compound Tool.	-do-	-do-	-do-
135.	-do-	Function of clamp in a jig or a fixture, design of different types of clamps.	Drawing of progressive tool with side cutter with cut and carry.	Friction – Coefficient of friction, simple problems.
136.	-do-	-do-	-do-	-do-
137.	-do-	Methods of overcoming the problem of accumulation of chip and or dirt in jigs and fixtures.	Drawing of compound tool conventional.	-do-
138.	-do-	-do-	Compound tool inverted type and detail drawing.	Shop problems related to friction.
139.	-do-	Drill bushes, tool guiding in a jig, different types of drill bushes.	-do-	-do-
140.	Assembly Tryout and rectification of compound tool.	Types of drill jigs.	Drawing of draw and detail drawing single stage.	-do-
141.	-do-	-do-	-do-	Conversion and conservation of

				energy.
142.	Project Work – Manufacture of Draw tool.	Functions and types of cutter guides in a fixture.	Combination tools blank and draw.	-do-
143.	-do-	Types of fixtures.	-do-	-do-
144.	-do-	Explanation of Embossing, Coining, Planishing a flanging.	Drawing of a eylet draw tool and detail drawing.	Introduction of non- conventional energy –applications.
145.	-do-	Process of drawing cylindrical cups. Forces acting on the blank during drawing, wrinkling and puckering.	-do-	-do-
146.	Assembly and Tryout and rectification of Draw tool.	-do-	Triple draw tool and detail drawing.	-do-
147.	-do-	Functional / design characteristics of a simple draw tools.	-do-	-do-
148.	Pneumatics and Hydraulics	-do-	Drawing of side cam tool. side piercing.	Introduction to Computers.
149.	-do-	Types of draw tools. Clearance for deep drawing, importance of punch and die radius.	Revision	-do-
150.	-do-	Press terms, connected with presses. Criteria for selecting a press. Die cushions.	-do-	-do-
151.	-do-	Fine blanking, working principle of a fine blanking tool.	-do-	Revision
152.	-do-	Fundamentals of hydraulics and pneumatics.	-do-	-do-
153.	-do-	-do-	-do-	-do-
154.	-do-	CNC	-do-	-do-
155.	Test	Revision	-do-	-do-

Modified syllabus for the Trade of Tool and Die Maker  
( Press Tools, Jigs and Fixtures )  
Under Apprenticeship Training Scheme

1. Material selection for the manufacture of different elements of Press Tool – jigs and Fixtures and Gauges. Heat treatment – It's effects of functioning of different parts- different methods of heat treatment etc.  
Material Testing – hardness- tensile and compressive strength – crack – x – ray etc
2. CNC Machines- programming of CNC machines- Capabilities and universality of CNC machines- Robotics, Automation – CAD- CAM, Wirecut EDM, Spark Erosion etc.
3. Tool Estimation.
4. Process Planning for manufacture of the Press Tools – Jigs and Fixtures, gauges etc.
5. Case Studies – advanced tooling – design of tools for Pres Tools and Jigs and Fixture – Trouble Shooting – Rectification of tools – Maintenance of tools – Simple Hydraulic / pneumatic circuits.
6. Quality and Inspection of Tools – Stage inspection – Inspection of additional tooling like electrodes, templates, masters etc. use of profile projectors, tool maker's microscope, comparators – Three co- ordinate measuring machine – surface measuring equipment etc.  
Application of gauges like form position gauges – gauging fixture – inspection gauge wear, gauge material and heat treatment.  
Final inspection of tools – product inspection etc.
7. Forging – Concept of Forging – details regarding forging dies for closed die forging and press forgings – manufacture methods for forging dies – Materials for forging dies.

Notes: The apprentice should be able to design tools for a given component and execute the process, inspection etc. by himself. He should attain the proficiency at the highly skilled level at the end of the apprenticeship training.

**TOOL AND DIE MAKER TRADE**  
 ( Press Tools, Jigs and Fixtures )  
 List of Tool and Equipment  
 ( For a batch or unit of 16 trainees)

SL	Description of Tools	For instructor	For batch of 16	Total
	<b>I. Trainee's Tool Kit</b>			
1.	Steel Rule 150 mm English and Metric combined	1	16nos.	17
2.	Engineer's Square 150 mm with knife edge	1	16nos	17
3.	Hacksaw frame adjustable with pistol grip for 200- 300-m mm blade	1	16nos	17
4.	Hammer Bell Pein 0,5 kg with handle	1	16nos	17
5.	Chisel cold flat 18*150mm	1	16nos	17
6.	Hammer Cross Pein 0, 75 kg with handle	1	16nos	17
7.	Chisel Cross Cut 10*3*200 mm	1	16nos	17
8.	Chisel Half Round 10*250 mm	1	16nos	17
9.	Chisel diamond point 10*200 mm	1	16nos	17
10.	Center punch 100mm	1	16nos	17
11.	Prick punch 150mm	1	16nos	17
12.	File flat bastard 350mm	1	16nos	17
13.	File flat 2 <sup>nd</sup> cut 250 mm	1	16nos	17
14.	File flat safe edge 200mm	1	16nos	17
15.	File three square smooth 200mm	1	16nos	17
16.	Needle file assorted ( 12nos.) 150mm	1	16nos	17
17.	Scraper flat 250mm	1	16nos	17
18.	File card	1	16nos	17
19.	Safety goggles	1	16nos	17
	<b>II Tools and Instruments</b>			
1.	Caliper inside spring type – 150mm	4nos.		
2.	Caliper outside spring type – 150-mm	4nos		
3.	Divider spring type – 150- mm	4nos		
4.	Odd leg caliper firm joint – 150 mm	2nos.		
5.	Screw driver – 150 mm	4nos		
6.	Screw driver – 200	4nos		
7.	Screw driver – Phillips type no. 1,2 and 3	2nos.(2each)		
8.	Centre gauge 55 <sup>0</sup> and 60 <sup>0</sup>	2nos.(1each)		
9.	Plier side cutting 150 mm	2nos		
10.	Oil cane 250 ml	4nos		
11.	File flat bastard 300mm	8nos.		
12.	File flat smooth 200mm	4nos		
13.	File flat smooth with safe edge 200mm	4nos		
14.	File half round bastard 300mm	8nos		
15.	File half round smooth 250mm	8nos		
16.	File three square bastard 250mm	4nos.		



17.	File three square smooth 200mm	8nos.		
18.	File round bastard 250mm	4nos.		
19.	File square bastard 300 mm	4nos.		
20.	File square smooth 250 mm	4nos.		
21.	Knife edge file 150mm	8nos.		
22.	Scribing block universal 300mm	4nos.		
23.	Surface plate 300*300mm	4nos.		
24.	surface plate 600*300mm	2nos.		
25.	Tap extractor 3mm to 12mm *1.5 mm (ezy out)	1set		
26.	Screw extractor sizes 1to8	1set		
27.	Taps and dies metric 3mm to 25mm complete set in a box	2set		
28.	Drill twist St. shank \$ 1.5 to 12.5 mm in steps of 0.5 mm	1set		
29.	Drill twist St. shank 8mm to 12mm in steps of 2mm	1set		
30.	Taper shank drills 6mm to 25mm in steps of 1mm	1set		
31.	D.E. spanners 3mm – 4mm, 6-8. 10-12, 13-14,15-16,18-19, 20-22, 24-26(8spanners)	2sets		
32.	Letter punch 3mm set	1set		
33.	Number punch 3mm set	1set		
34.	Drill chuck 12mm capacity	2nos		
35.	Drill gauge 1.5 to 12.5mm in steps of 0.5mm	1no		
36.	Allen key metric 3to12mm	2sets		
37.	Centre drills 1,2,3,4	4each		
38.	Parallel hand reamer 3mm to 25 in steps of 1mms	2sets		
39.	Long fluted machine reamer 6mm to 25mm insteps of 1mm	1set		
40.	Hand taper pin reamer 4mm, 5mm, 6mm, 8mm, 10mm and 12mm (setoff 6nos.)	2sets		
41.	Reamers adjustable 10mm to 15mm in steps of 1mm	2sets		
42..	Side and face milling cutter \$ 125*12mm width \$32mm bore	2nos.		
43.	Side and face milling cutter \$ 100mm * 10 mm width *\$ 32m bore	2nos.		
44.	Cylindrical milling cutter \$63mm *70mm width \$ 27mm bore	2nos		
45.	Slotting cutter \$ 63mm * 6mm width * \$ 22bore	2nos		
46.	Slotting cutter \$ 83mm *8mm width * \$ 27bore	2nos		
47.	Slotting cutter \$ 100 mm * 12mm width*\$32bore	2nos		
48.	Single angle cuter \$ 50mm * 12mm width * \$ 16 mm bore - 60 <sup>0</sup>	2nos		
49.	Single angle cutter \$ 63 mm * 18mm width * \$22 mm bore - 70 <sup>0</sup>	2nos		
50.	Single angle cutter \$ 63mm * 26mm width *\$	2nos		

	22bor- 85 <sup>0</sup>			
51.	Equal angle cutter \$63 mm * 18mm width * 22bore - 90 <sup>0</sup>	2nos		
52.	Shell end mill \$ 50 mm * 36mm width * \$ 22bore	2nos		
53.	Shell end mill \$ 100mm * 50mmwidth *\$ 32boer	2nos		
54.	Slide and face cutter \$ 63 mm * 6mm width * \$ 16 bore	2 nos.		
55.	Slide and face cutter \$ 63 mm * 10 mm width * \$ 22 bore	2 nos.		
56.	Slide and face cutter \$ 63 mm * 14 mm width * \$ 22 bore	2 nos.		
57.	Face cutter \$ 80 mm * 20 mm width * \$ 27 bore	2 nos.		
58.	Face cutter \$ 100 mm * 25 mm width * \$ 32 bore	2 nos.		
59.	Parallel shank end mills \$ 3, \$ 6, \$ 8, \$ 10 and \$ 12 mm	2 nos.		
60.	'T' slot cutter with parallel shank-cutter \$ 17.5 * 8 mm width * dia. Of shank 8 mm	2 nos.		
61.	Slitting cutter \$ 100 mm * 2 mm width * 27 mm bore	2 nos.		
62.	Ball end \$ mm, \$ 6 mm \$ 8 mm, \$ 10 mm and \$ 12 mm	2 nos.		
63.	Rivet snap and dollies 2 mm and 3 mm set	2 nos.		
64.	Tool makers clamp 50 mm , 75 mm, 100 mm and 150 mm	4 nos. each		
65.	C' clamp, 75 mm, 100 mm, 150 mm and 200 mm	2 nos. each		
66.	Lathe tools (solid – H.S.S.)- square shank to suit the size of the lathe	6 nos. each		
67.	H.S.S. tool bits 3 mm, 4 mm, 6 mm, 8 mm, square 100 mm length	12 nos. each		
68.	Tool holders – straight, L.H. and R.H. to suit the size of lathe	6 each		
69.	Parting tool holders to suit the size of the lathe	2 nos.		
70.	Parting tool blades 3 mm and 4 mm width HSS	3 each		
71.	Boring bars with holders to accommodate 3 mm, 4 mm, 6 mm and 8 mm HSS tool bits	3 each		
72.	Knurling tool holders – revolving type	2 nos.		
73.	Tool makers buttons - \$ 10 mm and \$ 12 mm	4 nos.		
74.	Tool holders for shaper and slotter – straight, L.H. and R.H. to suit the machine available	3 each		
75.	4 mm, 6 mm and 8 mm square H.S.S. tool bits	6 each		
76.	Oilstone assorted (10 mm square, \$ 10 mm and 10 mm side triangular) 100 mm lenth	2 each		
77.	Star dresser	2 each		
78.	Diamond dresser with holder	2 nos.		
79.	Electric soldering iron 60 watts	2 nos.		

80.	Soldering iron straight	2 nos.		
81.	Blow lamp	1 no.		
82.	Demagnetiser	1 no.		
83.	Lapping Cast iron plate 250 * 250	1 no.		
84.	Lever shearing machine hand operated complete with 300 mm blade	1 no.		
85.	Snips 200 mm blade	1 no.		
86.	Workbench 240 cm * 120 cm * 75 cm with 150 mm vice	4 nos. (each bench fitted with 4 vices)		
87.	Steel Lockers for 16 trainees	2 nos.		
88.	Steel cupboard 180 cm * 60 cm * 45 cm	6 nos.		
89.	Metal rock 180 cm * 60 cm * 45 cm	4 nos.		
90.	Fire extinguisher	2 nos.		
91.	Fire buckets with stand	4 nos.		
92.	Feeler gauge 0.05 mm to 0.3 mm by 0.05 and 0.4 mm to 1 mm by 0.1 mm (13 leaves)	2 sets		
93.	Screw pitch gauge – Range 0.4 -7 mm Metric 60 (21 leaves)	2 sets		
94.	Radius gauge 1-3 mm by 0,25 mm and 3,5-7 mm by 0.5 mm (34 leaves)	2 sets		
95.	Vernier height guage –range 300 mm vernier scale 0.02 mm	1 no.		
96.	Vernier height guage –Range 500 mm vernier scale 0.02 mm	1 no.		
97.	Universal vernier caliper 0-200 mm, Graduation 0,02 mm	4 nos.		
98.	Dial vernier caliper 0-200 mm, Graduation 0,02 mm	1 no.		
99.	Universal vernier caliper – Range 300 mm Vernier scale 0.02 mm	4 nos.		
100.	Universal bevel protractor – Blade range 150 and 300 mm, dial 1, vernier 5 min. with head, Acute angle attachment	2 nos.		
101.	Outside micrometer 0-25 mm (0.01 mm accuracy)	2 nos.		
102.	Outside micrometer 25-50 mm (0.01 mm accuracy)	2 nos.		
103.	Outside micrometer 50-75 mm (0.01 mm accuracy)	1 no.		
104.	Outside micrometer 75 -100 mm (0.01 mm accuracy)	1 no.		
105.	Combination square sets -300 mm blade with square head, centre head, protractor head	2 sets		
106.	Telescoping gauge range 8-150mm (6 pcs/set)	1 set		
107.	Sine bar 150mm with stopper plate	1 no.		
108.	Sine Table 200 mm length with magnetic bed	1 no.		
109.	Gauge blocks workshop grade – 87 pieces per	1 set.		

	set			
110.	Gauge block accessories consisting holders, half Round jaws, scriber point, centre point, triangular straight edge (14 pcs/set)	1 set		
111.	Central square – Size 400 x 250mm blade	1 no.		
112.	V-Block – Approx. 32 x 32 x 41 mm with clamping capacity of 25 mm with clamps	2 pairs		
113.	V – Block – Approx. 65 x 65 x 80 mm with clamping capacity of 50 mm with clamps			
114.	Magnetic V – Block 100 x 100 x 125 mm	1 no.		
115.	Angle plate 150 x 150 x 200mm	1 no.		
116.	Angle plate-adjustable 250 x 250 x 125mm	1 no.		
117.	Small hole gauge – Range 3 – 13mm (4 pcs/set)	1 set		
118.	Inside micrometer – Range 25 – 50mm	1 no.		
119.	Inside micrometer – Range 50 – 200mm	1 no.		
120.	Depth micrometer – Range 0 -200mm, accuracy 0.01mm	1 no.		
121.	Magnetic stand with magnetic base 60 x 47.5mm and with universal swivel clamp, dial holding rod (150mm) scriber	2 nos.		
122.	Dial test indicator – Lever type – Range 0 – 0.8mm Graduation 0.01mm, reading 0 -40 -0 with accessories	2 nos.		
123.	Dial test indicator – Plunger type – Range 0 – 10mm, Graduation 0.01 mm, Reading 0 – 100 with revolution counter	2 nos.		
124.	Bore gauge with dial indicator (1 mm range, 0 – 0.01mm graduation) – Range of bore gauge 18 – 150mm	1 set		
125.	Straight edge – Single beveled – Size 150mm and 250mm	1 each		
126.	Parallel blocks 15mm and 25mm in pairs	8 sets		
127.	Height master 300mm, Graduation 0.001mm Measuring block 10mm, spacing blocks 10mm	1 no.		

### III. General Machinery and Installation

1.	All geared gap bed lathe for general purpose SS and SC – bed length 1800 mm – Centre height 215 mm – motorized – fully equipped with all accessories including taper turning attachment.	2 nos.		
2.	Tool room lathe – bed length 1200 mm – Centre height 150 mm with standard accessories.	2 nos.		
3.	Shaper 450 mm stroke – motorized with all accessories.	1 nos.		
4.	Tool Room Milling Machine	1 nos.		
	<b>Adjustment Range</b>			
	Table slide longitudinal adjustment	300 mm		
	Table slide vertical adjustment	340 mm		
	Head stock transverse adjustment	150 mm		

	<b>Transversing Screws</b>			
	1 revolution of graduated dials:			
	Longitudinal adjustment	4 mm		
	Vertical and transverse adjustment	2.5 mm		
	1 division on graduated dials	0,025 mm		
	<b>Feed Box</b>			
	Number of feed rates	16		
	Feed range, geometrical progression	10 to 500 mm/min.		
	Ratio, minimum to maximum feed rate	1 : 50		
	<b>Max. Gear Box</b>			
	Number of spindle speeds	16		
	Speed range geometrical progression	40 to 2000 rpm		
	Ratio, minimum to maximum speed with standard equipment including index head, boring head etc.	1 : 50.		
5.	Universal Milling Machine -		1 no.	
	<b>Table</b>			
	Length x width	1350 x 310 mm		
	Longitudinal traverse by power	800 mm		
	Cross traverse by power	265 mm		
	Vertical traverse by power	400 mm		
	Swivel of table on either side	45°		
	<b>Milling spindle</b>			
	No. of speeds	18		
	Speed range rpm	35.5 to 1800		
	Spindle nose	ISO 40		
	Minimum, maximum, distance, centre Lower face of milling head spindle to table top face	60/475 mm		
	Distance spindle centre to lower face of arm	160 mm		
	Maximum distance column face to overarm brace	717 mm		
	<b>Feeds</b>			
	No. of feeds	18		
	Feed range : Long and cross	16 to 800 mm/min.		
	Vertical	4 to 200 mm/min.		
	Rapid traverse : Long and cross	3200 mm/min.		
	Vertical	800 mm/min.		
	<b>Power</b>			
	Maxi. Meter	5.6 KW		
	Feed motor	1.5 KW		
	With universal dividing head, circular table, long arbors, stub arbor, slotting attachment, vertical			

	indexing head, etc.			
6.	Vertical milling machine		2 nos.	
	<b>Table</b>			
	Length x width	1350 x 310 mm		
	Longitudinal traverse by power	800 mm		
	Cross traverse by power	265 mm		
	Vertical traverse by power	400 mm		
	<b>Milling spindle</b>			
	No. of speeds	18		
	Speed range rpm	13.5 to 1800		
	Spindle nose	ISO 40		
	Min. Max. distance, centre lower face of milling head spindle to table to face	57/542 mm		
	Distance spindle centre to column guide	350 mm		
	Vertical movement of quill	70 mm		
	Swivelling of milling head on either side	45°		
	<b>Feeds</b>			
	No. of feeds	18		
	Feed range : Long and cross	16 to 800 mm/min.		
	Vertical	4 to 200 mm/min.		
	Rapid traverse : Long and cross	3200 mm/min.		
	Vertical	800 mm/min.		
	<b>Power</b>			
	Main motor	5.6 KW		
	Feed motor	1.5 KW		
7.	Hydraulic Surface Grinding Machine		2 nos.	
	<b>Table</b>			
	Clamping area	600 x 178 mm		
	Grinding area	400 x 200 mm		
	Distance table – centre of spindle	400 mm		
	Table speed	1 – 25 m/min.		
	<b>Cross feed</b>			
	Automatic rapid transverse traverse	1,2 m/min.		
	1 graduation on hand wheel	0,02 mm		
	1 graduation on fine setting knob	0,01 mm		
	Automatic on feed infinitely variable	1 – 30 mm/stroke		
	1 revolution	2 mm		
	<b>Vertical feed</b>			

	1 graduation on hand wheel	0,002 mm		
	1 graduation on fine setting knob	0,001 mm		
	1 revolution	0,2 mm.		
	Automatic vertical traverse rapid	0,15 m/min.		
	<b>Grinding wheel</b>			
	Speed of 50 cycles	2800 rpm		
	Wheel size outside x width x bore	200 x 25 x 51 mm.		
	Motor			
	Grinding spindle	1.9 HP		
	Hydraulic spindle	1.1 HP		
	Cross feed	0,27 HP		
	Vertical feed	0,4 HP		
	Dust-extractor	1 HP		
	Coolant pump	0,12 HP		
	Power requirement	4 KW		
	With standard accessories like dust extractor with water separator, balancing device, table-mounted radius-tangent wheel dresser, wheel flanges, etc.			
8.	Tool and Cutter Ginder		1 no.	
	Largest diameter of cutter that can be ground	200 mm		
	Max. admit between centres	230 mm		
	Max. length of cutting edges ground	120 mm		
	Grinding spindle RPM	125		
	With standard equipment like adaptor bushes, cutter head holder assembly, adaptors, extension spindle, flanges for grinding wheel, etc.			
9.	Universal Grinding Machine		1 no.	
	Max. dia ground (effective)	725 mm		
	Max.grinding length	300 mm		
	Height of centre	130 mm		
	Max. distance between centres	340 mm		
	Max. workpiece weight			
	Max. workpiece without rest	60 kgs		
	Max. workpiece with rest	75 kgs		
	Max. travel	310 mm		
	Min. travel	2 mm		
	Max. swivel of table	20°		
	RPM	56 -630		
	Swivel of work head	90° towards wheel and 30° away from wheel		
	Internal grinding			
	<b>Internal grinding</b> (Max. speed 18,000 mm, min. 10,000rpm)			
	Grind dial	15 to 100 mm		
	Max. depth of grinding	80 mm		
	<b>Power</b>			

	Wheel head	4 KW
	Work head	0.35/0.75 KW
	Oil pump	1.1 KW
	Coolant pump	0.25 KW
	With special accessories like face plate, steady radius and face dressers, fine hand feed attachment, etc.	
10.	Pantograph engraving and copy milling machine	1 no.
	Working area (rectangle)	320 x 145 mm
	Ratios (3-dimensional)	1:1.5 to 1:10
	Max. height of work	380 mm
	<b>Worktable traverse:</b>	
	Longitudinal	160 mm
	Transverse	300 mm
	Work clamping area	360 x 200 mm
	Master clamping area	320 x 520 mm
	Drive motor	0.25 KW
	Spindle speeds	1600 to 20,000 rpm
	With attachment like index head, roll engraving attachment, type template holders, circular table, raised and sunk letters etc.	
11.	Sensitive drilling machine-capacity 12 mm motorized-with chuck and key etc.	1 no.
12.	Drilling machine-25 mm capacity-motorised with chuck, key etc.	1 no.
13.	Drilling machine 25 mm capacity with fixed bed and co-ordinate table(accuracy 0.01 mm) preferably with DRO	1 no.
14.	CNC trainmaster machining centre (Similar to HMT-VMC 200T) with standard tools, tool holders, CRT monitor, chucks, dividing head, collect holders, clamps, boring bars, edge finder, platter, etc. (This need not be provided if CNC trainer is available either in turner or machinist trade in the institute.)	1 no.
15.	Do all band saw machine	1 no.
16.	Fly press 3 tonne	1 no.
17.	Muffle furnace – Heating chamber 300 x 300 x 450mm for 1050 <sup>0</sup> c	1 no.
18.	Quenching tank – 600 x 600 x 600mm	1 no.
19.	Rockwall hardness testing machine standard accessories	1 no.
20.	Welding equipment (If welding trade is available in the institute may be used – otherwise to be provided as per list given below) <ol style="list-style-type: none"> <li>1. Transformer welding set 300 amps-continuous welding current with all accessories and electrode holder</li> <li>2. Welding cable to carry 400 amps 50 metre with flexible rubber.</li> </ol>	1 set



	3. Lugs for cable 4. Earth clamps 5. Arc welding table (all metal top)122cm x 12cm x 60cm with positioner 6. Oxy-acetylene gas welding set equipment with hoses, regulator and other accessories 7. Gas welding table with positioner 8. Welding torch tips of different sizes 9. Gas lighter 10. Trolley for gas cylinders 11. Chipping hammer 12. Gloves (Leather) 13. Leather apron 14. Welding torches 5 to 10 nozzles 15. Spindle key for cylinder valve 16. Welding goggles 17. Welding helmets with coloured glass 18. Tip cleaner	12 nos. 2 nos.    1 set 1 no. 1 set 6 nos. 1 no. 2 nos. 2 pairs 2 nos. 1 set 2 nos. 4 pairs  2 nos. 10 sets
<b>Note:</b> The specification given under “General Machinery Installation” can be worked out to the nearest size according to the availability in the Indian Market at the time of purchase.		
21.	Double ended grinder (Pedestal type) with 178mm wheels (ond fine and one rough) – motorized with twist drill grinding attachment.	1 no.