सत्यमेव जयते

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

COMPETENCY BASED CURRICULUM

FITTER

(Revised in 2017)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL - 5

कौशल बलम्

Industrial Training Institute

Skill India
कौशल भारत - कुशल भारत

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1. INTRODUCTION

Industry Context

Fitter trade under Craftsman Training Scheme (CTS) is one of the most popular courses running on pan India through ITIs. The course is of two years (04 semester) duration. It mainly consists of trade (skills and knowledge) and Core area (Workshop Calculation and science, Engineering Drawing and Employability Skills). After passing out the training programme, the trainee is being awarded National Trade Certificate (NTC) by National Council of Vocational Training (NCVT) having worldwide recognition.

During the 02 years duration a candidate is trained on subjects Professional Skill, Professional Knowledge, Engineering Drawing, Workshop Science & Calculation and Employability Skills. In addition to this a candidate is entrusted to make/do project work and Extra Curricular Activities to build up confidence. The practical skills are imparted in simple to complex manner & simultaneously theory subject is taught in the same fashion to apply cognitive knowledge while executing task. The practical part starts with basic fitting with tolerance level ± 0.5mm and finally to ± 0.02mm and angular tolerance from 1° to 10′ at the end of the course. Total three projects need to be completed by the candidates in a group.

After successful completion of this course the trainee shall be able to work in the field of pipe fitting, lathe, drilling, welding, Inspection & measurement, general fitting work observing safety precautions. The trainee can work on dismantling & assembly of various valves, test the accuracy of Machine tools; perform simple repair on machinery, dovetail slides and assemble with location dowel pins, stud and bolts and prepare snap gauge for checking diameters to an accuracy of ± 0.02 mm, etc.

About the Curriculum

This Competency based Curriculum Standard has been developed in keeping with the Qualification of "Fitter" in the National Qualifications Register under the Craftsman Training Scheme (CTS)[1] of the Government of India. The Curriculum Standard provides a structure for developing industry aligned practical skills and theoretical knowledge for performing various tasks of an Fitter as defined in the National Classification of Occupations (NCO)[2].

The objective of this course is to develop competence in the learners in performing the various tasks required of an Fitter by imparting training on the practical skills and their underpinning knowledge and generic abilities using a structured, outcome based training approach. This involved focusing on hands on practical training and assessment of specified learning outcomes.

The areas of competence and the key learning outcomes covered in the course are as follow:

Sr. No.	Broad Areas of Competence	Key Learning Outcomes
1	Plan and organise work	1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy. [Basic fitting operation – marking, Hacksawing, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]
	Joining techniques for sheet metal and metal	2. Manufacture simple sheet metal items as per drawing and join them by soldering, brazing and riveting.

[1] *For further details on CTS please refer to section 9 of this document*

[2] *The NCO classification code for the job roles that this course is aligned to is given in section 2 of this document*

	components	3. Join metal component by arc welding observing standard procedure. 4. Cut and join metal component by gas (oxy-acetylene) 5. Join metal components by riveting observing standard procedure.
	Producing metal components	6. Produce components by different operations and check accuracy using appropriate measuring instruments.[Different Operations - Drilling, Reaming, Taping, Dieing; Appropriate Measuring Instrument – Vernier, Screw Gauge, Micrometer] 7. Make different fit of components for assembling as per required tolerance observing principle of interchangeability and check for functionality. [Different Fit – Sliding, Angular, Step fit, 'T' fit, Square fit and Profile fit; Required tolerance: ±0.04 mm, angular tolerance: 30 min.] 8. Produce components involving different operations on lathe observing standard procedure and check for accuracy. [Different Operations – facing, plain turning, step turning, parting, chamfering, shoulder turn, grooving, knurling, boring, taper turning, threading (external 'V' only)] 9. Make & assemble components of different mating surfaces as per required tolerance by different surface finishing operations using different fastening components, tools and check functionality. [Different Mating Surfaces – Dovetail fitting, Radious fitting, Combined fitting; Different surface finishing operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools- hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.]
	Performing pipe fitting	10. Apply a range of skills to execute pipe joints, dismantle and assemble valves & fittings with pipes and test for leakages.[Range of skills – Cutting, Threading, Flaring, Bending and Joining]
2	Making gauges and drill jigs	11. Make different gauges by using standard tools & equipment and checks for specified accuracy. [Different Gauges – Snap gauge, Gap gauge; Specified Accuracy - ±0.02mm] 12. Make drill jig & produce components on drill machine by using jigs and check for correctness.
3	Assembly and fitting of pneumatic and hydraulic components	13. Identify, dismantle, replace and assemble different pneumatics and hydraulics components. [Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.]. 14. Construct circuit of pneumatics and hydraulics observing

		standard operating procedure& safety aspect.
4	Maintenance and Repair	15. Plan & perform simple repair, overhauling of different machines and check for functionality. [Different Machines – Drill Machine, Power Saw, Bench Grinder and Lathe] 16. Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. [Different Damage Mechanical Components – Pulley, Gear, Keys, Jibs and Shafts.] 17. Plan & perform basic day to day preventive maintenance, repairing and check functionality.[Simple Machines – Drill Machine, Power Saw and Lathe
	Erection and testing of simple machine tools	18. Plan, erect simple machine and test machine tool accuracy. [Simple Machines – Drill Machine, Power Saw and Lathe].
11.	Generic Skills • Health and Safety • Environment regulation and housekeeping • Mathematics • Science • Engineering drawing • Productivity and Quality • Personal Finance and Entrepreneurship • Planning and organisation	19. Recognize & comply safe working practices, environment regulation and housekeeping. 20. Understand and explain different mathematical calculation & science in the field of study including basic electrical. [Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure] 21. Interpret specifications, different engineering drawing and apply for different application in the field of work. [Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol] 22. Select and ascertain measuring instrument and measure dimension of components and record data. 23. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality. 24. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources. 25. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth. 26. Plan and organize the work related to the occupation.

Employment Opportunities

Fitters have a wide scope of Employability ranging from self-employment, contractual employment to Industrial jobs. On successful completion of this course, the candidates shall be gainfully employed in the following industries:

- Production & Manufacturing industries.
- Structural Fabrication like bridges, Roof structures, Building & construction.
- Automobile and allied industries
- Service industries like road transportation and Railways.
- Ship building and repair
- Infrastructure and defence organizations
- In public sector industries like BHEL, BEML, NTPC, etc and private industries in India & abroad.
- Self employment

Further learning pathways:

- On successful completion of the course trainees can pursue Apprenticeship training in the reputed Industries / Organizations.
- On successful completion of the course trainees can opt for Diploma course (Lateral entry).
- On successful completion of the course trainees can opt for CITS course.

2. JOB DESCRIPTION

Brief description of Job roles:

Fitter General sizes metal parts to close tolerances and fits and assembles them using hand tools for production or repairs of machines, or other metal products. Studies drawings to understand specification of different parts, fittings or assembles to be made and their functions. They select materials, appropriate tool and equipments to carry out their work. Holds the work in Vice, Cuts and shapes required parts to dimensions and specifications by processes of sawing, chipping, filing, grinding, drilling holes, screw cutting, scrapping etc., using hand tools for making specimens or finished components. Measures object while working using foot rules, calipers, micrometer, gauges etc. and checks for correct filing with square. Gets half-finished object marked or marks it himself using face plate, marking block scriber, vernier, height gauges, vee-blocks, angle plate, sine plate, slip gauges, combination set, etc. depending on accuracies required, to indicate guide lines for finished sizes, holes to be drilled and pitch centres, threads to be cut and other working details as specified in drawing or sample. Clamps object securely in correct position in vice and files it to required dimensions according to punch marks and guide lines frequently measuring it with calipers, micrometer, vernier, gauges etc, makes holes with drill, cuts threads with taps and dies ensuring that they are square or at required angle to base. Measures finished article with dial indicator, micrometer, vernier, height gauges, screw gauges, plug gauges, sine bar, slip gauge, etc according to prescribed accuracies. May make parts separately and assemble those with screws, rivets, pins, etc. as specified so as to make complete unit according to drawing. Dismantles or removes worn out, broken or defective parts using hand tools or power tools and replaces them by repaired or new ones. Performs repairing and maintenance work (including preventive maintenance) of simple machines, dismantles and replaces different components to construct circuit of Pneumatics and Hydraulics. Tests completed article/ assembly to ensure correct performance. May do simple turning of parts on machines and perform welding, brazing, and like operations. May explain heat treatment processes viz., annealing, hardening, tempering etc. May specialize in particular type of machine or product and be designated accordingly. May suggest alterations.

In addition Fitter have the ability to visualize the job, good coordination, mechanical attitude, manual dexterity and perform work related mathematical calculations. Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity. May be designated as FITTER General according to nature of work done.

Reference NCO & NOS:
i) NCO-2004: 7233.10
ii) NCO-2004: 7233.20

NOS:-

SL. NO.	TRADE NAME	QP MAPPING	NOS
1.	SHEET METAL WORKER	CSC/Q0301	(N/0301, N/1335, N/1336)
2.	FITTER MECHANICAL ASSEMBLY	CSC/Q0304	(N/0304, N/1335, N/1336)
3.	OPERATOR CONVENTIONAL TURNING	CSC/Q0110	(N/0110, N/1335, N/1336)
4.	MAINTENANCE -FITTER	CSC/Q0901	(N/0901, N/1335, N/1336)

	MECHANIC		
5.	FITTER FABRICATION	CSC/Q0303	(N/0303, N/0201, BRIDGE MODULE-MMAW/SMAW, N/1335, N/1336)
6.	ASSTT. MMAW/SMAW WELDER	CSC/Q-0202	(N/0202, N/0201, N/1335, N/1336)
7.	MMAW/SMAW WELDER	CSC/Q0204	(N/0204, N/0201, N/1335, N/1336)
8.	GRINDER HAND HELD TOOL	CSC/Q0302	(N/0302, N/1335, N/1336)
9.	PLUMBER (GENERAL) HELPER	PSC/Q0101	(N/0110, N/0108, N/0109)
10.	PLUMBER (GENERAL) ASSTT.	PSC/Q0102	(N/0129, N/0108, N/0109)
11.	TOOL & DIE MAKER	CSC/Q0306	(N/0307, N/0308, N/0302, N/0110, N/0309, N/0108, N/0109, N/1335, N/1336) *[except-N/0307, N/0108, N/0109]*
12.	SERVICE ENGINEER INSTALLATION	CSC/Q0501	(N/0501, N/1335, N/1336)
13.	SERVICE ENGINEER BREAKDOWN SERVICE	CSC/Q0503	(N/0501, N/0502, N/0505, N/1335, N/1336)

Career Progression Pathways

- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.

3. GENERAL INFORMATION

Basic Information

1. Qualification : **FITTER**
2. NSQC Level : Level - 5 *[3]
3. Duration of Craftsmen Training : 2 Years (4 Semesters each of six months duration)
4. Entry Criteria : Passed 10th Class with Science and Mathematics under 10+2 system of Education or its equivalent
5. Unit Strength (No. Of Student) : 16 (Max. supernumeraries seats : 5)

Distribution of training on Hourly basis (Indicative only)

Total Hrs /week	Trade Practical	Trade Theory	Workshop Cal. & Sc.	Engg. Drawing	Employability Skills	Extra-Curricular Activity
40 Hours	25 Hours	6 Hours	2 Hours	3 Hours	2 Hours	2 Hours

The training duration of course in hours during a period of two years (04 semesters) is as follows-

Sl. No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	2209
2	Professional Knowledge (Trade Theory)	510
3	Workshop Calculation & Science	170
4	Engineering Drawing	255
5	Employability Skills	110
6	Library & Extracurricular activities	146
7	Project work	240
8	Revision & Examination	520
	Total	**4160**

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[3] *For further details on NSQF level refer to Section 9 of this document*

4. TRADE SYLLABUS AND TRAINING PLAN

Semester 1 (6 Months)

Learning Objectives

1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy. [Basic fitting operation – marking, Hacksawing, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]
2. Manufacture simple sheet metal items as per drawing and join them by soldering, brazing and riveting.
3. Join metal component by arc welding observing standard procedure.
4. Cut and join metal component by gas (oxy-acetylene)
5. Join metal components by riveting observing standard procedure.

The session plan will be as follows:

Week	Learning Outcome	Trade Practical	Assessment Criteria and Underpinning knowledge
1.	Recognize & comply safe working practices, environment regulation and housekeeping.	1. Importance of trade training, List of tools & Machinery used in the trade.(1 hrs.) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (5 hrs.) 3. First Aid Method and basic training.(2 hrs.) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (2 hrs.) 5. Hazard identification and avoidance. (2 hrs.) 6. Safety signs for Danger, Warning, caution & personal safety message.(1 hrs.) 7. Preventive measures	***Assessment Criteria*** • Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements. • Recognize and report all unsafe situations according to site policy. • Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures. • Identify, handle and store / dispose off dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements. • Identify and observe site policies and procedures in regard to illness or accident. • Identify safety alarms accurately. • Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures. • Identify and observe site evacuation procedures according to site policy. • Identify Personal Productive Equipment (PPE) and use the same as per related working environment. • Identify basic first aid and use them under different

		for electrical accidents & steps to be taken in such accidents.(2 hrs.) 8. Use of Fire extinguishers.(7 hrs.) 9. Practice and understand precautions to be followed while working in fitting jobs. (2 hrs.) 10. Safe use of tools and equipments used in the trade. (1 hrs.)	circumstances. • Identify different fire extinguisher and use the same as per requirement. • Identify environmental pollution & contribute to avoidance of same. • Take opportunities to use energy and materials in an environmentally friendly manner • Avoid waste and dispose waste as per procedure • Recognize different components of 5S and apply the same in the working environment. ***Underpinning Knowledge*** • All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. • Soft Skills: its importance and Job area after completion of training. • Importance of safety and general precautions observed in the in the industry/shop floor. • Introduction of First aid. Operation of electrical mains. Introduction of PPEs. • Response to emergencies e.g.; power failure, fire, and system failure. • **Importance of housekeeping & good shop floor practices.** Introduction to 5S concept & its application. • **Occupational Safety & Health**: Health, Safety and Environment guidelines, legislations & regulations as applicable.
2.	Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy. *[Basic fitting operation – marking, Hacksawing, Chiseling, Filing,*	11. Identification of tools &equipments as per desired specifications for marking & sawing. (5 hrs.) 12. Selection of material as per application.(1 hrs.) 13. Visual inspection of raw material for rusting, scaling, corrosion etc.(1 hrs.) 14. Marking out lines,	***Assessment Criteria*** • Plan and Identify tools, instruments and equipments for marking and make this available for use in a timely manner. • Select raw material and visual inspect for defects • Mark as per specification applying desired mathematical calculation and observing standard procedure. • Measure all dimensions in accordance with standard specifications and tolerances. • Identify Hand Tools for different fitting operations and make these available for use in a timely manner. • Prepare the job for Hacksawing, • Perform basic fitting operations viz., Hacksawing to close

	Drilling, Taping and Grinding etc. Accuracy: ± 0.25mm]	gripping suitably in vice jaws, hacksawing to given dimensions. (10 hrs.) 15. Sawing different types of metals of different sections. (8 hrs.)	tolerance as per specification to make the job. • Observe safety procedure during above operation as per standard norms and company guidelines. • Check for dimensional accuracy as per standard procedure. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** • Linear measurements- its units, dividers, calipers, hermaphrodite, centre punch, dot punch, their description and uses of different types of hammers. • Description, use and care of 'V' Blocks, marking off table.
3.	-do-	16. Filing Channel, Parallel. (5 hrs.) 17. Filing- Flat and square (Rough finish), (10 hrs.) 18. Filing practice, surface filing, marking of straight and parallel lines with odd leg calipers and steel rule. (5 hrs.) 19. Marking practice with dividers, odd leg calipers and steel rule (circles, ARCs, parallel lines). (5 hrs.) (caliper practical here, but knowledge in week 10)	***Assessment Criteria*** • Identify Hand Tools for different fitting operations and make these available for use in a timely manner. • Prepare the job for filing • Perform basic fitting operations viz., filing to close tolerance as per specification to make the job. • Observe safety procedure during above operation as per standard norms and company guidelines. • Check for dimensional accuracy as per standard procedure. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** • Bench vice construction, types, uses, care & maintenance, vice clamps, hacksaw frames and blades, specification, description, types and their uses, method of using hacksaws. • Files- specifications, description, materials, grades, cuts, file elements, uses. Types of files, care and maintenance of files. • Measuring standards (English, Metric Units), angular measurements.
4.	-do-	20. Marking off straight lines and ARCs using scribing block and dividers. (5 hrs.) 21. Chipping flat surfaces	***Assessment Criteria*** • Mark as per specification applying desired mathematical calculation and observing standard procedure. • Observe safety procedure during above operation as per standard norms and company guidelines.

		along a marked line. (10 hrs.) 22. Marking, filing, filing square and check using tri-square.(10 hrs.)	• Check for dimensional accuracy as per standard procedure. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** • Marking off and layout tools, dividers, scribing block, odd leg calipers, punches- description, classification, material, care & maintenance. • Try square, ordinary depth gauge, protractor- description, uses and cares. • Calipers- types, material, constructional details, uses, care & maintenance of cold chisels- materials, types, cutting angles.
5 & 6	-do-	23. Marking according to simple blue prints for locating, position of holes, scribing lines on chalked surfaces with marking tools. (20 hrs.) 24. Finding center of round bar with the help of 'V' block and marking block. (5 hrs.) 25. Joining straight line to an ARC.(25 hrs.)	***Assessment Criteria*** • Plan and Identify tools, instruments and equipments for marking and make this available for use in a timely manner. • Mark as per specification applying desired mathematical calculation and observing standard procedure. • Measure all dimensions in accordance with standard specifications and tolerances. ***Underpinning Knowledge*** • Marking media, marking blue, Prussian blue, red lead, chalk and their special application, description. • Use, care and maintenance of scribing block. • Surface plate and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types, uses, accuracy, care and maintenance.
7 & 8.	-do-	26. Chipping, Chamfering, Chip slots & oils grooves (Straight).(10 hrs.) 27. Filing flat, square, and parallel to an accuracy of 0.5mm. (10 hrs.) 28. Chip curve along a line-mark out, key ways at various angles & cut key ways.(15 hrs.) 29. Sharpening of Chisel.(5	***Assessment Criteria*** • Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding. • Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job. • Observe safety procedure during above operation as per standard norms and company guidelines. • Check for dimensional accuracy as per standard procedure. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner

		hrs.) 30. File thin metal to an accuracy of 0.5 mm.(10 hrs.) (knowledge doesn't match with practicals)	and prepare for disposal. ***Underpinning Knowledge*** • Physical properties of engineering metal: colour, weight, structure, and conductivity, magnetic, fusibility, specific gravity. • Mechanical properties: ductility, malleability hardness, brittleness, toughness, tenacity, and elasticity.
9.	-do-	31. Saw along a straight line, curved line, on different sections of metal.(15 hrs.) 32. Straight saw on thick section, M.S. angle and pipes.(10 hrs.)	***Assessment Criteria*** • Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding. • Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job. • Observe safety procedure during above operation as per standard norms and company guidelines. • Check for dimensional accuracy as per standard procedure. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** • Power Saw, band saw, Circular saw machines used for metal cutting.
10.	-do-	33. File steps and finish with smooth file to accuracy of ± 0.25 mm.(10 hrs.) 34. File and saw on M.S. Square and pipe. (5 hrs.) (knowledge doesn't match with practicals, Npracticals for use of micrometer)	***Assessment Criteria*** • Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding. • Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job. • Observe safety procedure during above operation as per standard norms and company guidelines. • Check for dimensional accuracy as per standard procedure. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.

			Underpinning Knowledge • Micrometer- outside and inside – principle, constructional features, parts graduation, leading, use and care. • Micrometer depth gauge, parts, graduation, leading, use and care. Digital micrometer.
11.	-do-	35. File radius along a marked line (Convex & concave) & match.(15 hrs.) 36. Chip sheet metal (shearing). (5 hrs.) 37. Chip step and file.(5 hrs.) (knowledge doesn't match with practicals)	***Assessment Criteria*** • Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding. • Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job. • Observe safety procedure during above operation as per standard norms and company guidelines. • Check for dimensional accuracy as per standard procedure. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** • Vernier calipers, principle, construction, graduations, reading, use and care. • Vernier bevel protractor, construction, graduations, reading, use and care, • Dial Vernier Caliper, • Digital verniercaliper.
12.	-do-	38. Mark off and drill through holes. (5 hrs.) 39. Drill and tap on M.S. flat. (10 hrs.) 40. Punch letter and number (letter punch and number punch) (5 hrs.) 41. Practice use of different punches.(5 hrs.) (Need to mention whether job is done via hand tools,	***Assessment Criteria*** • Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding. • Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job. • Observe safety procedure during above operation as per standard norms and company guidelines. • Check for dimensional accuracy as per standard procedure. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.

		power tools or power machines, etc)	***Underpinning Knowledge*** • Drilling processes: common type (bench type, pillar type, radial type), gang and multiple drilling machine. • Determination of tap drill size.
13.	Manufacture simple sheet metal items as per drawing and join them by soldering, brazing and riveting.	42. Marking of straight lines, circles, profiles and various geometrical shapes and cutting the sheets with snips. (15 hrs.) 43. Marking out of simple development(5 hrs.) 44. Marking out for flaps for soldering and sweating.(5 hrs.)	***Assessment Criteria*** • Mark and develop various forms as per drawing using sheet metals. • Mark according to drawing. ***Underpinning Knowledge*** • Safety precautions to be observed in a sheet metal workshop, sheet and sizes, • Commercial sizes and various types of metal sheets, coated sheets and their uses as per BIS specifications. • Shearing machine- description, parts and uses.
14 & 15.	-do-	45. Make various joints: wiring, hemming, soldering and brazing, form locked, grooved and knocked up single hem straight and curved edges form double hemming,.(15 hrs.) 46. Punch holes-using hollow and solid punches. (2 hrs.) 47. Do lap and butt joints.(8 hrs.) (No assessment criteria for sheet metal joints)	***Assessment Criteria*** ***Underpinning Knowledge*** • 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, • Soldering iron, types, specifications, uses. • Trammel- description, parts, uses. • Hand grooves- specifications and uses.
16.	-do-	48. Bend sheet metal into various curvature form, wired edges- straight and curves. Fold sheet metal at angle using stakes. (8 hrs.) 49. Make simple Square	***Assessment Criteria*** • Identify Hand Tools for Sheet Metal work • Make of simple items with sheet metal as per drawing. • Observe safety procedure during riveting as per standard norms and company guidelines. ***Underpinning Knowledge***

		container with wired edge and fix handle.(17 hrs.) (No assessment criteria for bending of sheet metal)	• Stakes-bench types, parts, their uses. • Various types of metal joints, their selection and application, tolerance for various joints, their selection & application. • Wired edges.
17.	-do-	50. Make square tray with square soldered corner.(15 hrs.) 51. Practice in soft soldering and silver soldering. (10 hrs.) (Riveting covered in next learning outcome and assessment criteria. Hence should be removed from this one)	***Assessment Criteria*** 10. 1 Identify Hand Tools for Sheet Metal work, Soldering, Brazing & riveting and make these available for use in a timely manner. 10. 3 Make of simple items with sheet metal as per drawing. 10. 4 Prepare the job for Soldering, Brazing &riveting . 10. 5 Identify different type of rivets and use as per requirement. 10. 6 Identify tools for drilling and use these tools. 10. 7 Mark according to drawing. 10. 8 Drill through holes on the job. 10. 9 Solder, Braze and Rivet to prepare a job as per given drawing / sample following standard practices. 10. 10 Observe safety procedure during riveting as per standard norms and company guidelines. ***Underpinning Knowledge*** Solder and soldering: Introduction-types of solder and flux. Composition of various types of solders and their heating media of soldering iron. Method of soldering, selection and application-joints. Hard solder- Introduction, types and method of brazing.
18.	Join metal components by riveting observing standard procedure.	52. Make riveted lap and butt joint.(9 hrs.) 53. Make funnel as per development and solder joints.(10 hrs.) 54. Drill for riveting. (1 hrs.) 55. Riveting with as many types of rivet as available, use of counter sunk head rivets. (5 hrs.)	***Assessment Criteria*** • Identify Tools and equipments for riveting and make these available for use in a timely manner. • Prepare the job for lap and butt joint. • Identify different type of rivets and use as per requirement. • Identify tools for drilling and use these tools. • Mark according to drawing. • Drill through holes on the job. • Rivet to prepare a job as per given drawing / sample following standard practices. • Observe safety procedure during riveting as per standard norms and company guidelines. ***Underpinning Knowledge*** Various rivets shape and form of heads, importance of correct head

			size. Rivets-Tin man's rivets types, sizes, and selection for various works. Riveting tools, dolly snaps description and uses. Method of riveting, The spacing of rivets. Flash riveting, use of correct tools, compare hot and cold riveting.
19.	Join metal component by arc welding observing standard procedure.	56. Welding - Striking and maintaining ARC, laying Straight-line bead.(25 hrs.)	***Assessment Criteria*** • Identify different components/parts of arc welding machine, collect desired information and set each components/parts as per standard procedure. • Observe safety/ precaution during operation. • Select appropriate material & plan for arc welding. • Weld metal parts / mechanical components as per specification observing standard procedure. • Check joined part portion to ascertain proper welding. ***Underpinning Knowledge*** • 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. • Machines and accessories, welding transformer, welding generators.
20.	Cut and join metal component by gas (oxy-acetylene) & Join metal component by arc welding observing standard procedure	57. Making square, butt joint and 'T' fillet joint-gas and ARC. (15 hrs.) 58. Do setting up of flames, fusion runs with and without filler rod, and gas.(10 hrs.)	***Assessment Criteria*** • Identify different components/parts of arc welding machine, collect desired information and set each components/parts as per standard procedure. • Observe safety/ precaution during operation. • Select appropriate material & plan for arc welding. • Weld metal parts / mechanical components as per specification observing standard procedure. • Check joined part portion to ascertain proper welding. • Identify different components/parts of Gas (oxy-acetylene) machine, collect desired information and set each components/parts as per standard procedure. • Observe safety/ precaution during operation. • Select appropriate material & plan for gas cutting & joining operation. • Cut & join metal parts / mechanical components as per

			specification observing standard procedure. • Check cut portion/ joined part to ascertain proper welding. ***Underpinning Knowledge*** • Welding hand tools: Hammers, welding description, types and uses, description, principle, method of operating, • carbon dioxide welding. • H.P. welding equipment: description, principle, method of operating L.P. welding equipment: description, principle, method of operating. • Types of Joints-Butt and fillet as per BIS SP: 46-1988 specifications. • Gases and gas cylinder description, kinds, main difference and uses.
21.	Join metal component by arc welding observing standard procedure	59. Make butt weld and corner, fillet in ARC welding (25 hrs.)	***Assessment Criteria*** • Identify different components/parts of arc welding machine, collect desired information and set each components/parts as per standard procedure. • Observe safety/ precaution during operation. • Select appropriate material & plan for arc welding. • Weld metal parts / mechanical components as per specification observing standard procedure. • Check joined part portion to ascertain proper welding. ***Underpinning Knowledge*** Setting up parameters for ARC welding machines-selection of Welding electrodes. Care to be taken in keeping electrode.
22.	Cut and join metal component by gas (oxy-acetylene)	60. Gas cutting of MS plates (25 hrs.)	***Assessment Criteria*** • Identify different components/parts of Gas (oxy-acetylene) machine, collect desired information and set each components/parts as per standard procedure. • Observe safety/ precaution during operation. • Select appropriate material & plan for gas cutting & joining operation. • Cut & join metal parts / mechanical components as per specification observing standard procedure. • Check cut portion/ joined part to ascertain proper welding. ***Underpinning Knowledge*** • Oxygen acetylene cutting-machine description, parts, uses, method of handling, cutting torch-description, parts, function and

			uses.
23-25		Revision	
26		Examination	

Semester 2 (6 Months)

Learning Objectives

1. Produce components by different operations and check accuracy using appropriate measuring instruments.[Different Operations - Drilling, Reaming, Taping, Dieing; Appropriate Measuring Instrument – Vernier, Screw Gauge, Micrometer]
2. Make different fit of components for assembling as per required tolerance observing principle of interchangeability and check for functionality. [Different Fit – Sliding, Angular, Step fit, 'T' fit, Square fit and Profile fit; Required tolerance: ±0.04 mm, angular tolerance: 30 min.]
3. Produce components involving different operations on lathe observing standard procedure and check for accuracy. [Different Operations – facing, plain turning, step turning, parting, chamfering, shoulder turn, grooving, knurling, boring, taper turning, threading (external 'V' only)]
4. Plan & perform simple repair, overhauling of different machines and check for functionality. [Different Machines – Drill Machine, Power Saw, Bench Grinder and Lathe]

The session plan will be as follows:

Week	Learning Outcome	Trade Practical	Assessment Criteria and Underpinning knowledge
27.	Produce components by different operations and check accuracy using appropriate measuring instruments.*[Different Operations - Drilling, Reaming, Taping, Dieing; Appropriate Measuring Instrument – Vernier, Screw Gauge, Micrometer]*	61. Mark off and drill through holes. (5 hrs.) 62. Drill on M.S. flat. (1 hrs.) 63. File radius and profile to suit gauge.(13 hrs.) 64. Sharpening of Drills.(1 hrs.) 65. Practice use of angular measuring instrument. (5 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Produce component by observing standard procedure. • Check the dimensions of the produced components to ensure dimensions are within prescribed limit. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** • Drill- material, types, (Taper shank, straight shank) parts and sizes.

			• Drill angle-cutting angle for different materials, cutting speed feed. R.P.M. for different materials. • Drill holding devices- material, construction and their uses.
28.	-do-	66. Counter sink, counter bore and ream split fit (three piece fitting).(5 hrs.) 67. Drill through hole and blind holes.(2 hrs.) 68. Form internal threads with taps to standard size (through holes and blind holes).(3 hrs.) 69. Prepare studs and bolt.(15 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Produce component by observing standard procedure. • Check the dimensions of the produced components to ensure dimensions are within prescribed limit. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** • 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. • Screw threads: terminology, parts, types and their uses. Screw pitch gauge: 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).
29.	-do-	70. Form external threads with dies to standard size. (10 hrs.) 71. Prepare nuts and match with bolts.(15 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Produce component by observing standard procedure. • Check the dimensions of the produced components to ensure dimensions are within prescribed limit. • Avoid waste, ascertain unused materials and components for disposal, store these in an

			environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** Tap wrench: material, parts, types (solid &adjustable types) and their uses removal of broken tap, studs (tap stud extractor). Dies: British standard, metric and BIS standard, material, parts, types, Method of using dies. Die stock: material, parts and uses.
30.	-do-	72. File and make Step fit, angular fit, angle, surfaces (Bevel gauge accuracy 1 degree).(15 hrs.) 73. Make simple open and sliding fits.(10 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Produce component by observing standard procedure. • Check the dimensions of the produced components to ensure dimensions are within prescribed limit. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** • Drill troubles: causes and remedy. Equality of lips, correct clearance, dead centre, length of lips. • Drill kinds: Fraction, metric, letters and numbers, grinding of drill.
31.	-do-	74. Enlarge hole and increase internal dia. (2 hrs.) 75. File cylindrical surfaces.(5 hrs.) 76. Make open fitting of curved profiles.(18 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Produce component by observing standard procedure. • Check the dimensions of the produced components to ensure dimensions are within prescribed limit. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for

			disposal. ***Underpinning Knowledge*** • Grinding wheel: Abrasive, grade structures, bond, specification, use, mounting and dressing. Selection of grinding wheels. Bench grinder parts and use. • Radius/fillet gauge, feeler gauge, hole gauge, and their uses, care and maintenance.
32.	-do-	77. Correction of drill location by binding previously drilled hole.(5 hrs.) 78. Make inside square fit. (20 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Produce component by observing standard procedure. • Check the dimensions of the produced components to ensure dimensions are within prescribed limit. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** • Pig Iron: types of pig Iron, properties and uses. • Cast Iron: types, properties and uses.
33.	Make different fit of components for assembling as per required tolerance observing principle of interchangeability and check for functionality. *[Different Fit – Sliding, Angular, Step fit, 'T' fit, Square fit and Profile fit; Required tolerance: ±0.04 mm, angular tolerance: 30 min.]*	79. Make sliding 'T' fit.(25 hrs.)	***Assessment Criteria*** • Recognize general concept of Limits, Fits and tolerance necessary for fitting applications and functional application of these parameters. • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Set up workplace/ assembly location with due consideration to operational stipulation • Plan work in compliance with standard safety norms and collecting desired information. • Demonstrate possible solutions and agree tasks within the team. • Make components according to the specification for different fit using a range of practical skills and ensuring interchangeability of different parts. • Assemble components applying a range of skills to

			ensure proper fit. • Check functionality of components. ***Underpinning Knowledge*** • Interchangeability: Necessity in Engg, 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 • Different standard systems of fits and limits. British standard system, BIS system
34.	-do-	80. File fit- combined, open angular and sliding sides. (10 hrs.) 81. File internal angles 30minutes accuracy open, angular fit.(15 hrs.)	***Assessment Criteria*** • Recognize general concept of Limits, Fits and tolerance necessary for fitting applications and functional application of these parameters. • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Set up workplace/ assembly location with due consideration to operational stipulation • Plan work in compliance with standard safety norms and collecting desired information. • Demonstrate possible solutions and agree tasks within the team. • Make components according to the specification for different fit using a range of practical skills and ensuring interchangeability of different parts. • Assemble components applying a range of skills to ensure proper fit. • Check functionality of components. ***Underpinning Knowledge*** • Method of expressing tolerance as per BIS Fits: Definition, types, description of each with sketch. • Vernier height gauge: material construction, parts, graduations (English & Metric) uses, care and maintenance.
35-36.	-do-	82. Make sliding fit with angles other than $90^{o.}$(25 hrs.)	***Assessment Criteria*** • Recognize general concept of Limits, Fits and tolerance necessary for fitting applications and

			functional application of these parameters. • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Set up workplace/ assembly location with due consideration to operational stipulation • Plan work in compliance with standard safety norms and collecting desired information. • Demonstrate possible solutions and agree tasks within the team. • Make components according to the specification for different fit using a range of practical skills and ensuring interchangeability of different parts. • Assemble components applying a range of skills to ensure proper fit. • Check functionality of components. ***Underpinning Knowledge*** • Wrought iron- : properties and uses. • Steel: plain carbon steels, types, properties and uses. • Non-ferrous metals (copper, aluminum, tin, lead, zinc) properties and uses.
37.	-do-	83. Scrap on flat surfaces, curved surfaces and parallel surfaces and test. (5 hrs.) 84. Make & assemble, sliding flats, plain surfaces. (15 hrs.) 85. Check for blue math of bearing surfaces- both flat and curved surfaces by wit worth method.(5 hrs.)	***Assessment Criteria*** • Recognize general concept of Limits, Fits and tolerance necessary for fitting applications and functional application of these parameters. • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Set up workplace/ assembly location with due consideration to operational stipulation • Plan work in compliance with standard safety norms and collecting desired information. • Demonstrate possible solutions and agree tasks within the team. • Make components according to the specification for different fit using a range of practical skills and ensuring interchangeability of different parts. • Assemble components applying a range of skills to ensure proper fit. • Check functionality of components.

			Underpinning Knowledge • Simple scraper- circular, flat, half round, triangular and hook scraper and their uses. • Blue matching of scraped surfaces (flat and curved bearing surfaces)
38.	-do-	86. File and fit combined radius and angular surface (accuracy ± 0.5 mm), angular and radius fit. (18 hrs.) 87. Locate accurate holes & make accurate hole for stud fit.(2 hrs.) 88. Fasten mechanical components / sub-assemblies together using screws, bolts and collars using hand tools.(5 hrs.)	***Assessment Criteria*** • Recognize general concept of Limits, Fits and tolerance necessary for fitting applications and functional application of these parameters. • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Set up workplace/ assembly location with due consideration to operational stipulation • Plan work in compliance with standard safety norms and collecting desired information. • Demonstrate possible solutions and agree tasks within the team. • Make components according to the specification for different fit using a range of practical skills and ensuring interchangeability of different parts. • Assemble components applying a range of skills to ensure proper fit. • Check functionality of components. ***Underpinning Knowledge*** • Vernier micrometer, material, parts, graduation, use, care and maintenance. • Calibration of measuring instruments. • Introduction to mechanical fasteners and its uses. • Screw thread micrometer: Construction, graduation and use.
39.	-do-	89. Make sliding fits assembly with parallel and angular mating surface. (± 0.04 mm)(25 hrs.)	***Assessment Criteria*** • Recognize general concept of Limits, Fits and tolerance necessary for fitting applications and functional application of these parameters. • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Set up workplace/ assembly location with due

			consideration to operational stipulation • Plan work in compliance with standard safety norms and collecting desired information. • Demonstrate possible solutions and agree tasks within the team. • Make components according to the specification for different fit using a range of practical skills and ensuring interchangeability of different parts. • Assemble components applying a range of skills to ensure proper fit. • Check functionality of components. ***Underpinning Knowledge*** • Dial test indicator, construction, parts, material, graduation, • Method of use, care and maintenance. Digital dial indicator. • Comparators-measurement of quality in the cylinder bores.
40.	Produce components involving different operations on lathe observing standard procedure and check for accuracy. *[Different Operations – facing, plain turning, step turning, parting, chamfering, shoulder turn, grooving, knurling, boring, taper turning, threading (external 'V' only)]*	90. Lathe operations- 91. True job on four jaw chuck using knife tool.(5 hrs.) 92. Face both the ends for holding between centers. (9 hrs.) 93. Using roughing tool parallel turn ± 0.1 mm. (10 hrs.) 94. Measure the diameter using outside caliper and steel rule.(1 hrs.)	***Assessment Criteria*** • Ascertain basic working principles and safety aspect of lathe machine. • Understand functional application of different levers, stoppers, adjustment etc. • Identify different lubrication points and lubricants, their usage for application in lathe machine as per machine manual. • Identify different work and tool holding devices and collect information for functional application of each device. • Check accuracy/ correctness of job using appropriate equipment/gauge. ***Underpinning Knowledge*** • Safely precautions to be observed while working on a lathe, Lathe specifications, and constructional features. • Lathe main parts descriptions- bed, head stock, carriage, tail stock, feeding and thread cutting mechanisms.

			• Holding of job between centers, works with catch plate, dog, simple description of a facing and roughing tool and their applications.
41.	-do-	95. Holding job in three jaw chuck.(2 hrs.) 96. Perform the facing, plain turn, step turn, parting, deburr, chamfer-corner, roundthe ends, and use form tools. (11 hrs.) 97. Shoulder turn: square, filleted, beveled undercut shoulder, turning-filleted under cut, square beveled.(11 hrs.) 98. Sharpening of -Single point Tools.(1 hrs.)	***Assessment Criteria*** • Identify different work and tool holding devices and collect information for functional application of each device. • Mount the work and tool holding devices with required alignment and check for its functional usage to perform lathe operations. • Observe safety procedure during mounting as per standard norms. • Produce components observing standard procedure. • Check accuracy/ correctness of job using appropriate equipment/gauge. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** • Lathe cutting tools- Nomenclature of single point & multipoint cutting tools, • Tool selection based on different requirements 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.
42.	-do-	99. Cut grooves- square, round, 'V' groove. (10 hrs.) 100. Make a mandrel-turn diameter to sizes. (5 hrs.) 101. Knurl the job.(1 hrs.) 102. Bore holes –spot face, pilot drill, enlarge hole using boring tools. (9 hrs.)	***Assessment Criteria*** • Observe safety procedure during mounting as per standard norms. • Produce components observing standard procedure. • Check accuracy/ correctness of job using appropriate equipment/gauge. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.

			Underpinning Knowledge • Chucks 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 plate, drilling • Method of holding drills in the tail stock, Boring tools and enlargement of holes.
43.	-do-	103. Make a bush step bore-cut recess, turn hole diameter to sizes.(5 hrs.) 104. Turn taper (internal and external).(10 hrs.) 105. Turn taper pins. (5 hrs.) 106. Turn standard tapers to suit with gauge.(5 hrs.)	***Assessment Criteria*** • Observe safety procedure during mounting as per standard norms. • Produce components observing standard procedure. • Check accuracy/ correctness of job using appropriate equipment/gauge. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** • General turning operations- parallel or straight, turning. Stepped turning, grooving, and shape of tools for the above operations. • Appropriate method of holding the tool on tool post or tool rest, • Knurling: - tools description, grade, uses, speed and feed, coolant for knurling, speed, feed calculation. • Taper – definition, use and method of expressing tapers. Standard tapers-taper, calculations morse taper.
44.	-do-	107. Practice threading using taps, dies on lathe by hand. (2 hrs.) 108. Make external 'V' thread.(8 hrs.) 109. Prepare a nut and match with the bolt.(15 hrs.)	***Assessment Criteria*** • Observe safety procedure during mounting as per standard norms. • Produce components observing standard procedure. • Check accuracy/ correctness of job using appropriate equipment/gauge. • Avoid waste, ascertain unused materials and components for disposal, store these in an

			environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** • Screw thread definition – uses and application. • Square, worm, buttress, acme (non standard-screw threads), • Principle of cutting screw thread in centre lathe • principle of chasing the screw thread • use of centre gauge, setting tool for cutting internal and external threads, • use of screw pitch gauge for checking the screw thread.
45–46.	Plan & perform simple repair, overhauling of different machines and check for functionality. *[Different Machines – Drill Machine, Power Saw, Bench Grinder and Lathe]*	110. Simple repair work:Simple assembly of machine parts from blue prints. (15 hrs.) 111. Rectify possible assembly faults during assembly.(19 hrs.) 112. Perform the routine maintenance with check list(10 hrs.) 113. Monitor machine as per routine checklist(3 hrs.) 114. Read pressure gauge, temperature gauge, oil level(1 hrs.) 115. Set pressure in pneumatic system(2 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the repair, overhauling and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Demonstrate possible solutions and agree tasks within the team. • Select specific parts to be repaired and ascertain for appropriate material and estimated time. • Repair, overhaul and assemble the parts in the machine with the help of blue print. • Check for functionality of part and ascertain faults of the part/ machine in case of improper function. • Rectify faults of assembly. ***Underpinning Knowledge*** **Maintenance** • Total productive maintenance • Autonomous maintenance • Routine maintenance • Maintenance schedule • Retrieval of data from machine manuals • Preventive maintenance-objective and function of Preventive maintenance, section inspection. Visual and detailed, lubrication survey, system of symbol and colour coding.

			• Revision, simple estimation of materials, use of handbooks and reference table. • Possible causes for assembly failures and remedies.
47.	-do-	116. Assemble simple fitting using dowel pins and tap screw assembly using torque wrench.(25 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the repair, overhauling and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Demonstrate possible solutions and agree tasks within the team. • Select specific parts to be repaired and ascertain for appropriate material and estimated time. • Repair, overhaul and assemble the parts in the machine with the help of blue print. • Check for functionality of part and ascertain faults of the part/ machine in case of improper function. • Rectify faults of assembly. ***Underpinning Knowledge*** • Assembling techniques such as aligning, bending, fixing, mechanical jointing, threaded jointing, sealing, and torquing. • Dowel pins: material, construction, types, accuracy and uses.
48-49		**In-plant training** / Project work (Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration), Work to be assigned in a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and application of Learning. They need to submit **Project report.**	
50-51.	Revision		
52.	Examination		

Semester 3 (6 Months)

Learning Objectives

1. Make & assemble components of different mating surfaces as per required tolerance by different surface finishing operations using different fastening components, tools and check functionality. [Different Mating Surfaces – Dovetail fitting, Radious fitting, Combined fitting; Different surface finishing operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.]
2. Make different gauges by using standard tools & equipment and checks for specified accuracy. [Different Gauges – Snap gauge, Gap gauge; Specified Accuracy - ±0.02mm]
3. Apply a range of skills to execute pipe joints, dismantle and assemble valves & fittings with pipes and test for leakages.[Range of skills – Cutting, Threading, Flaring, Bending and Joining]

The session plan will be as follows:

Week	Learning Outcome	Trade Practical (Indicative Duration)	Assessment Criteria and Underpinning knowledge
53.	Make & assemble components of different mating surfaces as per required tolerance by different surface finishing operations using different fastening components, tools and check functionality. *[Different Mating Surfaces – Dovetail fitting, Radious fitting, Combined fitting; Different surface finishing operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening*	117. Make 'H' fitting.(17 hrs.) 118. Power tools: Practice operation of power tool for fastening.(5 hrs.) 119. Tightening of bolt/ screw with specified torque.(2 hrs.) 120. Selection of right tool as for Tightening or loosening of screw/bolt as per accessibility(1 hrs.)	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines. • Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality.

	tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.]		***Underpinning Knowledge*** Screws: material, designation, specifications, Property classes (e.g. 9.8 on screw head), Tools for tightening/ loosening of screw or bolts, Torque wrench, screw joint calculation uses. Power tools: its constructional features, uses & maintenance.
54	-do-	121. Assembly sliding for using keys, dowel pin and screw, ± 0.02 mm accuracy on plain surface and testing of sliding fitting job. (25 hrs.)	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines. • Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality. ***Underpinning Knowledge*** Locking device: Nuts- types (lock nut castle nut, slotted nuts, swam nut, grooved nut) Description and use.
55	-do-	122. File & fit angular mating surface within an accuracy of ± 0.02 mm & 10 minutes angular fitting.(25 hrs.)	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance -

			±0.02mm, angular tolerance ± 10 min.] • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines. • Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality. ***Underpinning Knowledge*** Various types of keys, allowable clearances & tapers, types, uses of key pullers.
56	-do-	123. Drill through and blind holes at an angle using swivel table of drilling machine.(10 hrs.) 124. Precision drilling, reaming and tapping and Test- Job.(15 hrs.)	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as

			per specification using appropriate tools & machines.Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality. ***Underpinning Knowledge*** Special files: types (pillar, Dread naught, Barrow, warding) description & their uses. Testing scraped surfaces: ordinary surfaces without a master plate.
57	-do-	125. Make Dovetailed fitting and radius fitting.(25 hrs.)	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines. • Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality. ***Underpinning Knowledge*** Templates and gauges- Introduction, necessity, types. Limit gauge: Ring gauge, snap gauge, plug gauge,

			description and uses. Description and uses of gauge- types (feeler, screw, pitch, radius, wire gauge)
58	-do-	126. File and fit, combined fit with straight, angular surface with ± 0.02 mm accuracy and check adherence to specification and quality standards using equipment like Vernier calipers, micrometers etc.(25 hrs.)	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines. • Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality. ***Underpinning Knowledge*** Slip gauge: Necessity of using, classification & 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.
59	-do-	127. Drilling and reaming, small dia. holes to accuracy & correct location for fitting.(4 hrs.) 128. Perform drilling using 'V' block and a clamp.(1 hrs.) 129. Make male and female fitting	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.]

		parts, drill and ream holes not less than 12.7 mm.(20 hrs.)	• Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines. • Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality. ***Underpinning Knowledge*** Application of slip gauges for measuring, Sine bar- Principle, application & specification. Procedure to check adherence to specification and quality standards.
60	-do-	130. Make Sliding Diamond fitting.(20 hrs.) 131. Lap flat surfaces using lapping plate. (5 hrs.)	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines.

			• Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality. ***Underpinning Knowledge*** Lapping: Application of lapping, material for lapping tools, lapping abrasives, charging of lapping tool. Surface finish importance, equipment for testing-terms relation to surface finish. Equipment for tasting surfaces quality – dimensional tolerances of surface finish.
61	-do-	132. Prepare Stepped keyed fitting and test job. (20 hrs.) 133. Lapping holes and cylindrical surfaces.(5 hrs.)	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines. • Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality. ***Underpinning Knowledge*** Honing: Application of honing, material for honing, tools

			shapes, grades, honing abrasives. Frosting- its aim and the methods of performance.
62	-do-	134. Dovetail and Dowel pin assembly.(20 hrs.) 135. Scrape cylindrical bore.(5 hrs.)	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines. • Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality. ***Underpinning Knowledge*** Metallurgical and metal working processes such as Heat treatment, various heat treatment methods -normalizing, annealing, hardening and tempering, purpose of each method, tempering colour chart.
63	-do-	136. Scrapping cylindrical bore and to make a fit-(15 hrs.) 137. Scrapping cylindrical taper bore and check taper angle with sine bar.(10 hrs.)	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] • Ascertain and select tools and materials for the job and make this available for use in a timely manner.

			• Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines. • Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality. ***Underpinning Knowledge*** Annealing and normalizing, Case hardening and carburising and its methods, process of carburising (solid, liquid and gas).
64	-do-	138. Make a cotter jib assembly.(25 hrs.)	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines.

			• Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality. ***Underpinning Knowledge*** Tapers on keys and cotters permissible by various standards.
65	-do-	139. Hand reams and fit taper pin. (15 hrs.) 140. Drilling and reaming holes in correct location, fitting dowel pins, stud, and bolts.(10 hrs.)	***Assessment Criteria*** • operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.] • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard and collecting necessary information. • Set up workplace/ assembly location with due consideration to operational stipulation • Demonstrate possible solutions and agree tasks within the team. • Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines. • Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. • Assemble different components using different fastening components, tools and check the functionality. ***Underpinning Knowledge*** The various coatings used to protect metals, protection coat by heat and electrical deposit treatments. Treatments to provide a pleasing finish such as chromium silver plating, nickel plating and galvanizing.

66	Make different gauges by using standard tools & equipment and checks for specified accuracy. *[Different Gauges – Snap gauge, Gap gauge; Specified Accuracy - ±0.02mm]*	141. Making a snap gauge for checking a dia of 10 ± 0.02 mm.(25 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Produce gauge by observing appropriate method and as per specification of drawing. • Perform Lapping of gauge to obtain required finish as per drawing. • Check tolerance and specified accuracy of gauge with appropriate measuring instruments as per drawing. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** Gauges and types of gauge commonly used in gauging finished product-Method of selective assembly 'Go' system of gauges, hole plug basis of standardization.
67	-do-	142. Scrape external angular mating surface and check angle with sine bar.(15 hrs.) 143. Scrape on internal surface and check.(10 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Produce gauge by observing appropriate method and as per specification of drawing. • Perform Lapping of gauge to obtain required finish as per drawing. • Check tolerance and specified accuracy of gauge with appropriate measuring instruments as per drawing. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** Bearing-Introduction, classification (Journal and Thrust), Description of each, ball bearing: Single row, double row, description of each, and advantages of double row.
68	-do-	144. Practice in dovetail fitting	***Assessment Criteria***

		assembly and dowel pins and cap screws assembly.(20 hrs.) 145. Industrial visit.(5 hrs.)	• Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Produce gauge by observing appropriate method and as per specification of drawing. • Perform Lapping of gauge to obtain required finish as per drawing. • Check tolerance and specified accuracy of gauge with appropriate measuring instruments as per drawing. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** Roller and needle bearings: Types of roller bearing. Description & use of each. Method of fitting ball and roller bearings Industrial visit.
69	-do-	146. Preparation of gap gauges.(15 hrs.) 147. Perform lapping of gauges (hand lapping only)(10 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Produce gauge by observing appropriate method and as per specification of drawing. • Perform Lapping of gauge to obtain required finish as per drawing. • Check tolerance and specified accuracy of gauge with appropriate measuring instruments as per drawing. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** Bearing metals – types, composition and uses. Synthetic materials for bearing: The plastic laminate materials, their properties and uses in bearings such as phenolic, teflon polyamide (nylon).

70	-do-	148. Preparation of drill gauges.(10 hrs.) 149. File and fit straight and angular surfaces internally.(13 hrs.) 150. Identify different ferrous metals by spark test(2 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Produce gauge by observing appropriate method and as per specification of drawing. • Perform Lapping of gauge to obtain required finish as per drawing. • Check tolerance and specified accuracy of gauge with appropriate measuring instruments as per drawing. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** the importance of keeping the work free from rust and corrosion.
71	Apply a range of skills to execute pipe joints, dismantle and assemble valves & fittings with pipes and test for leakages.*[Range of skills – Cutting, Threading, Flaring, Bending and Joining]*	151. Flaring of pipes and pipe joints. (3 hrs.) 152. Cutting & Threading of pipe length.(3 hrs.) 153. Fitting of pipes as per sketch observing conditions used for pipe work. (12 hrs.) 154. Bending of pipes- cold and hot.(7 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan to Dismantle and assemble valves and pipe fittings. • Dismantle valves and fittings in pipes applying range of skills andcheck for defect as per standard procedure. • Demonstrate possible solutions in case of defect and agree tasks within the team for repair or replacement. • Assemble valves and various pipe fittings using range of skills and observing standard procedure. • Test for leakage and appropriate functioning of valves. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** Pipes and pipe fitting- commonly used pipes. Pipe schedule and standard sizes. Pipe bending methods. Use

			of bending fixture, pipe threads-Std. Pipe threads Die and Tap, pipe vices.
72	-do-	155. Dismantling & assembling – globe valves, sluice valves, stop cocks, seat valves and non-return valve. (25 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan to Dismantle and assemble valves and pipe fittings. • Dismantle valves and fittings in pipes applying range of skills andcheck for defect as per standard procedure. • Demonstrate possible solutions in case of defect and agree tasks within the team for repair or replacement. • Assemble valves and various pipe fittings using range of skills and observing standard procedure. • Test for leakage and appropriate functioning of valves. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge*** Use of tools such as pipe cutters, pipe wrenches, pipe dies, and tap, pipe bending machine etc.
73	-do-	156. Fit & assemble pipes, valves and test for leakage & functionality of valves.(22 hrs.) 157. Visual inspection for visual defects e.g. dents, surface finish.(1 hrs.) 158. Measuring, checking and recording in control chart.(2 hrs.)	***Assessment Criteria*** • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan to Dismantle and assemble valves and pipe fittings. • Dismantle valves and fittings in pipes applying range of skills andcheck for defect as per standard procedure. • Demonstrate possible solutions in case of defect and agree tasks within the team for repair or replacement. • Assemble valves and various pipe fittings using range of skills and observing standard procedure. • Test for leakage and appropriate functioning of valves. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal. ***Underpinning Knowledge***

			Standard pipefitting- Methods of fitting or replacing the above fitting, repairs and erection on rainwater drainage pipes and house hold taps and pipe work. Inspection & Quality control -Basic SPC -Visual Inspection
74-75		In-plant training / Project work (Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration), Work to be assigned in a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and application of Learning. They need to submit Project report.	
76--77		Revision	
78.		Examination	

Semester 4 (6 Months)

Learning Objectives

1. Make drill jig & produce components on drill machine by using jigs and check for correctness.
2. Identify, dismantle, replace and assemble different pneumatics and hydraulics components. [Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.]
3. Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect.
4. Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. [Different Damage Mechanical Components – Pulley, Gear, Keys, Jibs and Shafts.]
5. Plan & perform basic day to day preventive maintenance, repairing and check functionality.[Simple Machines – Drill Machine, Power Saw and Lathe]
6. Plan, erect simple machine and test machine tool accuracy. [Simple Machines – Drill Machine, Power Saw and Lathe]

The session plan will be as follows:

Week	Learning Outcome	Trade Practical (Indicative Duration)	Assessment Criteria and Underpinning knowledge
79.	Make drill jig & produce components on drill machine by using jigs and check for correctness.	159. Make a simple drilling jig. (20 hrs.) 160. Use simple jigs and fixtures for drilling. (5 hrs.)	***Assessment Criteria*** • Set up workplace/ assembly location with due consideration to operational stipulation • Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Collect information related to standard procedure, methods and tools to make drill jigs.

			• Mark the components as per drawing. • Make drill jigs by turning, drilling, reaming, filing, taping, etc. • Test the functionality of jig. • Select suitable jigs for drilling considering desired result and collecting necessary information. • Produce component by using jig observing standard procedure and check the correctness of the job. • Comply with safety rules when performing the above operations. ***Underpinning Knowledge*** Drilling jig-constructional features, types and uses. Fixtures-Constructional features, types and uses.
80.	Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. [Different Damage Mechanical Components – Pulley, Gear, Keys, Jibs and Shafts.]	161. Marking out for angular outlines, filing and fitting the inserts into gaps. (10 hrs.) 162. Exercises on finished material such as aluminium/ brass/ copper / stainless steel, marking out, cutting to size, drilling, tapping etc. without damage to surface of finished articles. (15 hrs.)	***Assessment Criteria*** • Select and ascertain tools and materials for the job and make this available for use in a timely manner. • Plan to dismantle, repair and assemble mechanical components used for power transmission as per drawing and collecting necessary information. • Perform dismantling and appropriate repairing of mechanical components with accuracy applying range of skills and appropriate repairing processes. • Check the accuracy of the repaired components with appropriate gauge & instruments. • Assemble the repaired mechanical components observing standard procedure. • Comply with safety rules when performing the above operations. • Check different parameters of power transmission e.g. R.P.M, slackness of belts, matching of gears/ clutches, loss of RPM etc. • Check for functionality of power transmission system or any assembly as per standard parameters. ***Underpinning Knowledge*** Aluminium and its alloys. Uses, advantages and disadvantages, weight and strength as compared with steel. Non-ferrous metals such as brass, phosphor bronze,

			gunmetal, copper, aluminium etc. Their composition and purposes, where and why used, advantages for specific purposes, surface wearing properties of bronze and brass.
81.	-do-	163. Making an adjustable spanner: - Marking out as per Blue print, drilling, cutting, straight and curve filing, threading, cutting slot and cutting internal threads with taps. (25 hrs.)	***Assessment Criteria*** • Select and ascertain tools and materials for the job and make this available for use in a timely manner. • Plan to dismantle, repair and assemble mechanical components used for power transmission as per drawing and collecting necessary information. • Perform dismantling and appropriate repairing of mechanical components with accuracy applying range of skills and appropriate repairing processes. • Check the accuracy of the repaired components with appropriate gauge & instruments. • Assemble the repaired mechanical components observing standard procedure. • Comply with safety rules when performing the above operations. • Check different parameters of power transmission e.g. R.P.M, slackness of belts, matching of gears/ clutches, loss of RPM etc. • Check for functionality of power transmission system or any assembly as per standard parameters. ***Underpinning Knowledge*** Installation, maintenance and overhaul of machinery and engineering equipment. Power transmission elements. The object of belts, their sizes and specifications, materials of which the belts are made, selection of the type of belts with the consideration of weather, load and tension methods of joining leather belts.
82-84	-do-	164. Dismantling and mounting of pulleys. (10 hrs.) 165. Making & replacing damaged keys. (15 hrs.) 166. Dismounting, Repairing damaged gears and mounting and check for workability. (15	***Assessment Criteria*** • Select and ascertain tools and materials for the job and make this available for use in a timely manner. • Plan to dismantle, repair and assemble mechanical components used for power transmission as per drawing and collecting necessary information. • Perform dismantling and appropriate repairing of

		hrs.) 167. Repair & replacement of belts and check for workability. (10 hrs.)	mechanical components with accuracy applying range of skills and appropriate repairing processes. • Check the accuracy of the repaired components with appropriate gauge & instruments. • Assemble the repaired mechanical components observing standard procedure. • Comply with safety rules when performing the above operations. • Check different parameters of power transmission e.g. R.P.M, slackness of belts, matching of gears/ clutches, loss of RPM etc. • Check for functionality of power transmission system or any assembly as per standard parameters. ***Underpinning Knowledge*** Vee belts and their advantages and disadvantages, Use of commercial belts, dressing and resin creep and slipping, calculation. Power transmissions- coupling types-flange coupling,-Hooks coupling-universal coupling and their different uses. Pulleys-types-solid, split and 'V' belt pulleys, standard calculation for determining size crowning 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.
85.	-do-	168. Making of template/gauge to check involute profile. (25 hrs.)	***Assessment Criteria*** • Select and ascertain tools and materials for the job and make this available for use in a timely manner. • Plan to dismantle, repair and assemble mechanical components used for power transmission as per drawing and collecting necessary information. • Perform dismantling and appropriate repairing of mechanical components with accuracy applying range of skills and appropriate repairing processes. • Check the accuracy of the repaired components with appropriate gauge & instruments. • Assemble the repaired mechanical components observing standard procedure. • Comply with safety rules when performing the above

			operations. • Check different parameters of power transmission e.g. R.P.M, slackness of belts, matching of gears/ clutches, loss of RPM etc. • Check for functionality of power transmission system or any assembly as per standard parameters. ***Underpinning Knowledge*** Power transmission –by gears, most common form spur gear, set names of some essential parts of the set-The pitch circles, Diametral pitch, velocity ratio of a gear set.
86.	-do-	169. Repair of broken gear tooth by stud and repair broker gear teeth by dovetail. (25 hrs.)	***Assessment Criteria*** • Select and ascertain tools and materials for the job and make this available for use in a timely manner. • Plan to dismantle, repair and assemble mechanical components used for power transmission as per drawing and collecting necessary information. • Perform dismantling and appropriate repairing of mechanical components with accuracy applying range of skills and appropriate repairing processes. • Check the accuracy of the repaired components with appropriate gauge & instruments. • Assemble the repaired mechanical components observing standard procedure. • Comply with safety rules when performing the above operations. • Check different parameters of power transmission e.g. R.P.M, slackness of belts, matching of gears/ clutches, loss of RPM etc. • Check for functionality of power transmission system or any assembly as per standard parameters. ***Underpinning Knowledge*** Helical gear, herring bone gears, bevel gearing, spiral bevel gearing, hypoid gearing, pinion and rack, worm gearing, velocity ratio of worm gearing. Repair of gear teeth by building up and dovetail method.
87.	-do-	170. Make hexagonal slide fitting. (20 hrs.)	***Assessment Criteria*** • Select and ascertain tools and materials for the job and

		171. Prepare different types of documentation as per industrial need by different methods of recording information. (5 hrs.)	make this available for use in a timely manner. • Plan to dismantle, repair and assemble mechanical components used for power transmission as per drawing and collecting necessary information. • Perform dismantling and appropriate repairing of mechanical components with accuracy applying range of skills and appropriate repairing processes. • Check the accuracy of the repaired components with appropriate gauge & instruments. • Assemble the repaired mechanical components observing standard procedure. • Comply with safety rules when performing the above operations. • Check different parameters of power transmission e.g. R.P.M, slackness of belts, matching of gears/ clutches, loss of RPM etc. • Check for functionality of power transmission system or any assembly as per standard parameters. ***Underpinning Knowledge*** Importance of Technical English terms used in industry –(in simple definition only)Technical forms, process charts, activity logs, in required formats of industry, estimation, cycle time, productivity reports, job cards.
88.	-do-	172. Marking out on the round sections for geometrical shaped fittings such as spline with 3 or 4 teeth. Finishing and fitting to size, checking up the faces for universality. (25 hrs.)	***Assessment Criteria*** • Select and ascertain tools and materials for the job and make this available for use in a timely manner. • Plan to dismantle, repair and assemble mechanical components used for power transmission as per drawing and collecting necessary information. • Perform dismantling and appropriate repairing of mechanical components with accuracy applying range of skills and appropriate repairing processes. • Check the accuracy of the repaired components with appropriate gauge & instruments. • Assemble the repaired mechanical components observing standard procedure. • Comply with safety rules when performing the above operations.

			• Check different parameters of power transmission e.g. R.P.M, slackness of belts, matching of gears/ clutches, loss of RPM etc. • Check for functionality of power transmission system or any assembly as per standard parameters. ***Underpinning Knowledge*** Fluid power, Pneumatics, Hydraulics, and their comparison, Overview of a pneumatic system, Boyle's law. Overview of an industrial hydraulic system, Applications, Pascal's Law.
89.	Identify, dismantle, replace and assemble different pneumatics and hydraulics components. [Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.]	173. Identify pneumatic components – Compressor, pressure gauge, Filter-Regulator-Lubricator (FRL) unit, and Different types of valves and actuators. (2 hrs.) 174. Dismantle, replace, and assemble FRL unit(5 hrs.) 175. Demonstrate knowledge of safety procedures in pneumatic systems and personal Protective Equipment (PPE)(2 hrs.) 176. Identify the parts of a pneumatic cylinder (1 hrs.) 177. Dismantle and assemble a pneumatic cylinder(8 hrs.) 178. Construct a circuit for the direction & speed control of a small-bore single-acting (s/a) pneumatic cylinder(7 hrs.)	***Assessment Criteria*** • Select and ascertain tools for the job and make this available for use in a timely manner. • Identify different pneumatics and hydraulics components. • Plan to dismantle and replace pneumatics & hydraulics circuit as per drawing and collecting necessary information. • Perform dismantling and replacing of different components with accuracy applying range of skills and standard operating procedure. • Assemble different components. • Check functionality of the components. ***Underpinning Knowledge*** Compressed air generation and conditioning, Air compressors, Pressure regulation, Dryers, Air receiver, Conductors and fittings, FRL unit, Applications of pneumatics, Hazards & safety precautions in pneumatic systems. Pneumatic actuators:- Types, Basic operation, Force, Stroke length, Single-acting and double-acting cylinders.
90.	-do-	179. Construct a control circuit for the control of a d/a pneumatic cylinder with momentary input signals(5 hrs.) 180. Construct a circuit for the direct & indirect control of a d/a pneumatic cylinder with a	***Assessment Criteria*** • Select and ascertain tools for the job and make this available for use in a timely manner. • Identify different pneumatics and hydraulics components. • Plan to dismantle and replace pneumatics & hydraulics circuit as per drawing and collecting necessary information. • Perform dismantling and replacing of different components

		single & double solenoid valve(10 hrs.) 181. Dismantling &Assembling of solenoid valves(10 hrs.)	with accuracy applying range of skills and standard operating procedure. • Assemble different components. • Check functionality of the components ***Underpinning Knowledge*** Pneumatic valves:- Classification, Symbols of pneumatic components, 3/2-way valves (NO & NC types) (manually-actuated & pneumatically-actuated) & 5/2-way valves, Check valves, Flow control valves, One-way flow control valve Pneumatic valves: Roller valve, Shuttle valve, Two-pressure valve Electro-pneumatics: Introduction, 3/2-way single solenoid valve, 5/2-way single solenoid valve, 5/2-way double solenoid valve, Control components -Pushbuttons (NO & NC type) and Electromagnetic relay unit, Logic controls
91.	Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect.	182. Demonstrate knowledge of safety procedures in hydraulic systems (Demo by video) (5 hrs.) 183. Identify hydraulic components – Pumps, Reservoir, Fluids, Pressure relief valve (PRV), Filters, different types of valves, actuators, and hoses (5 hrs.) 184. Inspect fluid levels, service reservoirs, clean/replace filters(5 hrs.) 185. Inspect hose for twist, kinks, and minimum bend radius, Inspect hose/tube fittings(5 hrs.) 186. Identify internal parts of hydraulic cylinders, pumps/motors(5 hrs.)	***Assessment Criteria*** • Select and ascertain tools for the job and make this available for use in a timely manner. • Plan to construct pneumatics & hydraulics circuit as per drawing and collecting necessary information. • Demonstrate possible solutions and agree tasks within the team for constructing circuit. • Construct circuit of pneumatics and hydraulics observing standard procedure. • Comply with safety rules when performing the above operations. • Check different parameters and functionality of the system. ***Underpinning Knowledge*** - Symbols of hydraulic components, Hydraulic oils –function, properties, and types, Contamination in oils and its control - Hydraulic Filters – types, constructional features, and their typical installation locations, cavitation, Hazards & safety precautions in hydraulic systems - Hydraulic reservoir & accessories, Pumps, Classification – Gear/vane/ piston types, Pressure relief valves – Direct acting and pilot-operated types - Pipes, tubing, Hoses and fittings – Constructional details,

			Minimum bend radius, routing tips for hoses
92.	Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. *[Different Damage Mechanical Components – Pulley, Gear, Keys, Jibs and Shafts.]*	187. Construct a circuit for the control of a s/a hydraulic cylinder using a 3/2-way valve (Weight loaded d/a cylinder may be used as a s/a cylinder), 4/2 & 4/3 way valves. (10 hrs.) 188. Maintenance, troubleshooting, and safety aspects of pneumatic and hydraulic systems (The practical for this component may demonstrated by video) (15 hrs.) (This learning outcome does not match with any learning outcome in the Assessment Criteria table)	***Assessment Criteria*** ***Underpinning Knowledge*** - Hydraulic cylinders –Types - Hydraulic motors –Types - Hydraulic valves: Classification, Directional Control valves – 2/2- and 3/2-way valves - Hydraulic valves: 4/2- and 4/3-way valves, Centre positions of 4/3-way valves - Hydraulic valves: Check valves and Pilot-operated check valves, Load holding function - Flow control valves: Types, Speed control methods – meter-in and meter-out - Preventive maintenance & troubleshooting of pneumatic & hydraulic systems, System malfunctions due to contamination, leakage, friction, improper mountings, cavitation, and proper sampling of hydraulic oils
93.	Plan & perform basic day to day preventive maintenance, repairing and check functionality.*[Simple Machines – Drill Machine, Power Saw and Lathe]*	189. Dismantle, overhauling & assemble cross-slide & hand-slide of lathe carriage. (25 hrs.)	***Assessment Criteria*** • Ascertain preventive maintenance/repair procedure as per manual of machine and select appropriate tools & equipment for undertaking job. • Interpret construction, alignment and assembly of different parts of machine. • Plan to carry out the preventive maintenance/repair task with appropriate accuracy of simple machine by collecting necessary information. • Demonstrate possible solutions and agree tasks within the team. • Perform preventive maintenance/dismantle, repair parts and assemble sub-assemblies of simple machine as per layout plan and standard procedure. • Put the machine in operation complying Standard operating procedure. • Check for proper functioning of repaired machine and other parameters of simple machine as per manual after

			erection. • Dispose unsalvageable materials as per standard procedures. ***Underpinning Knowledge*** Method or fixing geared wheels for various purpose drives. General cause of the wear and tear of the toothed wheels and their remedies, method of fitting spiral gears, helical gears, bevel gears, worm and worm wheels in relation to required drive. Care and maintenance of gears.
94-96.	-do-	190. Simple repair of machinery: - Making of packing gaskets. (5 hrs.) 191. Check washers, gasket, clutch, keys, jibs, cotter, Circlip, etc. and replace/repair if needed. (5 hrs.) 192. Use hollow punches, extractor, drifts, various types of hammers and spanners, etc. for repair work. (15 hrs.) 193. Dismantling, assembling of different types of bearing and check for functionality. (15 hrs.) 194. Perform routine check of machine and do replenish as per requirement. (10 hrs.)	***Assessment Criteria*** • Ascertain preventive maintenance/repair procedure as per manual of machine and select appropriate tools & equipment for undertaking job. • Interpret construction, alignment and assembly of different parts of machine. • Plan to carry out the preventive maintenance/repair task with appropriate accuracy of simple machine by collecting necessary information. • Demonstrate possible solutions and agree tasks within the team. • Perform preventive maintenance/dismantle, repair parts and assemble sub-assemblies of simple machine as per layout plan and standard procedure. • Put the machine in operation complying Standard operating procedure. • Check for proper functioning of repaired machine and other parameters of simple machine as per manual after erection. • Dispose unsalvageable materials as per standard procedures. ***Underpinning Knowledge*** Method of lubrication-gravity feed, force (pressure) feed, splash lubrication. Cutting lubricants and coolants: Soluble off soaps, suds-paraffin, soda water, common lubricating oils and their commercial names, selection of lubricants. Clutch: Type, positive clutch (straight tooth type, angular tooth type) . Washers-Types and calculation of washer sizes. The making

			of joints and fitting packing. Chains, wire ropes and clutches for power transmission. Their types and brief description.
97.	Plan, erect simple machine and test machine tool accuracy. *[Simple Machines – Drill Machine, Power Saw and Lathe]*	195. Inspection of Machine tools such as alignment, levelling. (10 hrs.) 196. Accuracy testing of Machine tools such as geometrical parameters. (15 hrs.)	***Assessment Criteria*** • Ascertain erection procedure as per manual of machine and select appropriate tools & equipment for undertaking job. • Interpret construction, alignment and assembly of different parts of machine. • Set up workplace/ assembly location with due consideration to operational stipulation • Plan to carry out the erection of simple machine by collecting necessary information. • Demonstrate possible solutions and agree tasks within the team. • Erect simple machine as per layout plan and standard procedure. • Put the machine in operation complying Standard operating procedure. • Check alignment of erected machine and other parameters of simple machine as per manual after erection. • Dispose unsalvageable materials as per standard procedures. ***Underpinning Knowledge*** Lubrication and lubricants- purpose of using different types, description and uses of each type. Method of lubrication. A good lubricant, viscosity of the lubricant, Main property of lubricant. How a film of oil is formed in journal Bearings.
98-99.	-do-	197. Practicing, making various knots, correct loading of slings, correct and safe removal of parts. (5 hrs.) 198. Erect simple machines. (45 hrs.)	***Assessment Criteria*** • Ascertain erection procedure as per manual of machine and select appropriate tools & equipment for undertaking job. • Interpret construction, alignment and assembly of different parts of machine. • Set up workplace/ assembly location with due

			consideration to operational stipulation • Plan to carry out the erection of simple machine by collecting necessary information. • Demonstrate possible solutions and agree tasks within the team. • Erect simple machine as per layout plan and standard procedure. • Put the machine in operation complying Standard operating procedure. • Check alignment of erected machine and other parameters of simple machine as per manual after erection. • Dispose unsalvageable materials as per standard procedures. ***Underpinning Knowledge*** Foundation bolt: types (rag, Lewis cotter bolt) description of each erection tools, pulley block, crow bar, spirit level, Plumb bob, wire rope, manila rope, wooden block. 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.
100-101		**In-plant training**/ Project work (Emphasis should be on Teamwork: Knowing the power of synergy/ collaboration), Work to be assigned in a group (Group of at least 4 trainees). The group should demonstrate Planning, Execution, Contribution and application of Learning. They need to submit **Project report.**	
102-103		**Revision**	
104		**Examination**	

5. CORE SKILLS SYLLABUS AND TRAINING PLAN

Semester 1 (6 Months)

Core Skills

- Workshop Calculation
- Workshop Science
- Engineering Drawing
- Employability Skill – English Literacy
- Employability Skill – IT Literacy
- Employability Skill – Communication Skills

The session plan will be as follows:

Core Skills	Contents	Duration
WORKSHOP CALCULATION	1. **Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units. 2. **Fractions** : Fractions, Decimal fraction, L.C.M., H.C.F., Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Scientific Calculator. 3. **Square Root**: Square and Square Root, method of finding out square roots, Simple problem using calculator. 4. **Ratio & Proportion** : Simple calculation on related problems. 5. **Percentage** : Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	22 Hours
WORKSHOP SCIENCE	1. **Material Science** : properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys. 2. **Mass .Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals. 3. **Speed and Velocity**: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, simple related problems. 4. **Work, Power and Energy**: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	22 Hours
ENGINEERING DRAWING	**1. Engineering Drawing**: Introduction and its importance • Relationship to other technical drawing types	64 Hours

	• Conventions • Viewing of engineering drawing sheets. • Method of Folding of printed Drawing Sheet as per BIS SP:46-2003 **2. Drawing Instruments:** their Standard and uses • Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips. **3. Lines:** • Definition, types and applications in Drawing as per BIS SP:46-2003 • Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) • Drawing lines of given length (Straight, curved) • Drawing of parallel lines, perpendicular line • Methods of Division of line segment **4. Drawing of Geometrical Figures**: Definition, nomenclature and practice of • Angle: Measurement and its types, method of bisecting. • Triangle -different types • Rectangle, Square, Rhombus, Parallelogram. • Circle and its elements. **5. Lettering and Numbering as per BIS SP46-2003:** • Single Stroke, Double Stroke, inclined, Upper case and Lower case. **6. Dimensioning**: • Definition, types and methods of dimensioning (functional, non-functional and auxiliary) • Types of arrowhead • Leader Line with text **7. Free hand drawing of:** • Lines, polygons, ellipse, etc. • geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. **8. Sizes and Layout of Drawing Sheets:** • Basic principle of Sheet Size • Designation of sizes • Selection of sizes • Title Block, its position and content • Borders and Frames (Orientation marks and graduations) • Grid Reference • Item Reference on Drawing Sheet (Item List) **9. Method of presentation of Engineering Drawing**	

	• Pictorial View • Orthogonal View • Isometric view **10. Symbolic Representation (as per BIS SP:46-2003) of:** • Fastener (Rivets, Bolts and Nuts) • Bars and profile sections • Weld, brazed and soldered joints. • Electrical and electronics element • Piping joints and fittings	
EMPLOYABILITY SKILLS – ENGLISH LITERACY	**1. Pronunciation**: Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech) **2. Functional Grammar**: Transformation of sentences, Voice change, Change of tense, Spellings. **3. Reading**: Reading and understanding simple sentences about self, work and environment. **4. Writing**: Construction of simple sentences Writing simple English. **5. Speaking / Spoken English**: Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.	20 Hours
EMPLOYABILITY SKILLS – IT LITERACY	**1. Basics of Computer**: Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer. **2. Computer Operating System**: Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications. **3. Word processing and Worksheet**: Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets. **4. Computer Networking and Internet**: Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication.	20 Hours

	Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.	
EMPLOYABILITY SKILLS – COMMUNICATION SKILLS	**1. Introduction to Communication Skills:** • Communication and its importance • Principles of Effective communication • Types of communication - verbal, non verbal, written, email, talking on phone. • Non verbal communication -characteristics, components-Para-language • Body language • Barriers to communication and dealing with barriers. • Handling nervousness/ discomfort. **2. Listening Skills:** • Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. • Triple- A Listening - Attitude, Attention & Adjustment. • Active Listening Skills. **3. Motivational Training:** • Characteristics Essential to Achieving Success. • The Power of Positive Attitude. • Self awareness • Importance of Commitment • Ethics and Values • Ways to Motivate Oneself • Personal Goal setting and Employability Planning. **4. Facing Interviews:** • Manners, Etiquettes, Dress code for an interview • Do's & Don'ts for an interview. **5. Behavioral Skills:** • Problem Solving • Confidence Building • Attitude	15 Hours

Semester 2 (6 Months)

Core Skills

- Workshop Calculation
- Workshop Science
- Engineering Drawing
- Employability Skill – Entrepreneurship Skills
- Employability Skill – Occupational Safety, Health and Environment Education
- Employability Skill – Productivity
- Employability Skill – Labour Welfare Legislation
- Employability Skill – Quality Tools

The session plan will be as follows:

Core Skills	Contents	Duration
WORKSHOP CALCULATION	1. **Algebra**: Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables). 2. **Mensuration** : Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi-circle, Volume of solids – cube, cuboids, cylinder and Sphere. Surface area of solids – cube, cuboids, cylinder and Sphere. 3. **Trigonometry**: Trigonometrical ratios, measurement of angles. Trigonometric tables	21 Hours
WORKSHOP SCIENCE	1. **Heat & Temperature**: Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation. 2. **Basic Electricity:** Introduction, use of electricity, how electricity is produced, Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections – series, parallel, electric power, Horse power, energy, unit of electrical energy. 3. **Levers and Simple Machines:** Levers and its types. Simple Machines, Effort and Load, Mechanical Advantage, Velocity Ratio, Efficiency of machine, Relationship between Efficiency, velocity ratio and Mechanical Advantage.	21 Hours
ENGINEERING DRAWING	1. **Construction of Scales and diagonal scale** 2. **Practice of Lettering and Title Block** 3. **Dimensioning practice:** • Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003)	64 Hours

	• Symbols preceding the value of dimension and dimensional tolerance. • Text of dimension of repeated features, equidistance elements, circumferential objects. **4. Construction of Geometrical Drawing Figures:** • Different Polygons and their values of included angles. Inscribed and Circumscribed polygons. • Conic Sections (Ellipse & Parabola) **5. Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions.** **6. Free Hand sketch of hand tools and measuring tools used in respective trades.** **7. Projections:** • Concept of axes plane and quadrant. • Orthographic projections • Method of first angle and third angle projections (definition and difference) • Symbol of 1st angle and 3rd angle projection as per IS specification. **8.** Drawing of Orthographic projection from isometric/3D view of blocks **9.** Orthographic Drawing of simple fastener (Rivet, Bolts, Nuts & Screw) **10.** Drawing details of two simple mating blocks and assembled view.	
EMPLOYABILITY SKILLS – ENTREPRENEURSHIP SKILLS	**1. Concept of Entrepreneurship**: Entrepreneur - Entrepreneurship - Enterprises:- Conceptual issue **2.** Entrepreneurship vs. management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business. **3. Project Preparation & Marketing analysis**: Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of PLC, Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix. **4. Institutions Support**: Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme. **5. Investment Procurement**: Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.	15 Hours
EMPLOYABILITY SKILLS – PRODUCTIVITY	**1. Benefits**: Personal / Workman - Incentive, Production linked Bonus, Improvement in living standard. **2. Affecting Factors**: Skills, Working Aids, Automation, Environment, Motivation - How improves or slows down. **3. Comparison with developed countries**: Comparative productivity in developed countries	10 Hours

	(viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages. 4. **Personal Finance Management:** Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
EMPLOYABILITY SKILLS – OCCUPATIONAL SAFETY, HEALTH AND ENVIRONMENT EDUCATION	1. **Safety & Health**: Introduction to Occupational Safety and Health importance of safety and health at workplace. 2. **Occupational Hazards**: Basic Hazards, Chemical Hazards, Vibroacoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention. 3. **Accident & safety**: Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures. 4. **First Aid**: Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person. 5. **Basic Provisions**: Idea of basic provision legislation of India. safety, health, welfare under legislative of India. 6. **Ecosystem**: Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance. 7. **Pollution**: Pollution and pollutants including liquid, gaseous, solid and hazardous waste. 8. **Energy Conservation**: Conservation of Energy, re-use and recycle. 9. **Global warming**: Global warming, climate change and Ozone layer depletion. 10. **Ground Water**: Hydrological cycle, ground and surface water, Conservation and Harvesting of water. 11. **Environment**: Right attitude towards environment, Maintenance of in -house environment.	15 Hours
EMPLOYABILITY SKILLS - LABOUR WELFARE LEGISLATION	1) **Welfare Acts:** Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.	5 Hours
EMPLOYABILITY SKILLS - QUALITY TOOLS	1. **Quality Consciousness**: Meaning of quality, Quality characteristic. 2. **Quality Circles**: Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles. 3. **Quality Management System:** Idea of ISO 9000 and BIS systems and its importance in maintaining qualities. 4. **House Keeping**: Purpose of House-keeping, Practice of good Housekeeping. 5. **Quality Tools**: Basic quality tools with a few examples.	10 hours

Semester 3 (6 Months)

Core Skills

- Workshop Calculation
- Workshop Science
- Engineering Drawing

The session plan will be as follows:

Core Skills	Contents	Duration
WORKSHOP CALCULATION	**1. Geometrical construction & theorem:** Division of line segment, parallel lines, similar angles, perpendicular lines, isosceles triangle and right angled triangle. **2. Area of cut-out regular surfaces:** Circle and segment and sector of circle. **3. Area of irregular surfaces:** Application related to shop problems. **4. Volume of cut-out solids:** Hollow cylinders, frustum of cone, block section. - Volume of simple machine blocks. **5.** Material weight and cost problems related to trade. **6.** Finding the value of unknown sides and angles of a triangle by Trigonometrical method. **7.** Finding height and distance by trigonometry. **8.** Application of trigonometry in shop problems. (viz. taper angle calculation).	21 Hours
WORKSHOP SCIENCE	**1.** Forces definition. Compressive, tensile, shear forces and simple problems. Stress, strain, ultimate strength, factor of safety. Basic study of stress-strain curve for MS. **2.** Temperature measuring instruments. Specific heats of solids & liquids. **3.** Thermal Conductivity, Heat loss and heat gain. **4.** Average Velocity, Acceleration & Retardation. Related problems. **5. Circular Motion:** Relation between circular motion and Linear motion, Centrifugal force, Centripetal force.	21 Hours
ENGINEERING DRAWING	**1.** Revision of first year topics. **2.** Machined components; concept of fillet & chamfer; surface finish symbols. **3.** Screw thread, their standard forms as per BIS, external and internal thread, conventions on the features for drawing as per BIS. **4.** Free hand Sketches for bolts, nuts, screws and other screwed members. **5.** Free hand Sketching of foundation bolts and types of washers. **6.** Standard rivet forms as per BIS (Six types). **7.** Riveted joints-Butt & Lap (Drawing one for each type). **8.** Orthogonal views of keys of different types.	64 Hours

	9. Free hand Sketches for simple pipe, unions with simple pipe line drawings. **10.** Concept of preparation of assembly drawing and detailing. Preparation of simple assemblies & their details of trade related tools/job/exercises with the dimensions from the given sample or models. **11.** Free hand sketch of trade related components / parts (viz., single tool post for the lathe, etc.) **12.** Study of assembled views of Vee-blocks with clamps. **13.** Study of assembled views of shaft and pulley. **14.** Study of assembled views of bush bearing. **15.** Study of assembled views of a simple coupling. **16.** Free hand Sketching of different gear wheels and nomenclature**.**	

Semester 4 (6 Months)

Core Skills

- Workshop Calculation
- Workshop Science
- Engineering Drawing

The session plan will be as follows:

Core Skills	Contents	Duration
WORKSHOP CALCULATION	**1. Graph:** Read images, graphs, diagrams bar chart, pie chart. Graphs: abscissa and ordinates, graphs of straight line, related to two sets of varying quantities. **2. Simple problem on Statistics:** Frequency distribution table Calculation of Mean value. Examples on mass scale productions. Cumulative frequency Arithmetic mean **3. Acceptance of lot by sampling method** (within specified limit size) with simple examples	21 Hours

	(not more than 20 samples).	
WORKSHOP SCIENCE	**1.** **Friction-** Co-efficient of friction, application and effects of friction in Workshop practice. **Centre of gravity** and its practical application**.** **2.** Magnetic substances- Natural and artificial magnets. Method of magnetization. Use of magnets. **3.** Electrical insulating materials. Basic concept of earthing. **4.** Transmission of power by belt, pulleys & gear drive. Calculation of Transmission of power by belt pulley and gear drive. **5.** Heat treatment and advantages. **6.** **Concept of pressure –** units of pressure, atmospheric pressure, absolute pressure. **Gauge pressure** – gauges used for measuring pressure.	21 Hours
ENGINEERING DRAWING	**1.** Free hand Details and assembly of simple bench vice. **2.** Reading of drawing. Simple exercises related to missing lines, dimensions. How to make queries. **3.** Simple exercises relating missing symbols. Missing views **4.** Simple exercises related to missing section. **5.** Free hand sketching of different types of bearings and its conventional representation. **6.** Free hand sketching of different gear wheels and nomenclature/ Simple duct (for RAC). Free hand sketch of Reciprocating compressor – open type (for RAC) **7.** Solution of NCVT test. Simple exercises related to trade related symbols. Basic electrical and electronic symbols. **8.** Study of drawing & Estimation of materials. **9.** Solution of NCVT test papers.	63 Hours

5. ASSESSMENT CRITERIA & GUIDELINES

The trainee will be tested for his skill, knowledge and attitude during the period of course and at the end of the training programme as notified by Govt of India from time to time. The Employability skills will be covered and tested in first two semesters only.

a) The **Internal assessment** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as mentioned in the Assessment Criteria mentioned in the table below.

b) The final assessment will be in the form of summative assessment method. The All India trade Test for awarding NTC will be conducted by NCVT as per guideline of Govt of India. The pattern and marking structure is being notified by govt of India from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

Pass Regulation

For the purposes of determining the overall result, weighting of 25 percent is applied to each semester examination. The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%.

Specific Assessable Outcome:

SPECIFIC LEARNING / ASSESSABLE OUTCOME			
SEMESTER-I			
LEARNING / ASSESSABLE OUTCOME		**ASSESSMENT CRITERIA**	**MARKS**
1. Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check for dimensional accuracy. *[Basic fitting operation – marking, Hacksawing, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy:* ±	1. 1	Plan & Identify tools, instruments and equipments for marking and make this available for use in a timely manner.	Practical: 17 Theory: 8 Total: 25
	1. 2	Select raw material and visual inspect for defects.	
	1. 3	Mark as per specification applying desired mathematical calculation and observing standard procedure.	
	1. 4	Measure all dimensions in accordance with standard specifications and tolerances.	
	1. 5	Identify Hand Tools for different fitting operations and make these available for use in a timely manner.	
	1. 6	Prepare the job for Hacksawing, chiselling, filing, drilling, tapping, grinding.	
	1. 7	Perform basic fitting operations viz., Hacksawing, filing, drilling, tapping and grinding to close tolerance as per specification to make the job.	
	1. 8	Observe safety procedure during above operation as	

0.25mm]		per standard norms and company guidelines.	
	1. 9	Check for dimensional accuracy as per standard procedure.	
	1. 10	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.	
2. Manufacture simple sheet metal items as per drawing and join them by soldering, brazing and riveting.	2. 1	Identify Hand Tools for Sheet Metal work, Soldering, Brazing & riveting and make these available for use in a timely manner.	Practical: 17 Theory: 8 Total: 25
	2. 2	Mark and develop various forms as per drawing using sheet metals.	
	2. 3	make of simple items with sheet metal as per drawing.	
	2. 4	Prepare the job for Soldering, Brazing & riveting.	
	2. 5	Identify different type of rivets and use as per requirement.	
	2. 6	Identify tools for drilling and use these tools.	
	2. 7	Mark according to drawing.	
	2. 8	Drill through holes on the job.	
	2. 9	Solder, Braze and Rivet to prepare a job as per given drawing / sample following standard practices.	
	2. 10	Observe safety procedure during riveting as per standard norms and company guidelines.	
3. Join metal components by riveting observing standard procedure.	3. 1	Identify Tools and equipments for riveting and make these available for use in a timely manner.	Practical: 17 Theory: 8 Total: 25
	3. 2	Prepare the job for lap and butt joint.	
	3. 3	Identify different type of rivets and use as per requirement.	
	3. 4	Identify tools for drilling and use these tools.	
	3. 5	Mark according to drawing.	
	3. 6	Drill through holes on the job.	
	3. 7	Rivet to prepare a job as per given drawing / sample following standard practices.	
	3. 8	Observe safety procedure during riveting as per standard norms and company guidelines.	
4. Join metal component by arc welding observing standard procedure.	4. 1	Identify different components/parts of arc welding machine, collect desired information and set each components/parts as per standard procedure.	Practical: 17 Theory: 8 Total: 25
	4. 2	Observe safety/ precaution during operation.	
	4. 3	Select appropriate material & plan for arc welding.	
	4. 4	Weld metal parts / mechanical components as per specification observing standard procedure.	
	4. 5	Check joined part portion to ascertain proper welding.	
5. Cut and join metal component by gas (oxy-acetylene)	5. 1	Identify different components/parts of Gas (oxy-acetylene) machine, collect desired information and set each components/parts as per standard procedure.	Practical: 17 Theory: 8 Total: 25
	5. 2	Observe safety/ precaution during operation.	

	5. 3 Select appropriate material & plan for gas cutting & joining operation.	
	5. 4 Cut & join metal parts / mechanical components as per specification observing standard procedure.	
	5. 5 Check cut portion/ joined part to ascertain proper welding.	
SEMESTER-II		
LEARNING / ASSESSABLE OUTCOME	**ASSESSMENT CRITERIA**	**MARKS**
6. Produce components by different operations and check accuracy using appropriate measuring instruments. *[Different Operations - Drilling, Reaming, Taping, Dieing; Appropriate Measuring Instrument – Vernier, Screw Gauge, Micrometer]*	6. 1 Ascertain and select tools and materials for the job and make this available for use in a timely manner. 6. 2 Plan work in compliance with standard safety norms. 6. 3 Produce component by observing standard procedure. 6. 4 Check the dimensions of the produced components to ensure dimensions are within prescribed limit. 6. 5 Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.	Practical: 17 Theory: 8 Total: 25
7. Make different fit of components for assembling as per required tolerance observing principle of interchangeability and check for functionality. *[Different Fit – Sliding, Angular, Step fit, 'T' fit, Square fit and Profile fit; Required tolerance: ±0.04 mm, angular tolerance: 30 min.]*	7. 1 Recognize general concept of Limits, Fits and tolerance necessary for fitting applications and functional application of these parameters. 7. 2 Ascertain and select tools and materials for the job and make this available for use in a timely manner. 7. 3 Set up workplace/ assembly location with due consideration to operational stipulation 7. 4 Plan work in compliance with standard safety norms and collecting desired information. 7. 5 Demonstrate possible solutions and agree tasks within the team. 7. 6 Make components according to the specification for different fit using a range of practical skills and ensuring interchangeability of different parts. 7. 7 Assemble components applying a range of skills to ensure proper fit. 7. 8 Check functionality of components.	Practical: 17 Theory: 8 Total: 25
8. Produce	8. 1 Ascertain basic working principles and safety aspect of	Practical: 17

components involving different operations on lathe observing standard procedure and check for accuracy. *[Different Operations – facing, plain turning, step turning, parting, chamfering, shoulder turn, grooving, knurling, boring, taper turning, threading (external 'V' only)]*		lathe machine.	Theory: 8 Total: 25
	8. 2	Understand functional application of different levers, stoppers, adjustment etc.	
	8. 3	Identify different lubrication points and lubricants, their usage for application in lathe machine as per machine manual.	
	8. 4	Identify different work and tool holding devices and collect information for functional application of each device.	
	8. 5	Mount the work and tool holding devices with required alignment and check for its functional usage to perform lathe operations.	
	8. 6	Solve problem by applying basic methods, tools, materials and information during setting.	
	8. 7	Observe safety procedure during mounting as per standard norms.	
	8. 8	Produce components observing standard procedure.	
	8. 9	Check accuracy/ correctness of job using appropriate equipment/gauge.	
	8. 10	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.	
9. Plan & perform simple repair, overhauling of different machines and check for functionality. [Different Machines – Drill Machine, Power Saw, Bench Grinder and Lathe]	9. 1	Ascertain and select tools and materials for the repair, overhauling and make this available for use in a timely manner.	Practical: 17 Theory: 8 Total: 25
	9. 2	Plan work in compliance with standard safety norms.	
	9. 3	Demonstrate possible solutions and agree tasks within the team.	
	9. 4	Select specific parts to be repaired and ascertain for appropriate material and estimated time.	
	9. 5	Repair, overhaul and assemble the parts in the machine with the help of blue print.	
	9. 6	Check for functionality of part and ascertain faults of the part/ machine in case of improper function.	
	9. 7	Rectify faults of assembly.	
SEMESTER-III			
LEARNING / ASSESSABLE OUTCOME		**ASSESSMENT CRITERIA**	
10. Make & assemble components of different mating surfaces as per required tolerance by different surface finishing operations	10. 1	Ascertain and select tools and materials for the job and make this available for use in a timely manner.	Practical: 17 Theory: 8 Total: 25
	10. 2	Plan work in compliance with standard and collecting necessary information.	
	10. 3	Set up workplace/ assembly location with due consideration to operational stipulation	
	10. 4	Demonstrate possible solutions and agree tasks within	

using different fastening components, tools and check functionality. *[Different Mating Surfaces – Dovetail fitting, Radious fitting, Combined fitting; Different surface finishing operations – Scraping, Lapping and Honing; Different fastening components – Dowel pins, screws, bolts, keys and cotters; Different fastening tools-hand operated & power tools, Required tolerance - ±0.02mm, angular tolerance ± 10 min.]*	the team. 10. 5 Produce different components with appropriate accuracy by observing standard procedure& method as per specification using appropriate tools & machines. 10. 6 Perform scraping and lapping of components to obtain required surface finish of different mating surface. 10. 7 Comply with safety rules when performing the above operations. 10. 8 Check tolerance and accuracy of components as defined with appropriate instruments observing standard procedure. 10. 9 Assemble different components using different fastening components, tools and check the functionality.	
11. Make different gauges by using standard tools & equipment and checks for specified accuracy. *[Different Gauges – Snap gauge, Gap gauge; Specified Accuracy - ±0.02mm]*	11. 1 Ascertain and select tools and materials for the job and make this available for use in a timely manner. 11. 2 Plan work in compliance with standard safety norms. 11. 3 Produce gauge by observing appropriate method and as per specification of drawing. 11. 4 Perform Lapping of gauge to obtain required finish as per drawing. 11. 5 Check tolerance and specified accuracy of gauge with appropriate measuring instruments as per drawing. 11. 6 Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.	Practical: 17 Theory: 8 Total: 25
12. Apply a range of skills to execute pipe joints, dismantle and assemble valves &	12.1 Ascertain and select tools and materials for the job and make this available for use in a timely manner. 12.2 Plan to Dismantle and assemble valves and pipe fittings. 12.3 Dismantle valves and fittings in pipes applying range of	Practical: 17 Theory: 8 Total: 25

fittings with pipes and test for leakages. *[Range of skills – Cutting, Threading, Flaring, Bending and Joining]*	skills and check for defect as per standard procedure. 12.4 Demonstrate possible solutions in case of defect and agree tasks within the team for repair or replacement. 12.5 Assemble valves and various pipe fittings using range of skills and observing standard procedure. 12.6 Test for leakage and appropriate functioning of valves. 12.7 Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.	
SEMESTER-IV		
LEARNING / ASSESSABLE OUTCOME	**ASSESSMENT CRITERIA**	
13. Make drill jig & produce components on drill machine by using jigs and check for correctness.	13.1 Set up workplace/ assembly location with due consideration to operational stipulation. 13.2 Ascertain and select tools and materials for the job and make this available for use in a timely manner. 13.3 Collect information related to standard procedure, methods and tools to make drill jigs. 13.4 Mark the components as per drawing. 13.5 Make drill jigs by turning, drilling, reaming, filing, taping, etc. 13.6 Test the functionality of jig. 13.7 Select suitable jigs for drilling considering desired result and collecting necessary information. 13.8 Produce component by using jig observing standard procedure and check the correctness of the job. 13.9 Comply with safety rules when performing the above operations.	Practical: 16 Theory: 9 Total:25
14. Plan, dismantle, repair and assemble different damaged mechanical components used for power transmission & check functionality. *[Different Damage Mechanical Components – Pulley, Gear, Keys, Jibs and Shafts.]*	14.1 Select and ascertain tools and materials for the job and make this available for use in a timely manner. 14.2 Plan to dismantle, repair and assemble mechanical components used for power transmission as per drawing and collecting necessary information. 14.3 Perform dismantling and appropriate repairing of mechanical components with accuracy applying range of skills and appropriate repairing processes. 14.4 Check the accuracy of the repaired components with appropriate gauge & instruments. 14.5 Assemble the repaired mechanical components observing standard procedure. 14.6 Comply with safety rules when performing the above operations. 14.7 Check different parameters of power transmission e.g. R.P.M, slackness of belts, matching of gears/ clutches, loss of RPM etc.	Practical: 16 Theory: 9 Total:25

	14.8 Check for functionality of power transmission system or any assembly as per standard parameters.	
15. Identify, dismantle, replace and assemble different pneumatics and hydraulics components. *[Different components – Compressor, Pressure Gauge, Filter Regulator Lubricator, Valves and Actuators.]*	15.1 Select and ascertain tools for the job and make this available for use in a timely manner. 15.2 Identify different pneumatics and hydraulics components. 15.3 Plan to dismantle and replace pneumatics & hydraulics circuit as per drawing and collecting necessary information. 15.4 Perform dismantling and replacing of different components with accuracy applying range of skills and standard operating procedure. 15.5 Assemble different components. 15.6 Check functionality of the components.	Practical: 16 Theory: 9 Total:25
16. Construct circuit of pneumatics and hydraulics observing standard operating procedure& safety aspect.	16.1 Select and ascertain tools for the job and make this available for use in a timely manner. 16.2 Plan to construct pneumatics & hydraulics circuit as per drawing and collecting necessary information. 16.3 Demonstrate possible solutions and agree tasks within the team for constructing circuit. 16.4 Construct circuit of pneumatics and hydraulics observing standard procedure. 16.5 Comply with safety rules when performing the above operations. 16.6 Check different parameters and functionality of the system.	Practical: 16 Theory: 9 Total:25
17. Plan & perform basic day to day preventive maintenance, repairing and check functionality. *[Simple Machines – Drill Machine, Power Saw and Lathe]*	17.1 Ascertain preventive maintenance/repair procedure as per manual of machine and select appropriate tools & equipment for undertaking job. 17.2 Interpret construction, alignment and assembly of different parts of machine. 17.3 Plan to carry out the preventive maintenance/repair task with appropriate accuracy of simple machine by collecting necessary information. 17.4 Demonstrate possible solutions and agree tasks within the team. 17.5 Perform preventive maintenance/dismantle, repair parts and assemble sub-assemblies of simple machine as per layout plan and standard procedure. 17.6 Put the machine in operation complying Standard operating procedure. 17.7 Check for proper functioning of repaired machine and other parameters of simple machine as per manual after erection. 17.8 Dispose unsalvageable materials as per standard procedures.	Practical: 16 Theory: 9 Total:25

18. Plan, erect simple machine and test machine tool accuracy. *[Simple Machines – Drill Machine, Power Saw and Lathe]*	18.1 Ascertain erection procedure as per manual of machine and select appropriate tools & equipment for undertaking job.	Practical: 16 Theory: 9 Total:25
	18.2 Interpret construction, alignment and assembly of different parts of machine.	
	18.3 Set up workplace/ assembly location with due consideration to operational stipulation	
	18.4 Plan to carry out the erection of simple machine by collecting necessary information.	
	18.5 Demonstrate possible solutions and agree tasks within the team.	
	18.6 Erect simple machine as per layout plan and standard procedure.	
	18.7 Put the machine in operation complying Standard operating procedure.	
	18.8 Check alignment of erected machine and other parameters of simple machine as per manual after erection.	
	18.9 Dispose unsalvageable materials as per standard procedures.	
GRAND TOTAL		**Practical: 300** **Theory: 150** **Total: 450**

Generic Assessable Outcome:

GENERIC LEARNING / ASSESSABLE OUTCOME		
SEMESTER-I		
LEARNING / ASSESSABLE OUTCOME	**LEARNING / ASSESSABLE OUTCOME**	**MARKS**
1. Recognize & comply safe working practices, environment regulation and housekeeping.	1. 1. Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.	Practical: 15 Theory: 10 Total: 25
	1. 2. Recognize and report all unsafe situations according to site policy.	
	1. 3. Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.	
	1. 4. Identify, handle and store / dispose off dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.	
	1. 5. Identify and observe site policies and procedures in	

	regard to illness or accident.	
	1. 6. Identify safety alarms accurately.	
	1. 7. Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.	
	1. 8. Identify and observe site evacuation procedures according to site policy.	
	1. 9. Identify Personal Productive Equipment (PPE) and use the same as per related working environment.	
	1. 10. Identify basic first aid and use them under different circumstances.	
	1. 11. Identify different fire extinguisher and use the same as per requirement.	
	1. 12. Identify environmental pollution & contribute to avoidance of same.	
	1. 13. Take opportunities to use energy and materials in an environmentally friendly manner	
	1. 14. Avoid waste and dispose waste as per procedure	
	1. 15. Recognize different components of 5S and apply the same in the working environment.	
2. Understand, explain different mathematical calculation & science in the field of study including basic electrical and apply in day to day work. *[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]*	2.1 Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure, heat treatment, centre of gravity, friction.	Practical: 15 Theory: 10 Total: 25
	2.2 Measure dimensions as per drawing	
	2.3 Use scale/ tapes to measure for fitting to specification.	
	2.4 Comply given tolerance.	
	2.5 Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.	
	2.6 Ensure dimensional accuracy of assembly by using different instruments/gauges.	
	2.7 Explain basic electricity, insulation & earthing.	
3. Interpret	3. 1. Read & interpret the information on drawings and apply	Practical: 15

specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing- Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]*	in executing practical work. 3. 2. Read & analyse the specification to ascertain the material requirement, tools, and machining /assembly /maintenance parameters. 3. 3. Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.	Theory: 10 Total: 25
4. Select and ascertain measuring instrument and measure dimension of components and record data.	4.1 Select appropriate measuring instruments such as micrometers, vernier calipers, dial gauge, bevel protector and height gauge (as per tool list). 4.2 Ascertain the functionality & correctness of the instrument. 4.3 Measure dimension of the components & record data to analyse the with given drawing/measurement.	Practical: 15 Theory: 10 Total: 25
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.	5.1 Explain the concept of productivity and quality tools and apply during execution of job. 5.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws. 5.3 Knows benefits guaranteed under various acts	Practical: 15 Theory: 10 Total: 25

6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	6.1 Explain the concept of energy conservation, global warming, pollution and utilize the available recourses optimally & remain sensitive to avoid environment pollution.	
	6.2 Dispose waste following standard procedure.	
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	7. 1. Explain personnel finance and entrepreneurship.	Practical: 15 Theory: 10 Total: 25
	7. 2. Explain role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non-financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.	
	7. 3. Prepare Project report to become an entrepreneur for submission to financial institutions.	
8. Plan and organize the work related to the occupation.	8. 1. Use documents, drawings and recognize hazards in the work site.	Practical: 15 Theory: 10 Total: 25
	8. 2. Plan workplace/ assembly location with due consideration to operational stipulation	
	8. 3. Communicate effectively with others and plan project tasks	
GRAND TOTAL		**Practical: 120** **Theory: 80** **Total: 200**

Assessment Guideline

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitive to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude to be considered while assessing competency. Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment

- Project work

Evidence of internal assessment to be preserved until forthcoming semester examination for audit and verification by examination body. The following marking pattern to be adopted while assessing:

Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • Below 70% tolerance dimension achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b) Weightage in the range of above 75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% tolerance dimension achieved while undertaking different work with those demanded by the component/job. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Weightage in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% tolerance dimension achieved while undertaking different work with those demanded by the component/job. • A high level of neatness and consistency in the finish. •Minimal or no support in completing the project.

FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor :													**Year of Enrollment :**		
Name & Address of ITI (Govt./Pvt.) :													**Date of Assessment :**		
Name & Address of the Industry :													**Assessment location: Industry / ITI**		
Trade Name :		**Semester:**											**Duration of the Trade/course:**		
Learning Outcome:															
Sl. No	**Maximum Marks (Total 100 Marks)**		**15**	**5**	**10**	**5**	**10**	**10**	**5**	**10**	**15**	**15**	**Total internal assessment Marks**	**Result (Y/N)**
	Candidate Name	**Father's/Mother's Name**	Safety consciousness	Workplace hygiene	Attendance/ Punctuality	Ability to follow Manuals/ Written instructions	Application of Knowledge	Skills to handle tools & equipment	Economical use of materials	Speed in doing work	Quality in workmanship	VIVA		
1														
2														

7. INFRASTRUCTURE AND RESOURCES

1. Instructors Qualification : Degree in Electrical / Electrical andElectronics Engineering from recognized Engineering College/ university with one year experience in the relevant field

OR

Diploma in Electrical / Electrical and Electronics Engineering from recognized board of technical education with two years experience in the relevant field

OR

10th class examination and NTC/NAC in the Trade of "Electrician" With 3 years' post qualification experience in the relevant field.

2. Desirable qualification : Preference will be given to a candidate with CIC (Craft Instructor Certificate) in Electrician trade.

3. Space norms : 98 Sq. metres.

4. Power norms : 5.2 KW (for two units in one shift)

5. Tools, Equipment & Machinery : (As per Annexure – I)

Note:

1. Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma in the field.
2. Instructor qualification for WCS and E.D, as per the training manual.
3. The list of Tools, Equipment & General Machinery listed in Annexure – I are for a particular trade (Electrician) comprising of four semesters and not for single semester.

8. LIST OF TOOLS & EQUIPMENT

FITTER			
LIST OF TOOLS AND EQUIPMENT (For batch of 16 candidates)			
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit sl. 1-18 is required additionally)			
Sl. no.	**Name of the Tool &Equipments**	**Specification**	**Quantity**
1	Steel Rule with metric & British graduation	150 mm, Stainless steel	16 nos.
2	Try Square.	150 mm blade	16 nos.
3	Caliper inside spring type.	150 mm	16 nos.
4	Caliper hermaphrodite spring type	150 mm	16 nos.
5	Caliper outside spring type	150 mm	16 nos.
6	Divider spring type	150 mm	16 nos.
7	Scriber	150 mm	16 nos.
8	Centre Punch	10 mm and Length - 120 mm	16 nos.
9	Screw driver	150mm insulated flat type	16 nos.
10	Chisel cold flat	20 mm X 150 mm High carboon steel	16 nos.
11	Hammer ball peen With handle	450 grams (1 lb)	16 nos.
12	Hammer ball peen With handle.	220 grams (1/2 lb)	16 nos.
13	File flat - second cut	250 mm	16 nos.
14	File flat smooth	250 mm.	16 nos.
15	File half round second cut	150 mm.	16 nos.
16	Hacksaw frame fixed type	300 mm	16 nos.
17	Safety goggles.		16 nos.
18	Dot punch	100 mm	16 nos.
B. INSTRUMENTS AND GENERAL SHOP OUTFIT - For 2 (1+1) units no additional items are required			
INSTRUMENTS			
19.	Steel Rule Graduated both in Metric and English Unit	300 mm Stainless steel	4 nos.
20.	Straight edge steel	300 mm or above	2 nos.
21.	Spirit Level metal Type - 2	300 mm Basic Length Accuracy 0.1mm/Meter	1 no.
22.	Stud Extractor EZY - out	Set of 8	2 sets
23.	Combination Set	300 mm	2 nos.
24.	Micrometer outside.	0 - 25 mm	2 nos.
25.	Micrometer outside.	25 - 50 mm	2 nos.
26.	Micrometer outside.	50 - 75 mm	2 nos.
27.	Micrometer inside with extension rods.	Accuracy 0.01 mm with extension rods upto 150 mm	1 no.
28.	Vernier caliper	150 mm	4 nos.
29.	Vernier height gauges	0 - 300 mm with least count = 0.02 mm	1 no.
30.	Vernier bevel protractor Blade with Acute Angle Attachment	300 mm	1 no.
31.	Screw pitch gauge Metric	0.25 to 6 mm	1 no.
32.	Wire gauge, metric standard.		1 no.
GENERAL SHOP OUTFIT			
33.	Surface plate C.I/Granite with Stand and Cover	600 x 600 mm	1 nos.

34.	Marking table (Mild steel)	900X900X900 mm	1 no.
35.	Universal scribing block.	220 mm	2 nos.
36.	V-Block pair with clamps	150 x 100 x 100 mm	2 nos.
37.	Angle plate	150 X 150 X 250 mm	2 nos.
38.	Punch letter set.	3 mm	1 no.
39.	Punch number set.	3 mm	1 no.
40.	Portable hand drill (Electric)	0 to 13 mm Capacity	1 no.
41.	Drill twist straight shank	3 mm to 12 mm by 0.5 mm H.S.S.	2 sets
42.	Drill twist Taper shank	8 mm to 20 mm by 0.5 mm H.S.S.	2 sets
43.	Taps and dies complete set in box.	Wit-worth	1 no.
44.	Taps and dies complete set	5, 6, 8, 10 & 12 mm set of 5	2 Sets
45.	File knife edge smooth	150 mm	4 nos.
46.	File feather edge smooth	150 mm	4 nos.
47.	File triangular smooth	200 mm	8 nos.
48.	File round second cut	200 mm	8 nos.
49.	File square second cut	250 mm	8 nos.
50.	Feeler gauge	Gauge Feeler / Thickness - 0.05 mm to 0.3 mm by 0.05 and 0.4 mm to 1 mm by 0.1 mm - 13 leaves	1 set
51.	File triangular second cut.	200 mm	8 nos.
52.	File flat second cut safe edge.	300 mm	8 nos.
53.	File flat bastard	200 mm	10 nos.
54.	File flat bastard.	300 mm	10 nos.
55.	File Swiss type needle	Set of 12, Length = 150 mm	2 sets
56.	File half round second cut.	250 mm	10 nos.
57.	File half round bastard.	250 mm	10 nos.
58.	File round bastard.	250 mm	10 nos.
59.	File hand second cut.	150 mm	8 nos.
60.	File card.	3"x5" size, brass or steel wire	8 nos.
61.	Oil Can	250 ml	2 nos.
62.	Pliers combination insulated	150 mm	2 nos.
63.	Wooden handle forged Soldering Iron copper bit.	230V, 250 W, 350 gm	2 nos.
64.	Blow Lamp	0.5 litre	2 nos.
65.	Spanner- Double Ended	6x7, 8x9, 10x11, 12x13, 14x15, 16x17, 18x19, 20x22	1 set each
66.	Spanner adjustable	150 mm	2 nos.
67.	Interchangeable ratchet socket set	12 mm driver, sized10-32 mm set of 18 socket & attachments.	1 set
68.	Double Ended tubular Box spanner set with Tommy bar.	A/F 6-25 mm set of 10 Tommy Bar Dia 6, 8, 10, 12, 14, 16	1 set
69.	Glass magnifying	75 mm	2 nos.
70.	Clamp toolmaker	5 cm and 7.5 cm set of 2.	2 nos.
71.	Clamp "C"	100 mm	2 nos.
72.	Clamp "C"	200 mm	2 nos.
73.	Hand Reamer set (Tapar pin straight flute)	Nominal Dia 6, 8, 10, 12, 16mm	1 set
74.	Machine Reamer parallel (Helical flute)	12 - 16mm set of 5.	1 no.
75.	Scraper flat	150 mm	8 nos.
76.	Scraper triangular	150 mm	8 nos.
77.	Scraper half round	150 mm	8 nos.

78.	Chisel cold cross cut & diamond point.	9 mm X 150 mm	8 each
79.	Chisel cold flat	9 mm X 100 mm	8 nos.
80.	Chisel cold round noze.	9 mm X 100 mm	8 nos.
81.	Drill chuck with key	12 mm.	1 no.
82.	Pipe wrench	400 mm	1 no.
83.	Pipe vice	100 mm	1 no.
84.	Adjustable pipe die set BSP	cover pipe size 1" or 3/4"	1 Set
85.	Wheel dresser (One for 4 units) Star/Dresser with Holder	Length 150 mm, diamond point	1 no.
86.	Machine vice - Swivel Base	100 mm	1 no.
87.	Machine vice - Swivel Base	125 mm	1 no.
88.	Sleeve drill Morse	No. 0 - 1, 1 - 2, 2 - 3, 3 - 4, 4 - 5	1 Set
89.	Vice bench	150 mm	20 nos.
90.	Bench working.	2400 x 1200 x 900 mm	4 nos.
91.	Almirah.	1800 x 900 x 450 mm	2 nos.
92.	Lockers with 8 drawers (standard size).	One locker for each trainee	3 nos.
93.	Metal rack	1820 x 1820 x 450 cm	1 no.
94.	Instructor Table		
95.	Instructor Chair		
96.	Black board with easel.		
97.	Fire extinguisher (For 4 Units)	CO2 type, 3 kg capacity	
98.	Fire buckets.		
99.	Machine vice.	100mm	2 nos.
100.	Wing compass.	254 mm or 300 mm	2 nos.
101.	Hand hammer with handle.	1000 gm	1 nos.
102.	Torque wrench (Standard/Ratchet type)	14 to 68 Nm	1 no.
103.	Power tools for fastening	Capacity 10-18mm	1 No.
C. TOOLS FOR ALLIED TRADE - SHEET METAL WORKER (Note: - Those additional items are to be provided for the Allied Trade Training where the Sheet Metal trade does not exist.)			
1.	Trammel	300 mm	1 no.
2.	Pocker.		2 nos.
3.	Prick punch	100 mm	2 nos.
4.	Mallet.	Dia 100 mm X 150 mm	2 nos.
5.	Aviation Snips straight Cut	300 mm	2 nos.
6.	Flat headed hammers with handle.		2 nos.
7.	Planishing hammer.		2 nos.
8.	Snip bent Left Cut	250 mm	2 nos.
9.	Stake hatchet with Leg.	300 X 200 X 20 mm	2 nos.
10.	Stake grooving.	100 X 100 X 300 mm	2 nos.
D. MODIFIED LIST OF TOOLS FOR THE 3RD AND 4TH SEMESTER FOR FITTER TRADE			
INSTRUMENT			
*1.	Slip Gauge as Johnson metric set.	87 Pieces Set	1 Set
*2.	Gauge snap Go and Not Go	25 to 50 mm by 5 mm, Set of 6 pieces	1 Set
*3.	Gauge plug	Single ended 5 to 55 by 5 mm. Set of 11 pcs.	1 Set
**4.	Gauge telescopic set.	8 - 150 mm	1 no.
5.	Dial test indicator on stand	0.01 mm least count	1 no.
6.	Sine bar	125 mm	1 no.

**7.	Dial verniercaliper. (Universal type)	0 - 300 mm, LC 0.05 mm	1 no.
**8.	Screw thread micrometer with interchangeable. Pitch anvils for checking metric threads 60.	0 - 25 mm LC 0.01 mm	1 no.
9.	Depth micrometer. 0-25 mm	Accuracy 0.01 mm with standard set of extension rods upto 200 mm	1 no.
**10.	Vernier caliper.	0 - 150 mm with least count 0.02mm	1 no.
**11.	Digital Micrometer outside.	0 - 25 mm L.C. 0.001 mm.	1 no.
**12.	Comparators Gauge - Dial Indication with Stand and Bracket.	LC 0.01mm	1 no.
13.	Engineer's try square (knife-edge)	150 mm Blade	1 no.
**14.	Surface roughness comparison plates	N1 - N12 Grade	1 Set
15.	Digital Vernier caliper	0 - 200 mm L.C. 0.01 mm (Optional)	1no.
16.	Vernier Bevel protector	Range 360deg, LC. : 5min(150mm blade)	1no.
GENERAL SHOP OUTFIT			
16.	Carbide Wear Block.	1 mm - 2 mm	2 each
17.	Lathe tools H.S.S. tipped set.		2 nos.
18.	Lathe tools bit.	6 mm x 75 mm HSS/Carbide	4 nos.
19.	Lathe tools bit.	8 mm x 75 mm HSS/Carbide	4 nos.
20.	Lathe tools bit.	10 mm x 75 mm HSS/Carbide	4 nos.
21.	Arm strong type tool bit holder.	Right hand	2 nos.
22.	Arm strong type tool bit holder.	Left hand	2 nos.
23.	Arm strong type tool bit holder.	Straight	2 nos.
24.	Stilson wrenches	250 mm	2 nos.
25.	Pipe cutter wheel type.	6 mm to 25 mm	1 no.
26.	Pipe bender machine spool type with stand manually operated.	up to 25 mm cold bending	1 no.
27.	Adjustable pipe chain tonge to take pipes	up to 300 mm	1 no.
28.	Adjustable spanner.	380 mm long	1 no.
E. GENERAL MACHINERY INSTALLATION			
*1.	SS and SC centre lathe (all geared) with minimum specification	Centre height 150 mm and centre distance 1000 mm along with 3 & 4 jaw chucks, auto feed system, safety guard, taper turning attachment, motorized coolant system, lighting arrangement & standard accessories.	2 Nos.
2	Pillar Type Drilling machine	Sensitive 0-20 mm cap. with swivel table motorised with chuck & key.	1 no.
3	Drilling machine bench	Sensitive 0-12 mm cap motorised with chuck and key.	2 nos.
4	D.E. pedestal Grinding machine with wheels rough and smooth	2 H.P.-3Phase-415V, 1500 rpm,250 Dia wheel	1 no.

Note: - (*) No additional number of items are required to be provided up to four batches of trainees i.e. two batches in the first shift and two in the second shift.
(**) Only one number need be provided in each I.T.I. irrespective of No. of Units.

F. LIST OF ADDITIONAL TOOLS FOR ALLIED TRADE IN WELDING (Note: - Those additional items are to be provided for the Allied Trade Training where the Welder trade does not exist.)			
1	Transformer welding set - continuous welding current, with all accessories and electrode holder 60% Duty Cycle with Standard Accessories	300 A, OCV 60 - 100 V,	1 Set
2	Welder cable	Able to carry 300 amps. With flexible rubber cover	20 Meter
3	Lugs for cable		12 Nos.
4	Earth clamps.		2 Nos.
5	Arc welding table (all metal top) with positioner.	1200 X 1200 X 750 mm	1 No.
6	Oxy - acetylene gas welding set equipment with hoses, Oxygen & Acetylene cylenders, regulator and other accessories.		1 Set.
7	Gas welding table with positioner with Fire Bricks	900 X 600 X 750 mm	1 No
8	Welding torch tips of different sizes for Oxy - acetylene gas welding	To fit nozzel no. 1, 2, & 3	1 Set
9	Gas lighter.		2 Nos
10	Trolley for gas cylinders.		1 No
11	Chipping hammer.		2 Nos
12	Gloves (Leather)		2 Pairs
13	Leather apron.		2 Nos
14	Spindle key for cylinder valve.		2 Nos.
15	Welding torches.	Nozzles no. 1, 2, & 3	1 Set.
16	Welding goggles		4 Pairs.
17	Welding helmet with coloured flame retardent glass		2 Nos.
18	Tip cleaner		5 Sets.
#G. LIST OF TOOLS & ACCESSORIES FOR PNEUMATICS AND HYDRULICS			
1	Compressor unit	suitable for Pressure: 8 bar, Delivery: 50 lpm (or more), Reservoir capacity: 24 Litres (or more), 230V, 50 Hz, with pressure regulator and water separator	1 No.
2	Pneumatic Trainer Kit, each consisting of the following matching components and accessories:		01 sets
	I. Single acting cylinder	Max. stroke length 50 mm, Bore dia 20 mm	1 No
	II. Double acting cylinder	Max. stroke length 100 mm, Bore dia 20 mm, magnetic type	1 No
	III. 3/2-way valve	manually-actuated, Normally Closed	2 Nos
	IV. 3/2-way valve	pneumatically-actuated, spring return	1 No
	V. One-way flow control valve		2 Nos

	VI. 5/2-way valve	with manually-operated switch	1 No
	VII. 5/2-way valve	pneumatically-actuated, spring return	1 No
	VIII. 5/2-way pneumatic actuated valve	double pilot	1 No
	IX. 3/2-way roller lever valve	direct actuation Normally Closed	2 Nos
	X. Shuttle valve (OR)		1 No
	XI. Two-pressure valve (AND)		1 No
	XII. Pressure gauge	0-16 bar	1 Nos
	XIII. Manifold with self-closing	NRV, 6-way	1 No
	XIV. Pushbutton station for electrical signal input	with 3 illuminated momentary-contact switches (1 NO + 1 NC) and 1 illuminated maintained-contact switch (1 NO + 1 NC), Contact load 2A	1 No
	XV. Relay station	with 3 ralays each with 4 contact sets (3NO+1NC or Change-over type), 5 A	1 No
	XVI. 3/2-way single solenoid valve	with LED	1 No
	XVII. 5/2-way single solenoid valve	with manual override and LED	1 No
	XVIII. 5/2-way double solenoid valve	with manual override and LED	1 No
	XIX. Power supply unit,	Input voltage 85 – 265 V AC, Output voltage: 24 V DC, Output current: max. 4.5 A, short-circuit-proof.	1 No
	XX. Profile plate, Anodised Aluminium	1100x700 mm, with carriers, mounting frames and mounting accessories (To be fitted onto the pneumatic workstation)	1 sets
3	Pneumatic Workstation with 40 square mm aluminium profile legs, wooden work surface, and one pedestal drawer unit having 5 drawers, each with handles and individual locks, on metallic full panel drawer slide:	(1) Work Table – Size(Approx.) L1200mmXW900mmXH900mm, with four castor wheels including two lockable wheels at the front side, (2) Drawer – Size (Approx.) – L460mmxW495mm xH158mm each, and overall size of Drawer unit (Approx.) - L470mmxW495mmxH825mm and (3) Drawer slide height (Approx.) 85mm.	1 No
4	Carrier for mounting components, such as PB & relay boxes.		1 No
5	Cut section model for pneumatic components		1 set
6	Hydraulic Trainer Kit, each consisting of the following matching components and accessories:		01 set
	I. Hydraulic Power pack	with (1) external gear pump having a delivery rate of 2.5 lpm, (approx.) @ 1400 rpm operating pressure 60 bar, coupled to a single-phase AC motor (230 V AC) having start capacitor and	1 No.

			ON/OFF switch and overload protection, (2) pressure relief valve adjustable from 0 – 60 bar, (3) oil reservoir, ≥5 litres capacity having sight glass, drain screw, air filter, and P and T ports.	
	II.	Pressure relief valve	pilot-operated	1 No
	III.	Drip tray, steel	size 1160 mm x 760 mm.	1 No.
	IV.	Pressure Gauge	Glycerin-damped, Indication range of: 0 – 100 bar	1 No.
	V.	Four-Way distributor	with five ports, equipped with a pressure gauge	1 No.
	VI.	Double acting hydraulic cylinder	with a control cam, Piston diameter16 mm, Piston rod diameter10 mm, Stroke length 200 mm.	1 No.
	VII.	Suitable Weight	for vertical loading of hydraulic cylinder	1 No.
	VIII.	Mounting kit for weight	for realizing pulling and pushing load.	1 No.
	IX.	3/2-way directional control valve	with hand lever actuation.	1 No.
	X.	4/2-way directional control valve	with hand lever actuation.	1 No.
	XI.	4/3-way directional control valve	closed-centre position, with hand lever actuation.	1 No.
	XII.	Non-return valve.		1 No.
	XIII.	Pilot-operated check valve	pilot to open.	1 No.
	XIV.	One-way flow control valve	with integrated check valve.	1 No.
	XV.	T-Connector with self sealing coupling nipples (2 Nos.) and quick coupling socket (1 No.).		2 Nos.
	XVI.	Profile plate,	Anodised Aluminium, 1100x700 mm, with carriers, mounting frames and mounting accessories (To be fitted onto the Hydraulic workstation)	1 set
7	Hydraulic Workstation with 40 square mm aluminium profile legs, wooden work surface, and one pedestal drawer unit having 5 drawers, each with handles and individual locks, on metallic full panel drawer slide:		(1) Work Table – Size(Approx.) L1200mmXW900mmXH900mm, with four castor wheels including two lockable wheels at the front side, (2) Drawer – Size (Approx.) – L460mmxW495mm xH158mm each, and overall size of Drawer unit (Approx.) - L470mmxW495mmxH825mm and (3) Drawer slide height (Approx.) 85mm.	1 No
8	Cut-section models for hydraulic components			1 set

Note: -

1. *All the tools and equipment are to be procured as per BIS specification.*

2. *For items marked under '#G' the ITI may sign a MoU with following minimum guidelines in addition to other detailed terms and condition.*
   a. *For units less than 8(4+4), the ITI can enter into MoU with Facilitator who will provide the Training on Pneumatics & Hydraulics to Trainees admitted and undergoing training in above Trades.*
   b. *The Facilitator should be Government ITI/ Engineering/ Polytechnic College/Recognized Training Institute/Industry/ Private ITI (Facilitators are arranged in descending preference order). The Facilitator should have the related training infrastructure.*
   c. *If any of the facility is not available with facilitator then the same should be provided in the ITI.*
   d. *The facilities of Pneumatics & Hydraulics training should be made available to ITI trainees at the time of examination and this clause should be part of MoU to be signed.*
   e. *The training provider must be within the range of 15 Km or within city whichever is lower.*

9. VARIOUS AGENCIES INVOLVED

Craftsman Training Scheme (CTS)

India is one of the youngest nations in the world. Our youth are our strength. However, a challenge facing the country is that of skilling our youth as per the demands of the industry. Recognizing the need for quickly coordinating the skill development and entrepreneurship efforts of all concerned stakeholders, the Government of India created the Ministry of Skill Development and Entrepreneurship on 9th November, 2014.

The Ministry of Skill Development and Entrepreneurship is an apex organization for the development and coordination of the vocational training including Women's Vocational Training in our country. The Ministry conducts the vocational training programmes through the Craftsmen Training Scheme (CTS), Apprenticeship Training Scheme (ATS), Modular Employable Scheme (MES) under the Skill Development Initiative (SDI) Scheme, and Craftsmen Instructor Training Scheme (CITS) to cater the needs of different segments of the Labour market.

- Training courses under the CTS is being offered through a network of more than 11000 Government and Private Industrial Training Institutes (ITIs) located all over the country with a total seating capacity of more than 16 Lakhs with an objective to provide skilled workforce to the industry in 126 trades. Skill development courses exclusively for women are also being offered under CTS and other schemes through Government and Private ITIs and Regional Vocational Training Institutes (RVTIs) for Women.
- The Apprentices Act, 1961 was enacted with the objective of regulating the program of apprenticeship training in the industry by utilizing the facilities available within for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart on the job training for school leavers, and ITI passed outs to develop skilled manpower for the industry.
- The Ministry is implementing the Employable Scheme (MES) under the Skill Development Initiative Scheme to provide vocational training to people to develop skilled manpower for the industry through a network of Vocational Training Providers (VTPs) located across the country.

Various Agencies involved in the Rollout of this Competency Based Curriculum

The Directorate General of Employment & Training (DGE&T) in Ministry of Labour is the apex organisation for development and coordination at National level for the programmes relating to vocational training.

Central Staff Training and Research Institute (CSTARI), Kolkata is the nodal institute for the development/revision of curricula under all vocational training schemes of the Ministry.

National Instructional Media Institute (NIMI), Chennai is to make available instructional material in various trades for the use of trainees and trainers to ensure overall improvement in the standard of institutional training under the CTS and ATS schemes. The institute is actively involved in the development, production and dissemination of instructional media Packages (IMPs) comprising of books on Trade Theory, Trade Practical, Test/Assignment, and Instructor's Guide.

The Ministry has set up Mentor Councils to focus on courses under NCVT in various sectors with representation from thought leaders among different stakeholders viz., industries, innovative

entrepreneurs who have proved to be game-changers, academic/professional institutions, and champion ITIs for each of the sectors. The Mentor Council for each sector reviews curriculum, admission criteria, course duration, and requirement of trainers and assessment/evaluation systems for the sector on a continuous basis and make recommendations regarding the same. Sector-wise Core Groups are formed to plan and prepare the documentation for the competency-based curricula for the courses under each sector.

National Skills Qualification Framework (NSQF)

The National Skills Qualification Framework (NSQF), published in the Gazette of India on 27th December, 2013, is a national framework that aims to integrate general and vocational streams of education and training. The main goal of the NSQF is to focus on competency-based qualifications, which in turn facilitate and enhance transparency, both within and between general and vocational streams. The National Skill Development Agency (NSDA) under the Ministry is responsible for anchoring and implementation of the Framework, by bringing together the key stakeholders through the National Skill Qualifications Committee (NSQC).

The competency-based framework organizes qualifications into ten levels, with the entry level being 1, and the highest level being 10. Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are (1) Process, (2) Professional knowledge, (3) Professional skill, (4) core skill, and (5) Responsibility. The paradigm shift from learning focused on inputs to an outcome/competency-based education would help in the Recognition of Prior Learning (RPL), and simultaneously enable the alignment of the Indian qualifications with international ones. The NSQF notification provides a Qualification Register, which is the official national database of all qualifications aligned to NSQF levels. Through this Register, learners can expect access to all NSQF compliant qualifications.

5	Job that requires well developed skill, with clear choice of procedures in familiar context.	Knowledge of facts, principles, processes and general concepts, in a field of work or study.	A range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information.	Desired mathematical skill; understanding of social, political; and some skill of collecting and organising information, communication.	Responsibility for own work and learning and some responsibility for others' works and learning.
6	Demands a wide range of specialised technical skill, clarity of knowledge and practice in	Factual and theoretical knowledge in broad contexts within a field of work or study.	A range of cognitive and practical skills required to generate solutions to specific	Reasonable good in mathematical calculation, understanding of social, political and reasonably good in data	Responsibility for own work and learning and full responsibility fo other's works and learning.

	broad range of activity involving standard and non-standard practices.		problems in a field of work or study.	collecting organising information, and logical communication.	
7	Requires a command of wide-ranging specialised theoretical and practical skills, involving variable routine and non-routine contexts.	Wide-ranging factual and theoretical knowledge in broad contexts within a field of work or study.	Wide range of cognitive and practical skills required to generate solutions to specific problems in a field of work of study.	Good logical and mathematical skill understanding of social political and natural environment and organising information, communication and presentation skill.	Full responsibility for output of group and development.
8	Comprehensive, cognitive, theoretical knowledge and practical skills to develop creative solutions to abstract problems. Undertakes self-study; demonstrates intellectual independence, analytical rigour and good communication.			Exercise management and supervision in the context of work/study having unpredictable changes; responsible for the work of others.	
9	Advanced knowledge and skill. Critical understanding of the subject, demonstrating mastery and innovation, completion of substantial research and dissertation.			Responsible for decision making in complex technical activities involving unpredictable work/study situations.	
10	Highly specialised knowledge and problem solving skill to provide original contribution to knowledge through research and scholarship.			Responsible for strategic decisions in unpredictable complex situations of work/study.	

List of Trade Committee Members

The DGT sincerely express appreciation for the contribution of the Industry, State Directorate, Trade Experts, Academecia and all others who contributed in revising the curriculum. Special acknowledgement is expended by DGT to the following expert members who had contributed immensely in this curriculum.

Sl. No.	Name & Designation Sh/Mr./Ms.	Organization	Mentor Council Designation
Members of Sector Mentor council			
1.	A. D. Shahane, Vice-President, (Corporate Trg.)	Larsen &Tourbo Ltd., Mumbai:400001	Chairman
2.	Dr.P.K.Jain, Professor	IIT, Roorkee, Roorkee-247667, Uttarakhand	Member
3.	N. Ramakrishnan, Professor	IIT Gandhinagar, Gujarat-382424	Member
4.	Dr.P.V.Rao, Professor	IIT Delhi, New Delhi-110016	Member
5.	Dr.Debdas Roy, Asstt. Professor	NIFFT, Hatia, Ranchi-834003, Jharkhand	Member
6.	Dr. Anil Kumar Singh, Professor	NIFFT, Hatia, Ranchi-834003, Jharkhand	Member
7.	Dr.P.P.Bandyopadhyay Professor	IIT Kharagpur, Kharagpur-721302, West Bengal	Member
8.	Dr.P.K.Ray, Professor	IIT Kharagpur, Kharagpur-721302, West Bengal	Member
9.	S. S. Maity, MD	Central Tool Room & Training Centre (CTTC), Bhubaneswar	Member
10.	Dr. Ramesh Babu N, Professor	IIT Madras, Chennai	Member
11.	R.K. Sridharan, Manager/HRDC	Bharat Heavy Electricals Ltd, Ranipet, Tamil Nadu	Member
12.	N. Krishna Murthy Principal Scientific Officer	CQA(Heavy Vehicles), DGQA, Chennai, Tamil Nadu	Member
13.	Sunil Khodke Training Manager	Bobst India Pvt. Ltd., Pune	Member
14.	Ajay Dhuri	TATA Motors, Pune	Member
15.	UdayApte	TATA Motors, Pune	Member
16.	H B Jagadeesh, Sr. Manager	HMT, Bengaluru	Member
17.	K Venugopal Director & COO	NTTF, Peenya, Bengaluru	Member
18.	B.A.Damahe, Principal L&T Institute of Technology	L&T Institute of Technology, Mumbai	Member
19.	Lakshmanan. R Senior Manager	BOSCH Ltd., Bengaluru	Member
20.	R C Agnihotri Principal	Indo- Swiss Training Centre Chandigarh, 160030	Member

21.	M. K. Verma, Sr. Manager Trg. Capability Development	SNTI, TATA Steel Ltd., Jamshedpur	Member
22.	N.K Thakur, DGM-Trg.	L&T, Construction and Mining Machinery, Kanchipuram.	Member
23.	Vijayan K T,	Volkswagen Academy, Pune	Member
Mentor			
24.	Sunil Kumar Gupta (Director)	DGET HQ, New Delhi.	Mentor
Members of Core Group			
25.	N. Nath. (ADT)	CSTARI, Kolkata	Co-ordinator
26.	H.Charles (TO)	NIMI, Chennai.	Member
27.	Sukhdev Singh (JDT)	ATI Kanpur	Team Leader
28.	Ravi Pandey (V.I)	ATI Kanpur	Member
29.	A.K. Nasakar (T.O)	ATI Kolkata	Member
30.	Samir Sarkar (T.O)	ATI Kolkata	Member
31.	J. Ram EswaraRao (T.O)	RDAT Hyderabad	Member
32.	T.G. Kadam (T.O)	ATI Mumbai	Member
33.	K. Mahendar (DDT)	ATI Chennai	Member
34.	Shrikant S Sonnavane (T.O)	ATI Mumbai	Member
35.	K. Nagasrinivas(DDT)	ATI Hyderabad	Member
36.	G.N. Eswarappa (DDT)	FTI Bangalore	Member
37.	G. Govindan, Sr. Draughtsman	ATI Chennai	Member
38.	M.N.Renukaradhya, Dy.Director/Principal Grade I.,	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
39.	B.V.Venkatesh Reddy. JTO	Govt. ITI, Tumkur Road, Banglore, Karnataka	Member
40.	N.M.Kajale, Principal,	Govt. ITI Velhe, Distt: Pune, Maharashtra	Member
41.	SubrataPolley, Instructor	ITI Howrah Homes, West Bengal	Member
42.	VINOD KUMAR.R Sr.Instructor	Govt.ITIDhanuvachapuram Trivandrum, Dist., Kerala	Member
43.	M. Anbalagan, B.E., Assistant Training Officer	Govt. ITI Coimbatore, Tamil Nadu	Member
44.	L.K.Mukherjee, DDT	CSTARI, Kolkata	Member
45.	R. N. Manna, TO	CSTARI, Kolkata	Member
Other industry representatives			
46.	Venugopal Parvatikar	Skill Sonics, Bangalore	Member
47.	Venkata Dasari	Skill Sonics, Bangalore	Member
48.	Srihari, D	CADEM Tech. Pvt. Ltd., Bengaluru	Member

49.	Dasarathi.G.V.	CADEM Tech. Pvt. Ltd., Bengaluru	Member
50.	L.R.S.Mani	Ohm Shakti Industries, Bengaluru	Member
51.	P. Joji, Ex-JDT	DGT, MSDE, New Delhi	Member
52.	K. Lakshmi Narayanan	Skill Development Centre, JBM Auto System Pvt. Ltd., Kancheepuram	Member