

GENERAL INFORMATION

1	Name of the Trade	<u>Fitter</u>
2	Entry Qualification	Passed 10 th class examination under 10 +2 system of education or its equivalent.
3	Duration of Crafts Man Training	2 Years
4	Duration of Apprenticeship Training	3 Years including 1 Years Basic Training

TRADE :- FITTER

DURATION OF TRAINING:- TWO YEARS

QUALIFICATION:- PASSED IN MATRICULATION EXAMINATION 10TH CLASS UNDER 10+2 SYSTEM OR ITS EQUIVALENT

Week No.	Practical	Theory	Engg. Draw.	Workshop Cal. & Science
1	Familiarization with the Institute, importance of trade training, Machinery used in the trade, types of work done by the trainees in the trade, introduction to safety equipment and their uses.	Importance of safety and general precautions observed in the Institute and in the section. Importance of the trade in the development of industrial economy of the country. What is the related instructions subjects to be taught achievement to made. Recreational, medical facilities and other extra curricular activities of the Institute (All necessary guidance to be provided to the		

Week No.	Practical	Theory	Engg. Drag.	Workshop Cal. & Science
		new comers to become familiar with the working of Industrial Training Institute System including stores procedures.		
2	Marking out lines, gripping suitably in vice jaws, hacksawing to given dimensions sawing different types of metals of different sections.	Safety accident prevention linear measurements its units dividers, calipers, hermaphrodite, center punch dot punch, their description and uses of different types of hammers, description, use and care of 'V' Blocks, marking off table.	Egg. Drawing introduction to Engg. Drawing its importance.	Introduction Properties and uses of C.I. and W.I.
3	Filing Channel Parallel Filing. Filing Flat and Square (Rough Finish).	Bench vice construction, types, uses, care & maintenance, vice clamps, hacksaw frames and blades, specification description, types and their uses, method of using hacksaws.	Types of lines, their meaning & application as per IS-696.	Arithmetic : Fundamental operations, addition, subtraction, multiplication, division of decimal numbers
4	Filing practice, surface filing marking off straight and parallel lines with odd leg calipers and steel rule, marking practice with dividers oddleg calipers and steel rule (Circles, arcs,	Files specification, description, materials grades, cuts file elements uses, Measuring standards (English Metric units) angular measurements subdivisions, try square, ordinary depth gauge	Simple conventional symbols for material and parts as per IS-696.	Properties and uses of plain carbon steel and alloy steel.

Week No.	Practical	Theory	Engg. Drag.	Workshop Cal. & Science
	parallel lines).	protector description, use and care.		
5	Marking of straight lines and arcs using scribing block and dividers chipping flat surfaces along a marked line.	Marking of and layout tools, dividers, scribing block, oddleg calipers, punches description, classification material care & maintenance.	Use of drawing instruments in the construction of Geometrical drawings, angles, triangles.	Fraction and decimals conversion fraction to decimal and vice-versa.
6	Marking filing , filing square, use of trisquare	Calipers type material constructional details uses care & maintenance of cold chisels materials, types, cutting angles.	Geometrical construction of rectangles, square, circles	Properties and uses of copper, zinc, lead tin, aluminum
7 & 8	Marking according to simple blue prints locating position of holes scribing lines on chalked surfaces with marking tools finding center of round bar with the help of 'V' block and marking block, Joining St. line to an arc.	Marking media marking blue – Prussian blue –red lead, chalk and their special application description, Use , care and maintenance of scribing block.	Geometrical construction of polygons and ellipse, parabola & hyperbola	Composition, properties and uses of brass, bronze, solder, bearing metal, timber, rubber etc.
9	Chipping Chip slots & oils grooves (Straight)	Surface plate and ancillary marking equipment 'V' block , angle plates, parallel block, description types and uses, workshop surface plate and master surface plate their uses accuracy,	Geometrical construction of involute, oval and helix	System of units, British, metric and SI units for length area, volume, capacity , weight, time, angle, their conversions.

Week No.	Practical	Theory	Engg. Drag.	Workshop Cal. & Science
		care and maintenance.		
10	Filing flat, square, and parallel to an accuracy of 0.5 mm ,. Chip curve along a line mark out, Key way at various angles & cut key ways	Types of files convexing , taper, needle care and maintenance of files various types of keys, allowable clearance & tapers ; types, uses of key pullers	----do----	Effect of alloying elements on the property of C.I. & steel
11	File thin metal to an accuracy of 0.5 mm, chip chamfer, grooves and slots.	Physical properties of engineering metal ; colour , weight, structure, conductivity, magnetic, fusibility, specific gravity, Mechanical properties , ductility, malleability, hardness, brittleness, toughness , tenacity , elasticity.	Free hand sketching of St. lines rectangles . Circles square polygons, ellipse	Units of temperature, force, & related problems
12	Saw along a straight line, curved line on different sections of metal, straight saw of thick section M.S angle and pipes	-----do----- Drill process ;common type bench type pillar type, radial (type) , gang and multiple drilling machine.	Free hand sketching of simple geometrical solids, cube, cone, prism, cylinder, sphere, pyramids	Mass, volume , density, sp. gravity & specific weight S.I. M.K.S. and F.P.S. units of force weight etc. their conversion to related problems
13	Files steps and finish with smooth file accuracy +/- 0.25 mm. File and saw on M.S square and pipe weds	Micrometer outside and inside principle, constructional features, parts graduation reading, use and care, Micrometer depth gauge,	Standard printing style for letters and numbers as per IS :696 Industrial Visit	Mass, Volume, density, weight S.I. M.K.S and F.P.S. unit of force weight etc. their conversion to related problems.

Week No.	Practical	Theory	Engg. Drag.	Workshop Cal. & Science
	Industrial Visit	graduation, reading, use and care. Industrial visit		Industrial visit

Achievement : The trainee should be able to ;-

1. 1. Use fitters hand tools
2. 2. Do simple marking out according to simple Blue Print
3. 3. Do filing /hack sawing and chipping.

14	File radius along a marked line (Convex & Concave) & match. Chip step and file.	Vernier calipers, principle, construction , graduations, reading, use and care. Vernier depth gauge construction, graduations, reading , use and care . Vernier bevel protractor, construction, graduations, reading, use and care , Dial Vernier Caliper	Free hand practice of printing style for standard letters & numbers	Inertia, rest and motion velocity and acceleration.
15	Punch , letter and number (letter and number punch) use of different punches Revision and Test	Drill holding devices : material , construction and their uses. Drill processes : common type (bench type, pillar type, radial type) , gang and multiple drilling machine. Revision and Test	Scales construction of plain scale Representing fraction. Revision and Test	Concept of scalar and vector quantity with examples , Newton's Law of motion. Revision & Test
16	Prepare forge. Fire for heating metals. Forge a	Safety precautions to be observed in a smith shop forge:	Construction of diagonal scale	Power and Roots Factor, power, base exponents.

	square rod from round stock. Judge the forging temperature of various metals.	Necessity, description uses, fuel used for heating, bellows blowers description and uses		
17	Forge M.S. bar to square Octagon and hexagon	Anvil and swage— blocks Description and uses, Forging tools hammers band and sledge description and uses . Chisels , set hammers, flatters, hardier, fuller swage & uses	Simple dimensioning technique size and location dimension for parts, holes angles, taper, screw etc. as per IS: 696	Multiplication and division of power and root of a number
18	Forge flat Chisel grind and heat treat chisels	Measuring and checking tools steel rule, brass rule, calipers, 'T' Square description and uses, General idea about the main operations performed in a forging shop such as upsetting, drawing , twisting, bending , punching, drifting , welding	Transferring measurements for linear, angular, circular dimensions from the given object to the related free hand sketches using different measuring instruments.	Square root of by arithmetic and problems.
19	Forge-punches, screw drivers, chisels, grind them to shape and heat treat to requirement, bending metals to angles, curves & twisting. Preparation of brackets	Heat treatment – necessary, various heat treatment methods such as normalizing, annealing, hardening and tempering. Power hammer construction features, method of operating and uses	Pictorial drawings isometric drawing of simple geometrical solids	Work energy and power their units and applied problems.
20	Marking of straight lines, circles , profiles and various	Safety precautions to be observed in a sheet metal workshop sheets		

	geometrical shapes and cutting the sheets with snips. Marking out of simple development marking out for flaps for soldering and sweating	and sizes, commercial size and various types of metal sheets coated sheets and their uses as per ISI specifications	-----do-----	-----do-----
21	Make various joints, wiring hemming, soldering and brazing form locked, grooved and knocked up /sin gle hem straight and curved edges form double hemming. Punch holes – using hollow and solid punches. Do lap and butt joints.	Marking and measuring tools wing compass Prick punch tin man’s square tools, snips, types and uses. Tin man’s hammers and mallets type-sheet metal tools, stakes –bench types, parts their uses, Soldering iron, types specifications, uses. Trammel, description, parts, uses. Hand grooves specifications and uses	Oblique projection of simple geometrical solids	Percentage, changing percentage to decimal and fraction and vice-versa, applied problems.
22	Bend sheet metal into various curvature – form wired edges straight and curves. Fold sheet metal at an angle using stakes, Bend sheet metal to various curvature, Make simple square –container with wired edge and fix handle.	Solders-composition of various types of solders, and their heating media of soldering iron. Fluxes : types, selection and application – joints and wiring – various types of metal joints, their selection and application Tolerance for	Oblique projection of simple geometrical solids	Problem on percentage related to trade

		various joints, their selection & application		
23	Make square tray with square soldered corner Make funnel as per development and solder joints. Make riveted lap and belt joint.	Rivets – Tin man’s rivets, types, sizes selection for various works Riveting tools, dolly, snaps Description and uses, Method of riveting shearing machine description, parts and uses	Isometric drawing of simple machined and casting blocks	Different types of loads stress, strain modulus of elasticity.
24	Striking and maintaining arc, straight line head	Safety –importance of safety and general precautions observed in a welding shop. Precautions in electric and gas welding. (Before during, after) Introduction to safety equipment and their uses	Isometric drawing of simple machined and casting blocks	Ultimate strength different types of stress, factor of safety examples
25	Make square butt joint and ‘T’ fillet joint –gas and arc. Do setting up of flames, fusion runs with and without filler rod, gas and arc.	Hand tools: hammers, welding description, types and uses, Machines and accessories, welding transformer, welding generators, description principle, method of operating	-----do-----	-----do-----
26	Make butt weld and corner fillet welding Gas and Arc, Practice in hard soldering and silver soldering	H.P. welding equipment description, principle method of operating L.P. welding, equipment, description,	Free hand sketches of trade related hand tools measuring tools.	Ratio & proportion Ratio, finding forms and ratio proportions, direct proportion and indirect proportions

	and steel rule.	work catch plate , dog, simple description of a facing and roughing tool and their applications		
29	Grind the facing, parting and form tools, plain ,turn, step turn, holding job in three jaw chuck – deburr chamfer- corner round the ends, Shoulder : Square filleted –	Lathe cutting tools Brief study of the nomenclature of lathe cutting tools and necessity of correct grinding, solid and tipped , throw away type tools, cutting speed and feed and comparison for H.S.S carbide tools. Use of coolants and lubricants.	Machines basic principles , velocity, ratio, mechanical advantage, efficient, simple problems.	Simple machine principle velocity ratio mechanical advantage, efficiency. Simple Problems
30	Cut grooves, square , round ‘V’ groove. Make a mandrel – turn diameter to size, knurl the job	Chuck and chucking the independent four jaw chuck. Reversible features of jaws, the back plate, Method of clearing the thread of the chuck-mounting and dismounting chucks , chucking true, face plats, drilling method of holding drills in the tail strock , Boring tools and enlargement of holes.	Orthographic drawings, application of both the first angle and third angle. Method in representing the drawings for simple and complex machine given for exercises with dimensions	ALGEBRIC SYMBOLS FUNDAMENTAL ALGEBRA OPERATION SIGN AND SYMBOLS USE in algebra coefficient terms, and unlike terms.
31	Bore holes spot face, pilot drill, enlarge hole, using boring tools make a push. Step bore- cut rarness turn hole diameter to sizes	General turning operations parallel on straight turning. Stepped turning grooving , shape of tools for the above operation Appropriate method	-----do-----	Algebraic addition, subtraction, multiplication and division.

		of holding the tools on tool post or tool rest. Knurling tools description , grade, use, speed and feed , coolant for knurling		
32	Turn taper (Internal and external) Turn taper pins. Turn standard tapers to suit with gauge	Taper-definition use and method of expressing tapers .standard tapers – taper calculations.	Orthographic drawing application of both the first angle and third angle. Method in representing the drawings for simple and complex machine blocks given for exercises with dimensions	Power and exponent Law of exponent
33	Cut threads using taps & dies on lathe by hand, cut ‘V’ thread-external . Prepare a bolt – cut “V” thread internal – prepare a nut and match with the bolt.	Screw thread definition – uses and application , Terminology of screw threads, square , worm buttress (non standard –screw threads) , Principle of cutting screw thread in centre lathe –principle of cutting screw thread –use of centre gauge, setting tool for cutting internal and external thread cutting –use of screw pitch gauge, checking the screw thread.	-----do-----	Algebraic simplification problems.
34	Mark off and drill through holes – drill on M.S. flat , file radius and profile to suit	Drill –material, types, (taper shanks straight shank) parts and sizes , Drill angle –cutting	Standard method of sectioning as per IS: 696. Exercises for different	Simple machine like winch pulley and compound axle etc.

	gauge	angle for different materials. Cutting speed, feed . R.P.M. for different materials	sectional views on the given orthographic drawing of machine parts , casting etc.	
35	Step fit, angular fit, file and make angle , surfaces (Bevel gauge accuracy : degree) make simple open and sliding fits	Drill troubles : causes and remedy Equality of lips , correct clearance, dead centre, length of lips, Drill kinds :fractions , metric, letters and numbers, grinding of drill	----- do-----	Factors and equation: Algebraic formula.
36	Enlarge hole and increase internal dia. File cylindrical surface. Make open fitting of curved profiles	Grinding wheel : Abrasive, grit grades specification , use mounting and dressing Bench grinder parts and use-radius gauge, fillet gauge, material, construction, parts fraction and metric , different dimension convex and concave uses care and maintenance.	Structure bond	Factors and different types of factorisation
37	Make the circles by bridging a previously drilled hole . Test angular match up	Radius gauge, feeler, hole gauge, and their uses.	Standard method of sectioning as per IS “696. Exercises for different sectional views on the given orthographic drawing of machine parts, casting etc.	Equations simple simultaneous.
<p>ACHIEVEMENT ; THE TRAINEE SHOULD BE ABLE TO DO;</p> <p>1. 1. Chucking, centering , plain turning, taper turning, boring and thread cutting</p>				

2. 2. Position marking, fit contours and geometrical figures and make male and female parts				
38	Inside square fit , make combined open and sliding fit, straight sides “T” fit	Vernier height gauge :Material construction, parts, graduations (English & Metric) uses, care and maintenance, Pig Iron : manufacturing process (Blast furnace)types, properties and uses.	Interconversion of isometric, oblique drawings to orthographic drawings and vice-versa, Related problems such as ‘V’ Block oriented by various machining operations etc.	Equations simple, simultaneous, quadratic.
39	File fit combined open angular and sliding sides. File internal angles 30 minutes accuracy open angular fit.	Cast iron : manufacturing process (Cupola furnace) types, properties and uses, Wrought iron : manufacturing process (Fuddling and Astor process) properties and uses.		Application , construction and solution of problems by equations.
40	Make sliding fit with angles other than 90 deg. Sliding fit with an angle.	Steel : manufacturing process Plain carbon steels types, properties and uses	----- do-----	Atmospheric pressure , pressure gauge , gauge pressure and absolute pressure and their units
41	Make simple bracket by bending the twisting non-ferrous metal. Drill small holes (2 mm) Drill holes on sheet metal, bend sheet for round bracket	Non-ferrous metals (copper, aluminum, tin, lead, zinc) properties and uses.	----- do-----	Logarithms and use of logarithm tables: Logarithms: logarithm and exponent
42	Form internal threads with taps to standard size (through holes	Screw threads: its terminology, parts, types and their uses. Screw pitch gauge:	-----do-----	Use of logarithms and anti-logarithm tables

	and blind holes) – Drill through hole and tap drill blind hole and tap; prepare stubs and bolt.	material, parts and uses, Taps British standard (B.S.W, B.S.F., B.A. & B.S.P.) AND METRIC/ BIS (course and fine) – material, parts (shank body, flute, cutting edge). Method of using and use of calculating tap hole sizes. Tap wrench: material, parts type (solid & adjustable types) and their uses removal of broken tap, studs(tap stud extractor).		
43	Form external threads with dies to standard size. Prepare nuts and match with bolts	Dies: British standard, metric and BIS standard, material, parts, types. Method of using dies . Die stock: material, parts and uses	----- do-----	Arithmetical operations involving logarithms in the computations.
44	Countersink, counter bore and ream split fit (three piece fitting)	Counter sink, counter bore and spot facing-tools and nomenclature. Reamer material, types (Hand and machine reamer) kinds, parts and their uses, determining hole size (or reaming), Reaming procedure.	-----do-----	Problems related to the trade using logarithm tables
45	Filing & scarping of bearing to close precision.	Scrapers and their types, methods of scraping.	Surface development of simple geometrical	-----do-----

			solids like cube, rectangular block, cone, pyramid, cylinder, prism etc.	
46	File and fit combined radius and angular surface (accuracy +/- .5 mm) angular and radius fit. Locate accurate holes. Make accurate hole for stud fit.	Vernier micrometer, material, parts graduation, use, care and maintenance.	-----do-----	Specific gravity principle of Archimedes.
47	Make assembly for dovetail sliding fits using lower pins and screws (+/- 0.04 mm)	Screw thread micrometer: construction, graduation and uses.	-----do-----	Relation between specific gravity and density simple experimental determination.
48	Make sliding fits assemble with parallel and angular mating surface (+/- 0.04 mm)	Dial test indicator, construction, parts material, graduation. Method of use. Care and maintenance. Comparatore measurement of quality in the cylinder bores.	Interpretation of solids and conventional application of intersectional curves on drawing.	Geometry: Fundamental geometrical definitions angles and properties of angle, triangles, and properties of triangles.
49	Practice on testing of machine tools and general shop maintenance.	Preventive maintenance objective and function of P.M. section inspection. Visual and detailed lubrication survey system of symbol and color coating.	-----do-----	Pythagoras' theorem, properties of similar triangles.
50 & 51	Simple repair work, simple assembly of machine parts from blue prints	Revision simple estimation of materials use of hand books and reference table	Solution of N.C.V.T. test of paper preliminary revision.	Revision

52	Test	Test	Test preliminary	
----	------	------	------------------	--

ACHEIVEMENTS: The trainee should be able to do

1. 1. Drill holes, counter bores and spot face.
2. 2. Sharpen drill.
3. 3. Use height and depth gauge, micrometer and Vernier calipers, to an accuracy of 1/ 1000/100 mm.
4. 4. Mark punch , cut, chip and file job as per blue prints and able to finish an accuracy of 0.003/0-8 mm.
5. 5. Operate a bench drill and to drill ream holes.
6. 6. Use of tap and dies.

53	Prepare triangle , hexagon on ends of a cylinder bar. Prepare female end and fit	Keys and key ways, types, and their uses construction(shape)	Revision of first year topics	Revision first year course
54	Make key and key ways on the shaft and fit V grooves and slots on the cast iron block.	Spring material types and uses.	-----do-----	-----do-----
55	Make riveted joints (lap and butt joints)	Bolts and nuts: material types (hexagonal and square head) and their uses	Screw thread their standard forms as per ISI , external and internal thread, convention on the features for drawings as per ISI.	Rectangle , square, rhombus, parallelogram and their properties.
56	Drill on cylindrical surface	Washers: material, types (spring type plain washer, fiber washer	-----do-----	Circle and properties of circle : regular polygons
57	Scrape on flat surfaces scrap on curved surfaces and scrap surface , parallels, and test. Make and assemble sliding fits plain surfaces.	Simple hydraulic circuit (flat, half round, triangular and hook scraper) and their uses.	Sketches for bolts, nuts, screws and other screwed members	Application of geometry to shop problems.
58	Make simple dowel pins-	Dowel pins: natural construction, types	Sketches for bolts nuts ,	Heat and temperature

	fitting dowel pins and tap screw assembly.	accuracy and uses.	screws and other screwed members.	Thermos-metric scales their conversions
59	Assembly sliding for using keys and dowel pin and screw to 0.02mm plain surfaces.	Screws : material, different types (inch & metric) uses.	Standard rivet forms as ISI.	Temperature measuring instruments.
60	Testing of sliding fitting job, scrap on two flat surfaces-and curved surfaces.	Testing scraped surfaces: ordinary surfaces without a master plate.	-----do----- --	Specific heats of solids & liquids quantity of heat.
61	File & fit angular mating surface :- plain within an accuracy of + , - 0.02mm& angular +/-, 15minutes angular fitting.	Special files : types (Pillar, Dread nought, Barrow, Warding) description.	Riveted joint.	Heat loss and heat gain, with simple problems.
62	Drill through and blind holes at an angle-drill blind holes "Y" fitting.	System of drill size. Fractional size: number, letter and metric. Templates and gauges. Introduction, necessity types.	Riveted joints butt.	Menstruation Plain figures- triangles, square, rectangle, parallelogram.
63	Dovetailed fitting radius fitting .	Gauge: Introduction, necessity types-description and uses of gauges- types (Feeler screw, pitch, radius, wire gauge)-description and use.	Sketches of keys cutter , keys cutter and pin joints.	Plain figures. Trapezium regular polygons , circle hollow circles.
64	Precision drilling, reaming and tapping. Test - job .	Limit gauge: Ring gauge, snap gauge, plug gauge, description and use.	-----do-----	Plain figures-segment and sector of circle ellipse, fillets.
<p>ACHIEVEMENT : the trainee should be able to do :</p> <ol style="list-style-type: none"> 1. 1. Make key and key ways on the shaft and fit. 2. 2. Make riveted joints. 3. 3. Scrap on flat and curved surfaces. 				

4. 4. File to an accuracy of +/- 0.05mm and +/- 10 minutes on angle filling & sliding assembly				
65	File and fit combined fit with straight, angular surface + or - 0.02 mm, hexagonal fitting.	Slip gauge: Necessity of using, classification of accuracy, set of blocks (English and Metric) , Details of slip gauge, Metric sets 46 :103: 112 . Wringing and building up of slip gauge and care and maintenance. Application of slip gauges for measuring, Sine bar – Principle, application & specification.	Sketches for simple pipe unions with a simple pipe line drawings.	Solid figure : Prism, cylinder , pyramid , cone.
66	Drill and ream small dia holes to accuracy – correct location for fitting, Make male and female fitting parts – drill and ream holes not less than 12.7 mm	Locking device : Nuts types (Lock nut –castle nut, slotted nuts , sawing nut , grooved nut) Description and use	----do---	Solid figures “ friskier of cone. Sphere tours spherical segment.
67	Sliding fitting – Diamond fitting, lapping flat surfaces using lapping plate	Lapping : application of leaping material for lapping tools, lapping abrasives charging of lapping tool. Surface finish importance equipment for testing –terms relation to surface finish . Equipment for testing surfaces quality – dimensional tolerances of surface finish.	Concept of preparation of assembly drawing and detailing. Simple assemblies & their details of trade related tools / job / exercises with the dimensions from the given sample or models . Tool post for the lathe with	MATERIAL WEIGHT AND COST PROBLEMS RELATED TO TRADE.

			washer and screw	
68	Stepped keyed fitting – test job, Lapping holes and cylindrical surfaces	Honing: Application of honing- material for honing tools shapes, grades-honing abrasives. Frosting its aim and the methods of performance.	----- do-----	Trigonometry: trigonometrically ratios use of trigonometrically table.
69	Make a snap gauge +/- 0.02mm.	Interchangeability: Necessity in Eng. Field definition - BIS. Definition , types of limit-terminology of limits and fits-basic size, actual size, deviation, high and low limit, zero line, tolerance zone.	Details and assembly of Vee-block with clamps.	Area of triangle by trigonometry.
70	Scrape angular mating surface scrap on internal surface.	Different standard system of fits and limits. British std. system BIS system. Method of expressing tolerance as per BIS.	Details and assembly of V-blocks with clamps.	Finding height and distance by trigonometry .
71	Practice in dovetail fitting assembly and dowel pins and cap screws assembly.	Fits: Definition, types description of each with sketch.	Details of assembly of shaft and pulley.	Application of trigonometry to shop problems.
	Industrial Visit.	Industrial Visit.	Industrial Visit .	Industrial Visit.
72	Preparation of gap gauges.	Manufacture: The name and type of gauges commonly used in gauging finished product-method of selective assembly “Go” system of gauges, hole plug basis of standardization.	Details of assembly of shaft and pulley.	----- Do-----
73	Dovetail and	Bearing- introduction	Details of	Triangle of forces,

	dowel pin assembly –scrape cylindrical bore.	,classification(Journal and Thrust Description of each , ball bearing : Single row, double row, description of each , advantages of double row.	assembly of bush bearing.	parallelogram of forces.
74	Scrap cylindrical bore and to make a fit – make a cotter jib assembly.	Roller and needle bearings: Types of roller bearing – Description & use of each. Method of fitting ball and roller bearings.	Details of assembly bush bearing.	Composition and resolution of forces.
75.	Scrape cylindrical taper bore check taper angle with sine bar –check taper angle (flat) with sine bar.	Bearing metals – types, Composition and uses lubricants-purpose of using different types, description and uses of each type.	Details of assembly of simple coupling.	Representation of forces by vectors – simple problems on lifting tackles like jib cranes, Wall cranes etc.
76.	Preparation of center squares, drills gauges.	Synthetic materials for bearing: The plastic laminate and material their properties and uses in bearings such as phoneolc, peilon polyamide (nylon).	----- Do-----	----- Do-----
<p>ACHIVEMENT : The trainee should be able to:</p> <ol style="list-style-type: none"> 1. File to an accuracy of +/- 0.04mm. on flat surfaces and on angular surfaces +/- 5 minutes. 2. Drill and ream to +/- 0.04mm. 3. Fit dowel pin ,studs, bolts and dovetailed slides etc. 4. Use of sine bar and slip gauges inspect angles to +/- 1minute. 5. Remetal scrape and assemble bearing's 				
77	File and fit straight and annular surface internally..	Hardening and tempering purpose of each method ,tempering colour	Details and assembly of a simple hand vice.	Moments of force couples..

		chart		
78	Heat treatment of tools .	Annealing and normalizing purpose of each method.	----- do-----	Simple problems on straight and bell cranked lever.
79	Flaring of pipes and pipe joints – heat treatment of cold chisels	Case hardening and carburising and its method process of carborising (solid liquid and gas)	Details and assembly of simple hand vice.	Center of gravity simple experimental determination , stable unstable & natural equilibrium – simple explanation.
80	H fitting exercises on lapping of gauges (hand lapping only)	Solder and soldering . Introduction –types of solder and flex method of soldering – Hard solder – introduction – types and method of brazing. -	-----do-----	-----do-----
81	Hand ream and fit taper pin drilling and reaming holes in correct location fitting dowel pins, studs and bolts.	Production of gauges, templates and jigs. The object of importance for preparing inter-changeable components.	-----do-----	Friction – co-efficient of friction.
82	Simple jig and fixtures for drilling	Drilling jig – constructional features, types and uses.	Blue print reading , simple exercises related to missing lines.	Simple problem related to friction.
83	Prepare a V Block and a clamp .	Fixtures – constructional features., types and uses.	Blue print reading, Simple exercises related to missing lines.	Magnetic substances – natural and artificial magnets.
84	Marking out as per blue print drilling, straight and curve filing. Threading with die, cutting slot, cutting internal threads with taps,	Revision	Blue print reading, simple exercises related to missing views	Method of magnetisation, use of magnets.

	making an adjustable spanner.			
85	Cutting and threading of pipe length – fitting of pipes as per sketch, conditions used for pipe work to be followed, bending of pipes cold and hot.	Pipes and pipe fitting commonly used pipes, pipe bending method, use of bending fixture, pipe threads std, pipe threads – die and tap, pipe vices.	-----do-----	Electricity and its uses, Electric current positive and negative terminals.
86	Practice dismantling and assembling globe valves, sluice valves, stop cocks, seat valves, and non-return valves. Fitting of pipes and testing for leakage.	Standard pipe fitting, methods of fitting or replacing the above fitting – repairs and erection on rain water drainage pipes, and house hold taps and pipe work. Use of tools such as pipe cutters, pipe wrenches, pipe dies, and taps, pipe bending machine etc.	Simple exercises relating missing symbols.	Use of fuses and switches conductors and insulator
87	Practice in handling fire extinguishers of different types, refilling of fire extinguishers.	Fire precautions, causes and types of fires – precautions against out break of fire, fire extinguishers, types and uses.	Simple exercises relating missing symbols.	Simple electric circuits, simple calculations.
88	Marking detail include male female screw cutting, male and female fitting parts, making and tempering springs.	Working material with finished surface as aluminum, duralum, stainless steel, The importance of keeping the work free from scratches or rust and corrosion the various coatings used to protect metals, protection coat by heat and electrical deposit	Simple exercises related to missing section.	Ohm's Law simple calculation, electrical insulating materials.

		treatments. Treatments and provide a pleasing finish as Chromium silver plating and nickel plating and galvanising.		
--	--	--	--	--

ACHIEVEMENTS:- The trainee should be able to :

1. 1. Carry out simple plumbing assembly.
2. 2. Male simple jigs and fixtures.
3. 3. Mark male and female parts of regular contours including tongue and groove, dove tailed slide to an accuracy of +/- 0.04 mm.

89	Exercises on finished material as aluminum and stainless steel, marking out cutting to sizes drilling etc. without damage to surface of finished articles.	Aluminum and its alloys. Uses advantages, and disadvantages; weight and strength as compared with steel.	Simple exercises related to missing section.	Graphs : Abscises and ordinates, graphs of straight line, related to two sets of varying quantities.
90	Making out for angular outlines – filing and fitting the inserts into gaps. Marking simple drilling jig Marking out - filing to line-drilling and tapping brass and copper jobs.	Tapers on keys and cutters permissible by various standards. Discuss non-ferrous metals as brass, phosphor-bronze, gun metal copper aluminum etc;. Their composition and purpose where and why used – advantages for specific purposes – surface wearing properties of bronze and brass	Simple exercises related to missing dimensions.	----do---
91	Complete exercises covering the assembly of parts working to detail and arrangement –Drawings., Dismantling and mounting of pulleys, Making replacing damaged keys, Repairing damaged gears and mounting . Repair & replacement of	Power transmission elements, The objects of belts – their sizes and specifications – materials of which the belts are made – selection of the type of belts with the consideration of weather lead and tension – methods of joining leather belts. Vee belts and their advantages and disadvantages - Use commercial belts	----do----- Industrial Visits.	Practice on simple pocket calculator

	belts. Industrial Visits	dressing and resin – creep and slipping – calculation for the size of new belt.		
92	Complete exercises covering the assembly of parts working to details and arrangements –drawings. Dismantling and mounting of pulley , Making replacing damaged keys . Repairing damaged gears and mounting them on shafts.	Power transmission – coupling – types – flange coupling – Holes coupling – universal coupling – universal coupling and their different uses	Further practice on logarithm.	Mechanical properties of metals
93	More difficult work in marking out including tangents templates involving use of vernier protractor.	Pulleys- types – solid split and “ V” belt pulleys – standard calculation for determining size crowing of pulleys width of faces – loose and fast pulleys Jockey pulley. Types of drives – open and cross belt drives. The geometrical explanation of the belt drivers at an angle	----do-----	----do-----
94	Fitting of dovetail slides	Power transmission – by gears most common form spur gear, set names of some essential parts of the set – The pitch circles- Diametal pitch velocity ratio of a	Solution of NCVT test	Heat treatment of steel- hardening , annealing, tempering, normalizing, case hardening , standard and measurement,.

		gear set Helical gear, herring bone gears, bevel gearing , spiral bevel gearing – hypoid gearing, pinion and rack , worm gearing, velocity of ratio of worm gearing. Repair to gear teeth by building up and dovetail method.		
95	Male and female dovetail fitting repairs to geared teeth, repair of broken gear tooth by stud. Repair broken gear teeth by dovetail.	Method of fixing geared wheels for various purpose drives. General causes of the wear and tear of the toothed wheels and their remedies – method of fitting – spiral gears- helical gears- bevel gears- worm and work wheels in relation to required drive. Care and maintenance of gears.	Solution of NCVT test papers.	Heat treatment of steel hardening , annealing, tempering, normalizing, case hardening, standard and measurement
96	Marking out on the round sections for geometrical shaped fittings . Finishing and fitting to size , checking up the faces for universality,	Lubrication and lubricants . How lubrication is done . A good lubricant , viscosity of the lubricant. Main property of lubricant. Main property of lubricant – How a film of oil is formed in journal. Bearing method of lubrication –gravity feed , force(pressure) feed, splash lubrication , Cutting lubricants and coolants:	----- do-----	Transmission of power by belt pulley & gear drive.

		Soluble oil – soaps _sudes _ paraffin – soda water – common lubricating oils and their commercial names selection of lubricants.		
97	Shaping- parallel black & W-Block.	Chains wire ropes and clutches for power transmission , Their types and brief description.	Solution of NCVT test papers.	Transmission of power belt pulley and gear drive.
98	Drilling for riveting . Riveting with as many types of rivet as available – use of counter sunk head rivets- use of counter bore tools to fit cheese head bolts . Use of pop rivets and gun.	Discuss the various rivets shape and form of heads _ riveting tools for drawing up the importance of correct head size. The spacing of rivets. Flash riveting use of correct tools- compare hot and cold riveting.	Revision.	----- do-----
99	Dismantling removal and reassemble of a simple machine tool. Dismantling and assemble of pillar type drilling machine.	Installation maintenance and overhaul of machinery and engineering equipment and alignment of machines.	Revision.	Solution of NCVT test papers.
100	Milling- plain ,Slot & angular cutting .	Clutch : Type positive clutch (straight tooth type , angular tooth type) FRICTION TYPE(flat and conical type). Washers. Types and calculation of washer sizes	Revision .	----- do-----
101- 102-	Griping –surface & circular.	The making of joints and fitting,	Revision.	----- do-----

	Simple repair of machinery- making of packing gaskets- use of hollow punches, extractor- drifts- various types of hammers and spanners, etc. Practicing, making various knots correct-loading of slings, correct and safe removal of parts. Erect simple machine.	packing.-The use of lifting appliances, extractor presses and their use . Practical method of obtaining mechanical advantage . The slings and handling of heavy machinery special precautions in the removal and replacement of heavy parts.		
103	Revision .	Revision.	Institute Test.	Institute Test.
104	Test.	Test.	Institute Test.	Institute Test.

ACHIVEMENT: The trainee should be able to:-

- 1 1 Dismantle and assemble simple machine parts and accessories.
- 2 2 Repair broken gear tooth.
- 3 3 Make simple drilling jig.
- 4 4 Erect machine.

TRADE:FITTER
LIST OF TOOLS AND EQUIPMENT FOR THE FIRST 52-WEEK(1YEAR)
For a batch of 16 trainees

Sr. No.	Name of tools & equipment	Quantity for		
		Instructor	Trainees	Total
1. 1.	2. 2.	3. 3.	4. 4.	5. 5.
1.	Rule steel 15 cm with metric graduations.	1	16	17
2.	Square try 10cm blade.	1	16	17
3.	Caliper outside 15cm spring.	1	16	17
4.	Caliper inside 15cm spring.	1	16	17
5.	Caliper 15 cm hermaphrodite	1	16	17
6.	Divider 15 cm spring.	1	16	17
7.	Scriber 15 cm.	1	16	17
8.	Punch center 10 cm .	1	16	17
9.	Screw driver 15 cm.	1	16	17
10.	Chisel cold 10	1	16	17
11.	Hammer ball pein 0. 45 kg. With handle.	1	16	17
12.	Hammer ball pein 0. 22 kg. With handle.	1	16	17
13.	File flat 25 cm. Second cut.	1	16	17
14.	File flat 25 cm smooth.	1	16	17
15.	File half round second cut 15cm.	1	16	17

16.	Hacksaw frame adjustable 20 – 30 cm.	1	16	17
17.	Safety goggles.	1	16	17
18.	Dot slot punch.	1	16	17

Tools -Instruments &General shop Outfit per Unit.

19.	Rule steel 30 cm to read metric.	4		
20.	Rule steel 60 cm.	4		
21.	Straight edge 45 cm steel.	2		
22.	Plate surface 45 cm x45 cm.	2		
23.	Marking table 91 x91 x 122 cm.	1		
24.	Universal scribing block 22cm.	2		
25.	Block – Vee pair 7 cm and 15 cm with clamps.	2		
26.	Square adjustable 15 cm blade.	2		
27.	Angle plate 10 x 20 cm.	2		
28.	Level sprit 15 cm metal.	1		
29.	Punch letter 3 mm set.	1		
30.	Punch number set 3 mm.	1		
31.	Punch hollow 6mm to 19 set of 5.	2		
32.	Punch round 3mm x4mm set of 2	2		
33.	Portable hand drill (Electric)0 to 6mm.	2		
34.	Drill brace hand to 12mm.	2		
35.	Drill twist S/S 1.5 to 12mm. By 0.4mm	1set		
36.	Drill twist S/S 8mm to 15mm by 1/2mm	1set		
37.	Brace ratchet with pillar.	1		
38.	Taps and dies complete set in box B .A .	1		
39.	Taps and dies complete set in box B.S.F	1		
40.	Taps and dies complete set in box whit worth.	1		
41.	Taps, dies complete set in box American.	1		
42.	Taps and dies complete set in box (Metric).	1		
43.	File warding 15cm smooth.	4		

44.	File knife edge 15cm smooth.	4		
45.	File cut saw 15cm smooth.	4		
46.	File feather edge 15cm smooth.	4		
47.	File triangular 15cm smooth.	2		
48.	File round 20 cm second cut.	8		
49.	File square 15 cm second cut.	4		
50.	File square 25 cm second cut.	4		
51.	Feeler gauge 10 blades.	1set		
52.	File triangular 20 cm second cut .	8		
53.	File flat 30 cm second cut.	8		
54.	File flat 20cm bastard.	8		
55.	File flat 30 cm bastard.	8		
56.	File Swiss type needle set of 12.	2sets		
57.	File half round 25cm second cut.	8		
58.	File half round 25cm bastard.	8		
59.	File round 30 cm bastard.	4		
60.	File hand 15cm second cut.	8		
61.	Card file.	8		
62.	Stone oil 15cm x 5cm x 2.5cm.	4		
63.	Stone carborandum 15cm x 5cm x 5cm x 4cm.	2		
64.	Can oil 0.25 liters.	2		
65.	Pliers combination 15 cm.	2		
66.	Iron soldering 350 gm.	2		
67.	Lamp blow 0.55 liters.	2		
68.	Spanner whit-worth D>E> 6mm. To 25 mm set of.	8		
69.	Spanner adjustable 15cm.	2		
70.	Interchangeable ratchet socket set with a 12mm driver-socket range : 4mm set of 8.	1set		
71.	“Apollo” box spanner set in mm 3x 4. 6x7,9x11,12x14, 15x19, 22x25, set of 6.	1set.		
72.	Glass magnifying 7cm.	2		
73.	Clamp tool maker 5cm and 7.5 cm set of 2.	2		
74.	Clamp “C” 5 cm.	2		
75.	Clamp “C” 10 cm.	2		
76.	Reamer adjustable max.9mm 12m, 19mm- set of 3.	1set		
77.	Reamer taper 4mm to 9 mm set of 4.	1		
78.	Reamer parallel 16mm to 12 mm set of 5.	1		
79..	Scraper flat 15 cm.	8		

80.	Scraper 3 corner 15cm.	8		
81.	Scraper half round 15 cm.	8		
82.	Chisel cold 9mm cross cut 9mm diamond.	8each.		
83.	Chisel cold 19mm flat.	8		
84.	Chisel cold 9mm round nose.	8		
85.	Extractor stud EZY- out.	2		
86.	Set combination 30 cm.	2		
87.	Micrometer 0-2.5 cm outside.	3		
88.	Micrometer 25-50 mm outside.	3		
89.	Micrometer 50-25mm outside.	4		
90.	Micrometer 50-75 mm outside.	1		
91.	Micrometer inside 25mm to 50mm with extension rods.	1		
92.	Vernier caliper 20 cm.	1		
93.	Vernier height gauge 30cm.	1		
94.	Veriner level protractor.	1		
95.	Screw pitch gauge.	1		
96.	Wire gauge , metric standard.	1		
97.	Drill twist T/S6mm to 25 mm x 1.5mm.	1set		
98.	Drill chuck 12mm.	1		
99.	Pipe wrench 40 cm.	1		
100.	Pipe wrench 30 cm.	1		
101.	Pipe vice No. 4.	2		
102.	Adjustable pipe die 0-205 cm cap.	1		
103.	Wheel dresser (One for 4 units).	1		
104.	Machine vice 10 cm.	1		
105.	Machine vice 15 cm.	1		
106.	Sleeve drill morse 0-1 , 1-2 . 2-3.	1 Set		
107.	Vice bench 12 cm jaw.	16		
108.	Vice leg 10-cm jaw.	2		
109.	Bench working 240 cm x 120 cm x 60 cm..	4		
110.	Almirah ;180 x 90 x 30 cm.	2		
111.	Lockers with 8 drawers (standard size).	2		
112.	Metal rack 182 cm x 182 cm x 4.5 cm.	1		
113.	Desk.	1		
114.	Stool.	1		
115.	Black board with easel.	1		
116.	Fire extinguisher (For 4 Units).	2		
117.	Fire buckets.	2		
118.	Machines vice.	2		

119.	Wing compass 25.4 cm or 30 cm.	2		
120.	Hand hammer 1 kg . with handle.	2		

Tools for Allied Trade – Backsmithy & Sheet Metal work

121.	Hammer smith 2 kg , with handle.	2	
122.	Tongs round	2	
123.	Tong flat.	2	
124.	Smith's square 45 cm x 30 cm.	1	
125.	Cold set rodded.	2	
126.	Hot set rodded.	1	
127.	Swages top & Bottom 12 mm/ 19 mm/ 25 mm (pair)	1 Each	
128.	Swage block 35 cm x 35 x 12 cm	1	
129.	Flatters (rodded) 55 mm squares.	2	
130.	Fuller top & bottom 6 mm,9mm (Pair).	2	
131.	Anvil 50 kg.	2	
132.	Anvil Stand.	2	
133	Shovel	2	
134	Trammer	1	
135	Racks	2	
136	Quenching tank	1 (to be made in the institute)	
137	Pocker	2	
138	Handle	2	
139	Leather apron	2	
140	Prick punch	2	
141	Mallet	2	
142	Snips straight 25 cm	2	
143	Setting hammer with handle	2	
144	Planishing hammer	2	
145	Snip bent 25 cm	2	
146	Stake hatchet	2	
147	Stake grooving	2	
148	Gauge imperial sheet	1	

GENERAL MACHNERY INSTALLATION :

1	Anvil 50 kg. On stand	1
2	Drilling machine piller sensitive 0 –20 mm cap with swivel table motorised with chuck & key	1
3	Drilling machine bench sensitive 0- 12 mm cap motorized with chuck & key	2

4	Forge portable hand blower 38 cm to 45 cm	1
5	Grinding machine (general purpose) D.E. pedestal with 20 cm dia. Wheels rough and smooth with twist drill grinding attachment	1

NOTE :

1. 1. No additional items of the above list are required to be provided for a batch of 16 trainees working in the second shift except the item under trainees tool kit and lockers.
2. 2. No additional number of items (*) marked are required to be provided up to four batches of trainees I.E. two batches in the first shift and two in the 2nd shift.
3. 3. Drilling machine (bench type) one additional number is required to be provided for each additional batches i.e. in the Ist and IInd shift.

MODIFIED LIST OF TOOLS FOR THE IIND YEAR OF FITTER TRADE

1	Gauge slip as Johnson metric set	1
2	Carbide wear block 1 mm- 2mm	2each
3	Gauge snap go and no go 25 to 50 mm by 5 mm	1 set
4	Gauge plug single 3ended 5 to 55 mm by 1mm	1set
5	Gauge telescopic	1 set
6	Dial test indicator .01 mm on stand	1
7	Sine bar 125 mm	1
8	Sine bar 250mm	1
9	Lathe tools HSS tipped set	2
10	Lathe tools bit 6mm x 75 mm	12
11	Lathe tools bit 7mm x 75 mm	12
12	Lathe tools bit 9mm x 85 mm	12
13	Arm strong type tool bit holder R.H.	2
14	Arm strong type tools bit holder L.H.	2
15	Arm strong type tool bit holder straight	2
16	Stilson wrenches 20 cm	2
17	Spanner monkey up to 5 cm	2
18	Pipe cutter 6mm to 50mm wheel type	1
19	Pipe face to grip pipe up to 50mm	2
20	Pipe stock and dies complete with stocks , bushing, bushing holders, tap, tap wrenches size covered 19mm 25mm 32mm 6mm 9mm 12mm 19mm 25mm 32mm 38mm 50mm	1 set
21	Pipe bender spool type with stand manually operated	1
22	Adjustable spanner 38 cm long	1
23	Adjustable pipe chain tongs 22 cm long to take pipes from 3 cm to 63 cm	1
24	Dial Vernier caliper 0- 130 mm LCO .05 mm (Universal types)	1
25.	Screw thread micrometer with interchangeable 0.4 – 1.75 mm pitch anvils for checking metric threads 60	1
26	Depth micrometer 0-100 mm 0.01 mm	1
27	Vernier caliper with thumb block 0-130 mm LCO 0.2 mm	1
28	Comperator stand with dial indicator	1
29	Engineers try square (knife and wedge)	1
30	Surface roughness comparison plates ruberts	1 set

SYLLABUS FOR THE TRADE OF FITTER
UNDER
APPRENTICESHIP TRAINING SCHEME
PERIOD OF TRAINING : 3 YEARS

NOTE :

1. 1. All freshers should under go one year Basic Training followed by two years training on the shop floor. The apprentice should have more practice on the shop floor on those operations/ skills which have been already learnt during Basic training.
2. 2. The content of first year of two year training in the Industrial trg. Inst. In this trade is exactly same as mentioned in (1)above. The trainees in Industrial training Institute who may be engaged in Industrial Training Shop Floor Training after one year training in ITI should follow the same course for apprenticeship as in (1) above.
3. 3. The operations / skills marked (*) would be taught to the trainees in ITI in this trade in the second year. The Ex-ITI trainees i.e. those who after completions of two yr. In ITI's would be engaged for under going apprenticeship training for the remaining period of one year in this trade should learn the remaining operations/ skills, if , any, on the shop floor during apprenticeships and develop his method of work speed, accuracy/ skills already learnt by him earlier.

Sr. no.	List of operations/ skills to be learnt during apprenticeship
1	2
	BASIC TRAINING : 1 YEAR
1	File surfaces flat, sq. and parallel to an accuracy of .04mm
2	Drill holes through and blind (from 6.. to 12 mm)
3	Form threads internal and external for standard screw sizes above (6mm to 15mm)and ¼ to ¾ “ (using taps and dies)
4	Punch letters and nos. along a line with correct spacing
5	Make and fit sliding fits to an accuracy of .04 mm and conforming IS standard specifications
6	Make sq. , triangular and hexagonal fits to an accuracy of + .02 mm and conforming ISI standards specs.
7	Prepare keys and key ways on shaft and assemble
8	Chip surfaces flat, chip slots, and cut oil grooves.
9	Scrape flat surfaces and bearings.
10	Counter sink, counter bore, spot face.
12	Finish drilled hole by hand and machine reaming
12	File angles internal and external to an accuracy of 90 min.
13	File radius internal and external and check with radius gauge
14	File and fit internal and external profiles.
15	Make small rectangular contains from sheet metal
16	Bend brackets from thin mild steel strips.

17	Carry out forging and heat treatment operations required for reconditioning and repairing of chisels, punches, scribes and screw drivers.
18	Repair and maintain ordinary fitters tools such chisel hammer screw drivers, scribes, center punch dividers and scrappers
19	Dismantle repair & assemble simple machine and sub assemble
20	Repair broken gear teeth by dovetail patch and fixing studs
21	Weld a MS bracket
22	Weld base to plate
23	Weld two plates of same thickness
24	Weld two lengths of M.S. rods of same diameter
25	Gas cut plates & sheets for the required dimensions

SHOP TRAINING : 2 YEARS

1	File and fit matting parts with an accuracy +.02 mm and to ISI specs.
2	Scrape angular matting & sliding surfaces & originate flat surfaces without master
3	Assemble components accurately using dowel pins & screws
4	Re metal & scrape bearings
5	Check taper & angles width sine bar ream tapers and fit pins
6	Ream tapers and fit pins
7	Drill through & blind holes at an angles
8	Thread standard pipes, join pipes & make pipe assemble
9	Lap and finish flat surfaces
10	Solder & joint ferrous and non ferrous components (soft & hard)
11	Heat treat plain carbon steel
12	Make spring & heat treat
13	Make oil grooves on bearing with chisel
14	Bond steel pipes to different radius & angles.
15	Anneal and bend copper pipes to different shapes
16	Handle jig and fixtures
17	Make simple limit gauges & templates
18	Repair a broken gear teeth by pegging and dovetailing
19	Dismantle & minor repair and assemble, simple machine tools such as drilling machine, shaper, slotter, lathe & saw
20	Erect and align machines
21	Size metal parts to close tolerances and fits and assemble them using hand tool for production for repairs of mechanical device or other metal products
22	Assemble parts by riveting screwing pinning welding so as to make complete unit according to drg.
23	Assemble finished mechanical components to form specific unit or machine such as grinder pump etc. using hand tools machines.
24	Dismantle or remove worn out broken or defective parts using hand tools and replaced them by repaired or new ones test completed article to ensure

	correct performance.
25	Fit parts together in set order using nuts bolts, screws and pins etc. with necessary wrenches spanners & other special tools
26	Mounting of pulleys and gears on shaft
27	Mechanical handling of machines for transportation purposes involving the use of screw jacks pulleys blocks, cranes, hoists and slings roller bars & wire ropes etc.
29	Remove & fit Ball & roller bearings
30	Familiarisation with pumps air compressor pneumatic tools and hydraulic driver machines.

NOTE :

During the training period stress should be given to form safe working habits & where ever facilities available they should be taught handling of fire fighting equipment.

SYLLABUS FOR RELATED INSTRUCTIONS III RD YEAR

Related Instructions should be imparted to all the apprentices during the entire period of training. Including basic training. The subjects to be taught to the apprentices in the Related Instructions :

1.	1.	Trade theory	3 weeks	or	105 hrs.
2.	2.	W/s cal. & science	2 weeks	or	70 hrs.
3.	3.	Engg. Drg.	2 weeks	or	70 hrs.
4.	4.	Social studies	1 week	or	35 hrs.
Total =			8 weeks	or	280 hrs.

TRADE THEORY :

1st week :

Safety at work accident their causes general safety rules & apprentices in a w/s

Safe working devices guards attachments.

Machine tools & operative constructional features, types, functions & uses of Lathe drilling M/c shaping M/c grinding machine and their care & maintenance.

Common running operations cutting speed & feeds, cutting tools its different angles chucks and checking threads threading use of coolants gearboxes & drives

Common drilling boring & reaming operations its tools & ,materials speed & feeds different frilling techniques.

Description of grinding machines surface grinder portable grinder and pedestal grinder common grinding operations.

Common shaping operations tools its material speed & feed different work holding methods

Limits fits and interchangeability. Definition of interchangeability & its necessity in Engg. Field

Terms of limits as per IS : 919- 1963

Def types of limit basic size actual size deviation high & low limit

Methods of expressing tolerance as per IS , tolerance , zeroes, clearance, & interference (max, min, mean)

Fits : def. Types description of each with sketches system of limit hole shaft basis

Simple problems on limit fits using relevant ISI

2nd week

heat treatment of metals annealing tempering normalizing & case hardening of mild steel components heat treatment of cutting tools changes in the properties of materials due to heat effects.

Joining & fastening devices permanent semi permanent and temporary fasteners of different types & their functions bolts nuts rivets studs pins cotters keys screws tapers etc.

Power transmission & drives belts & belting its types sizes & use of belts belt fastener speed parallel & cross drives

Use of commercial belt dressing resins, creep & slip calculation for the size of the new belt

Toothed gear & gearing types & uses of spur helical bevel herring bone spiral bevel gearing rack & pinion worm & worm wheel method of fixing geared wheels for various purpose devices.

Chain & sprockets description types uses & method of fixing

Mechanical hydraulic pneumatic drives basic principles

Prime movers line shaft drive system & self drive system different drive reciprocating reverse eccentric crank cam, rotary to linear & vice versa.

System of speed variation using stepped pulleys gear box disc contact speed control (electrically & hydraulically)

Bearing necessity & classification description of each ball bearing single row & double row description & advantage roller & needle bearing type & description of each.

Lubrication lubricants necessity & types of lubricants liquid semiliquid & solid properties of lubricants, viscosity oiliness, sp. Gravity, flash point, fire point, freezing point, qualities of good lubricants & importance of correct use of lubricants & their commercial names.

System of lubrication gravity feed force feed splash method etc.

3rd week : Inspection –need of inspection, types of inspection . stage inspection, routine inspection, final inspection. Types of instruments and equipment used for inspection.

Introduction to work simplifications related to the trade- job study, job analysis, planning of sequence of operations.

Maintenance- it's importance in productivity, safety, service life of tools/equipments;

General maintenance- work- cleaning, lubrication, adjustments of parts, repairing, inspection/ testing, overhauling and painting ; system of maintenance – routine , preventive , breakdown, details of daily maintenance – daily , weekly.

Material Handling – different types of appliances and tackle for shifting. Loading and unloading of machine and equipment.

Screw-jack- use and working principle.

Chain pulley blocks- use and working principle.

Cranes and hoists for lifting purposes – working principle and main constructional features.

Working principles and use of other tackles like crab and wrenches, slings, rollers, bars and levers.

Special precautions in the handling of heavy equipment , removal and replacement of heavy parts.

Quality and finish of work- Surface finish – necessity – degree of surface finish – surface finish symbol and its numerical value, methods of surface finish processes such as lapping, honing buffing.

Protection of finished surface - like pickling, oxidising , electroplating, galvanising, metal spraying, metalisation and anodizing.

WORKSHOP CALCULATION & SCIENCE

Ist – Week : Revision and further problems in ;relation to the trade.

Problems on mensuration, work , power and energy.

Mechanical properties – tenacity, elasticity , malleability , brittleness, hardness , ;compressibility and ductility.

Stress, strain , modulus of elasticity , ultimate tensile strength , factor of safety and different types of stresses.

Gear and belt drive. Determination of horse power , speed and size of pulleys and gears.

2nd Week : Difference between pressure and force.

Velocity , acceleration ;and retardation.

Description and explanation of solids, liquids and gases due to heat ; coefficient of expansion;

Description of transfer heat, conduction , convection and ;radiation.

ENGINEERING DRAWING :

1st Week : Advance blue print reading ;

Free hand sketching of details from assembly drawings and vice – versa.

2nd Week : Code practice for General Engineering Drawing according to IS : 696 - 1960

Further free hand sketching of isometric view of different parts.