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

COMPETENCY BASED CURRICULUM

TECHNICIAN - PLANT MAINTENANCE

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

(Flexi MoU)

NSQF LEVEL- 5

SECTOR – AUTOMOTIVE

'Technician - Plant Maintenance'

(Engineering Trade)

Version: 1.0

CRAFTSMEN TRAINING SCHEME (CTS)

(Flexi MoU)

NSQF LEVEL - 5

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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1. COURSE INFORMATION

Flexi- MoU is one of the pioneer program under NCVT on the basis of the MoU in between DGET & Maruti Suzuki India Limited for propagating vocational training to allow industries to take advantage of various schemes for conducting training program in higher employment potential courses according to needs of industries. The concept of Flexi- MoUs was introduced in June-July 2014. DGT and Maruti Suzuki India Limited have decided to sign this memorandum of understanding to provide an opportunity to the youth to acquire skills related to Automobile and Manufacturing industry through specially designed "Learn and Earn" approach consisting a mix of theoretical and On-the-Job Training (OJT) components and hence improve their employability potential & to contribute in the overall growth of automobile and manufacturing industry by creating a pool of skilled resources.

During the two-year 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 content broadly covers skills in manufacturing process of automobiles components and automobiles in today's automobile industry. The year wise course coverage is categorized as below:

FIRST YEAR :–

In the first year, the contents covered are safety aspects covers components like OSH&E, PPE, Fire extinguisher, First Aid and in addition 5S of Kaizen is being taught related to trade.

Basic electrical work such as working on basic electrical wiring (low voltage Control system power, Single phase, 3 phase power & earthing), electrical elements (Switch Gears, Motors, Drives and lighting), use of measuring tools. And impart training on basic Electrical and Electronics sub-systems and its measuring techniques using appropriate Measuring instruments, operateand troubleshoot AC/DC equipment's. Acquire the skill of reading and analyzing Electrical and Electronics drawings. Construct, analyze and troubleshoot Electrical and Electronic circuits. Assemble and Disassemble Electrical and Electronic components by Soldering and de-soldering techniques. Carry out Industrial panel wiring. Understand and troubleshoot Protective devices in Electrical system

And basic mechanical elements and its working principles i.e. Pneumatic application & Strengths such as (Compressors ,Cylinder, valves, fittings, FRL, Filtration and Lubrication and its symbols used in drawing) Mechanical elements (Bearing and bushes, ball screw & LM guide and nut bolts), automobile manufacturing process such as basic fitting operation (marking, filling, sawing, chiseling, drilling tapping & grinding), basic brazing/welding operation using Gas, MIG & ERW (but joint, lap joint, T-joint), Preventive maintenance of the equipment's including greasing, Filter cleaning, Belt checking, Oil top-up, Chain tightening etc. This year also covers practical training starting with

practice with tools & measuring instruments viz. Vernier calliper, micrometer, height gauge, dial gauge, slip gauge, feeler gauge, go-no go gauges etc. This is followed by on job training in practice at different shops as Assembly shop (Engine, Transmission & Vehicle), Machine Shop, Casting shop etc.

SECOND YEAR –

In this year, the trainee also gets knowledge of different sensors viz., inductive, capacitive, magnetic etc. and carries out related practical on the same. The student Understand the principles of hydraulics, the basic functions of hydraulic systems, the functions of valves (flow control, pressure control, directional control). Attain the skill of reading and analyzing Hydraulic and Pneumatic drawings. Recognize circuit symbols and diagrams to ISO 1219, construct basic hydraulic circuits as per drawings, understand and follow safe practice. Acquire the knowledge on the functions of power packs, pumps, filters and reservoirs. Understand the units and measurement scales associated with compressed air system. Understand the functioning of standard pneumatic cylinders and valves, read pneumatic circuit diagrams and understand Pneumatic symbols. Construct simple pneumatic controls as per drawing. Read, understandand analyze Electro-Pneumatic circuit diagrams, understand fundamental terminology and symbols of Electro-Pneumatic control, understand the function and operation of a range of proximity sensors, read, interpret and construct motion diagrams. Construct multi-cylinder control circuit. Fault diagnostics procedure and Troubleshooting of Hydraulics and Pneumatics sub- systems. Executes programming on PLC.

The Trainee gets awareness on Robotics and its application, the trainee will be able to develop, test and troubleshoot circuits using simulator software for Electrical, Electronics, and Hydraulic and Pneumatic systems. Able to fabricate and repairing of electrical and mechanical equipment's, involving Fitting, Drilling, Turning, Milling, Grinding, Electrical wiring, programming, Hydraulic circuit assembly, Pneumatic circuit assembly, Drives, system assembly and Interfacing, functional testing, trouble shooting and repair. Safety and Quality measures in each stage.

2. TRAINING SYSTEM

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. DGT is futuristic in preparing the prospective Indian workforce in building skills and capabilities as per the needs of the industry. In this quest, it has changed the paradigm of growth to a job oriented growth by partnering with industry to be an enabler of responsible, sustainable and inclusive growth. Towards this end, DGT signed this MOU with the Maruti Suzuki India Limited.

Maruti Suzuki India Limited shall conduct courses pan-India locations leveraging the facilities and services available at ITIs, regional training centers, training centers of training partners, vendors and dealers associated with Maruti Suzuki. Maruti Suzuki will ensure that not less than 50% of trainees are placed with Maruti Suzuki or its business partners for not less than six month duration. It will also ensure the eligible trainees take up Apprenticeship / higher education in suitable streams and shall also guide the students to become Entrepreneurs. Maruti Suzuki India Limited will strictly follow the policy guidelines for Flexi - MoU as in place from time to time. No deviation for the same would be permitted. Every Alternate Month Admission and Exam for trades run under Flexi MoU at training locations of Maruti. Theory content to be 30% and practical content to be 70%.

Broadly candidates need to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools.
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations.
- Apply professional knowledge, core skills & employability skills while performing the job and maintenance work.
- Check the task/job for functioning, identify and rectify errors in task/job.
- Document the technical parameters related to the task undertaken.

2.2 CAREER PROGRESSION PATHWAYS

- 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.

2.3 COURSE STRUCTURE

Table below depicts the distribution of training hours across various course elements during a period of two years:

S No.	Course Element	Notional Training Hours
1	Professional Skill (Trade Practical)	2944
2	Professional Knowledge (Trade Theory)	552
3	Workshop Calculation & Science	160
4	Engineering Drawing	160
5	Employability Skills	240
6	Revision & Project work	92
7	Examination	252
	Total	**4400**

2.4 ASSESSMENT & CERTIFICATION

I. Conducting training of selected candidates is the sole responsibility ofIndustrial Training Partner (ITP).
II. Assessment will be jointly done by ITP and DGT. Practical and formative assessment shall be conducted by ITP, and Computer Based theoretical exams shall be conducted by DGT.
III. ITP must refer to the latest examination reform guidelines issued by DGT dated 4th October 2018 any changes or revisions to the same shall be applicable to flexi-MoU scheme.
IV. Maximum attempts for clearing the exam and obtaining NTC shall be in line with CTS.
V. For practical examination and formative assessment, ITP has been given flexibility to design the questions, assess the candidates and upload their marks in the scheme portal.
VI. ITP shall develop a comprehensive Question Bank (in English and Hindi) of minimum 1000 questions, grouped by chapters and difficulty level. The same shall be vetted by NIMI experts and then be handed over to DGT for conducting theory exams. DGT may add some questions to the same before conducting actual exams.
VII. Theoretical exams shall be conducted by DGT in Computer Based Test format. Upon completion of course and payment of requisite examination fee by ITP, admit cards shall be generated by scheme portal.
VIII. DGT shall arrange for conduct of computer based theory exam at designated examination centres & certify the successful trainees with e-NTC under flexi-MoU scheme with mention of ITP name in the Certificate.
IX. Students, who have successfully appeared in the final exam after completion of course, are eligible to register as apprentices.

The trainee will be tested for his skill, knowledge and attitude during the period of the course and at the end of the training program as notified by the Government of India (GOI) from time to time. The employability skills will be tested in the first year itself.

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 has to maintain an individual trainee portfolio as detailed in assessment guideline. The marks of internal assessment will be as per the template (Annexure –II).

The learning outcome and assessment criteria will be the basis for setting question papers for final assessment. The examiner during final examination will also check the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

The minimum pass percentage for practical is 60% & minimum pass percentage of theory subjects is 33%. For the purposes of determining the overall result, 50% weightage is applied to the result of each yearly examination.

2.4.2 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 the assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are 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-voice
- Progress chart
- Attendance and punctuality
- Assignment
- Project work

Evidences of internal assessments are to be preserved until forthcoming yearly examination for audit and verification by examining 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 should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. Below 70% accuracy 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 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	Good skill levels in the use of hand tools, machine tools and workshop equipment. 70-80% accuracy 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 more than 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% accuracy 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.

3. JOB ROLE

Technician Plant Maintenance are specialized trade-technician workers. Maintenance technicians will usually assist to maintain machine basic condition as per its design, working application, development and engineering, as well as working closely with other trades persons to install, maintain, modify and repair plant Electro-mechanical & control systems, equipment and component parts.

Technician Plant Maintenance may…….

- Fit and assemble parts and sub-assemblies made from mechanical and electrical - electronic and computer components.
- Manufacture, install, modify, repair and fault-find hydraulic and pneumatic equipment and systems.
- Inspect machinery and make repairs.
- Erect machinery and equipment on site.
- Cut, thread, bend and install hydraulic and pneumatic pipes and lines
- Dismantle faulty items and assemblies and repair or replace defective parts
- Set up and operate hand and machine tools and equipment.
- Check accuracy and quality of finished parts, tools or sub-assemblies.

Maintenance technicians repair & maintain manufacturing plant systems for industry which involves mechanics, conveyors, hydraulics, pneumatics, control systems and computers. The computer technology element covers programmable logic control systems (PLC), and technology which enable communication between machines, equipment and people. In addition Maintenance Person has 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 and 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.

Reference NCO-2015:

- 7233.0100 - Fitter, General
- 7233.0101 - General Maintenance Fitter-Mechanical
- 7412.0101 - Automation Specialist
- 7412.0201 - Fitter-Electrical and Electronic Assembly
- 7411.0100 - Electrician, General
- 7421.0300 - Electronics Mechanic

4. GENERAL INFORMATION

Name of the Trade	**Technician - Plant Maintenance**
NCO - 2015	7233.0100, 7233.0101, 7412.0101, 7412.0201, 7411.0100, 7421.0300
NSQF Level	Level-5
Duration of Craftsmen Training	2 years
Entry Qualification	Passed 10th Class with Science and Mathematics or its equivalent
Unit Strength (No. Of Student)	20
Space Norms	192 Sq. m.
Power Norms	17 KW
Instructors Qualification for	
1. Technician - Plant MaintenanceTrade	Degree in Mechanical or Electrical or instrumentation or Automobile Engineering from recognized Engineering College /university with one year experience in the relevant field. **OR** Diploma in Mechanical or Electrical or instrumentation or Automobile Engineering from recognized board of technical education with two years' experience in the relevant field. **OR** NTC/NAC in the Trade of "Mechatronics" With 3 years' post-qualification experience in the relevant field. ***Essential Qualification:*** Craft Instructor Certificate in relevant trade under NCVT. Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications.
2. Workshop Calculation & Science	Degree in Engineering with one year experience. OR Diploma in Engineering with two years' experience. **Essential Qualification:** Craft Instructor Certificate in RoD& A course under NCVT.
3. Engineering Drawing	Degree in Engineering with one year experience. **OR** Diploma in Engineering with two years' experience. **OR** NTC / NAC in the Draughtsman (Mechanical) with three years' experience.

	Essential Qualification: Craft Instructor Certificate in RoD& A course under NCVT.
4. Employability Skill	MBA OR BBA with two years' experience OR Graduate in Sociology/ Social Welfare/ Economics with Two years' experience OR Graduate/ Diploma with Two years' experience and trained in Employability Skills from DGT institutes. **AND** Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above. **OR** Existing Social Studies Instructors duly trained in Employability Skills from DGT institutes**.**
List of Tools and equipment	As per Annexure – I

Distribution of training on Hourly basis: (Indicative only)

Year	Total Hours/Week	Trade Practical	Trade Theory	Workshop Cal. &Sc.	Engineering Drawing	Employability Skills
1st	48 Hours	32 Hours	6 Hours	3 Hours	3 Hours	4 Hours
2nd	48 Hours	32 Hours	8 Hours	3 Hours	3 Hours	2 Hours

5. NSQF LEVEL COMPLIANCE

NSQF level for **Technician - Plant Maintenance** trade CTS (Flexi MoU): **Level -5.**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

a. Process
b. Professional Knowledge
c. Professional Skill
d. Core Skill
e. Responsibility

The broad learning outcome of **Technician - Plant Maintenance** trade under CTS (Flexi MoU) mostly matches with the Level descriptor at Level- 5.

The NSQF Level-5 descriptor is given below:

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
Level 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 problem by selecting and applying basic methods, tools, materials and information.	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication.	Responsibility for own work and learning and some responsibility for other's works and learning.

6. LEARNING OUTCOME

Learning outcomes are a reflection of total competencies of a trainee and assessment will be carried out as per the assessment criteria.

6.1 GENERIC LEARNING OUTCOME

1. Recognize & comply general safe working practices, environment regulation and housekeeping.

2. Explain & perform 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]
3. 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]

4. Select and ascertain measuring instrument and measure dimension of components and record data.

5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.

6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.

7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.

8. Plan and organize the work related to the occupation.

6.2 SPECIFIC LEARNING OUTCOME

FIRST YEAR

9. Understand & explain maintenance, purpose & types of maintenance in general, requirement of maintenance in manufacturing industry.

10. 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 – Filing, Marking, Hack sawing, Drilling, Taping, chipping and Grinding etc. Accuracy: ± 0.1mm]

11. Make different fit of components for assembling as per required tolerance observing principle of interchangeability and check for functionality. [Different Fit –Open & Square Fit; Required tolerance: ±0.05 mm]

12. Plan and organize to prepare jobs for sheet metal brazing, electric resistance welding, and structure steel, plates, piping for welding work using power tools such as abrasive cutter and grinder. Perform perfect V joint for weld filling. Perform joining of metals by welding and brazing observing standard procedure.

13. Carry Out Different Computer Operations & troubleshoot { Different Computer operations) Settings of Computer & MS Office Operations)
14. Produce components / jobs involving different operations on Lathe, Milling ,Drilling, Tapping, Chamfering, Facing and Grinding machines observing standard procedure and check for accuracy. (Different Operations –facing, plain turning, step turning, parting, chamfering, plain milling, surface grinding and cylindrical grinding (internal and external)
15. Define electricity and construct different electrical sub- systems and measure parameters. [Different electrical sub-systems: - AC/DC Motors, DC machine, DC motors, DC motor starter, Universal motor, Induction motor, AC drive, Servo drive, transformer.]
16. Explain basic electronics and construct different electronics sub system and test electronic devices and sub system. [Different sub system: - Diodes, rectifier circuit, voltage regulator, transistor power electronic devices, op-amp circuit, LED circuit, SCR etc.]
17. Construct and verify different Digital Logic Circuits.
18. Trouble shoots and repairs different Electrical, Electronic systems/ devices. [Different Electrical, Electronic systems/ devices:- Fuse, MCB, Power circuit, Control panel,Circuit Breaker, Stabilizer, AC/DCdrives
19. Recognize various types of conveyor systems, their components, their utility, common defects occurs in different types of conveyors in industry and perform overhauling and repairing of each type of conveyors.
20. Demonstrate function of different types of measuring, monitoring & control system devices / instruments, i.e. sensors, solenoid, relays, switches, fuses etc.
21. Perform Infra-red thermography of electrical motors and identify faults by interpreting thermograph.
22. Explain piping and tubing. Plan & organize to make jobs in piping and tubing using all types of fittings.
23. Demonstrate functioning of different mechanical elements in plant and perform connections, removal, re-fitting, servicing of fastners, fittings, hoses, valves, bearings, ball screw, LM guides & rails, spindles, belts, chains & sprockets, drive belts, pulleys, couplings, gears, pumps, pressure gauges and gauge indicators.
24. Explain Power pack & power locks - Types of Power pack & power locks, Uses of different types of Power pack & power locks, common defects & maintenance activities in Power pack & power locks.

25. Identify & explain the Seals & O-Rings - Types of Seals & O-Rings, Uses of different types of Seals & O-Rings, common maintenance activities in Seals & O-Rings.

SECOND YEAR

26. Explain Maintenance planning basics and prepare Maintenance - Schedules for mechanical, electrical and control system maintenance under supervisors guidance.
27. Prepare & update Maintenance documents - Charts, reports and register.
28. Explain concepts of all Mechanical systems, components, and functions in plant viz Hydraulic system, Lubrication system, Coolant system, Pneumatic system. Perform preventive maintenance of mechanical systems.
29. Explain Basic Pneumatic system and elements. Capable to designing of pneumatic circuit. Construct simple pneumatic circuit and check functionality.
30. Explain Basic Hydraulic system and elements. Capable to designing of pneumatic circuit. Demonstrate installation of accessories in hydraulic system and trouble shoot and defects.
31. Construct hydraulic circuit and verify various processes to assess functioning of valves and auxiliaries. [Various processes: - speed control, lubrication system, press control etc.].
32. Plan and organize the work and carryout service and maintenance activities in various mechanical assemblies (Ball screws and LM guides) using standard procedure and proper tools, tackles and consumables.
33. Plan & Organize work to Instal hydraulic pump, motors and carryout maintenance of these components.
34. Construct different hydraulic system and operate to achieve desired functions. [Different hydraulic system:- Clamp control, hydraulic press control]
35. Program PLC and interface with other devices to check its Applications.
36. Explain robot anatomy and perform programming robot using teach box, software.
37. Simulate the electrical circuits on simulation software and detect fault as per diagnostic procedure for Electrical system design.
38. Simulate the electronic circuits on simulation software and detect fault as per diagnostic procedure for Electronics system design.
39. Simulate the Hydraulic and Pneumatic circuit on simulation software and detect fault as per diagnostic procedure for Hydraulics and Pneumatics system design.
40. Perform project work on Plant Maintenance (Projects- involving Fitting, Drilling, Turning, Milling, Grinding, Electrical wiring, programming, Hydraulic circuit assembly, Pneumatic circuit assembly, Conveyor or Drives system assembly and Interfacing, functional testing, trouble shooting and repair. Safety measures in each stage)

7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
LEARNING OUTCOME	**ASSESSMENT CRITERIA**
1. Recognize and 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.
	1.2 Recognize and report all unsafe situations according to sitepolicy.
	1.3 Identify and take necessary precautions on fire and safetyhazards and report according to site policy and procedures.
	1.4 Identify, handle and store / dispose of 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 toIllness or accident.
	1.6 Identify safety alarms accurately.
	1.7 Report supervisor/ Competent 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 tosite policy.
	1.9 Identify Personal Protective Equipment (PPE) and use the same as per related working environment.
	1.10 Identify basic first aid and use them under different circumstances
	1.11Identify different fire extinguisher and use the same as perrequirement.
	1.12 Identify environmental pollution and contribute to avoidance ofsame.
	1.13 Take opportunities to use energy and materials in anenvironmentally friendly manner
	1.14 Avoid waste and dispose waste as per procedure
	1.15 Recognize different components of 5S and apply the same inthe working environment.
2. Understand, explain different mathematical calculation and science in the field of study including basic electrical and apply in	2.1 Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat and temperature, force, motion, pressure, heat treatment, Center of gravity, friction.
	2.2 Measure dimensions as per drawing.

day to day work. [Differentmathematicalcalculation andscience - Work, Power and Energy,Algebra, GeometryandMensuration, Trigonometry,Heat and Temperature, Levers and Simple machine, graph, Statistics, Centre of gravity,Powertransmission, Pressure]	2.3 Use scale/ tapes to measure for fitting to specification.
	2.4 Comply given tolerance.
	2.5 Prepare list of appropriate materials byinterpreting detaildrawings and determine quantities of such materials.
	2.6 Ensure dimensional accuracy of assembly by using differentinstruments/ gauges.
	2.7 Explain basic electricity, insulation and earthing.
3. Interpret specifications, differentengineering drawing and apply for different application in the field of work. [Engineering drawing, Layout, Symbol, scales, Projections, Assembly drawing, Sectional views, Electrical and electronic symbol]	3.1 Read and interpret the information on drawings and apply inexecuting practical work.
	3.2 Read and analyze the specification to ascertain the materialRequirement, 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.
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, and height gauge(as per tool list).
	4.2 Ascertain the functionality and correctness of the instrument.
	4.3 Measure dimension of the components and record data toanalyzewith given drawing/measurement.
5. Explainthe concept in productivity, quality tools, andlabor welfare legislation and apply such in day to day work to improve productivity and quality.	5.1 Explain the concept of productivity and quality tools and apply during execution of job.
	5.2 Understand the basic concept of labor welfare legislation and adhere to responsibilities and remain sensitive towards suchlaws.
	5.3 Knows benefits guaranteed under various acts.

6. Explainenergy 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, and pollution and utilize the available recourses optimally and 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 and societal growth.	7.1 Explain personnel finance and entrepreneurship.
	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/Program and procedure and 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 worksite.
	8.2 Plan workplace/ assembly location with due consideration to operational stipulation
	8.3 Communicate effectively with others and plan project tasks
	8.4 Assign roles and responsibilities of the co-trainees for executionof the task effectively and monitor the same.

SPECIFIC LEARNING OUTCOME	
LEARNING OUTCOME	**ASSESSMENT CRITERIA**
First Year	
9. Understand & explain maintenance, purpose & types of maintenance in general, requirement of maintenance in manufacturing industry.	9.1 Define maintenance in general and explain Plant maintenance and its objectives.
	9.2 Explain types of maintenance and schedule for each type of maintenance.
	9.3 Describe the job description and responsibilities of a Technician – Plant Maintenance.
	9.4 Able to read and explain technical specification and materials and tools requirement to carry out maintenance.
	9.5 Explain broad maintenance activities in a plant.
10. 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 Filing, Marking, Hack sawing, Drilling, Taping, chipping and Grinding etc. Accuracy: ± 0.1mm].	10.1 Plan and Identify tools, instruments and equipmentfor marking and make this available timely.
	10.2 Select raw material and visual inspection for defects.
	10.3 Mark as per specificationapplyingdesired mathematical calculation and observing standardProcedure.
	10.4 Identify Hand Tools for different fitting operationsand make these available timely.
	10.5 Prepare the job for Hacksawing, chiseling, filing.
	10.6 Perform basic fitting operations viz., Hacksawing, Filing and Chipping of close tolerance as per specification to make the job.
	10.7 Observe safety procedure during above operationsas per standard norms and guidelines.
	10.8 Measure and Check all dimensions of the work pieces as per standard procedure in accordance withSpecifications and tolerances.

	10.9 Identify unused materials and components for storing in an appropriate environment and preparefor disposal.
11.Make different fit of components for assembling as per required tolerance observing principle of interchange ability and check for functionality. [Different Fit –Open & Square Fit; Required tolerance: ±0.05 mm]	11.1 Recognize general concept of Limits, Fits and tolerances necessary for fitting applications andfunctional application of these parameters.
	11.2 Plan and Identify tools, instruments and equipmentfor work piece and make this available timely.
	11.3 Set up workplace/ assembly location with dueconsideration to operational stipulation.
	11.4 Plan work in compliance with standard safety normsand collecting desired information.
	11.5 Demonstrate possible solutions and agree taskswithin the team.
	11.6 Make components according to the specification for different fits, practical skills including scraping and ensuring interchangeability of differentparts.
	11.7 Measure the components using Vernier,Micrometer, Height gauge.
	11.8 Assemble components applying a range of skills toensure proper fit.
	11.9 Check functionality of components.
12. Plan and organize to prepare jobs for sheet metal brazing, electric resistance welding, and structure steel, plates, piping for welding work using power tools such as abrasive cutter and grinder. Perform perfect V joint for weld filling. Perform joining of metals by welding and brazing observing standard procedure.	12.1 Plan and select the right hand and power tools to carry out job preparation for welding / brazing considering all health & safety aspects.
	12.2 Perform fabrication and fitting / tach welding of jobs for the desired weld position and joint.
	12.3 Prepare edges of metal plates and pipes and tach weld in the position as per drawing using hand & power tools sfely.
	12.4 Use proper PPE for the work and perform housekeeping on completion of work.

	12.5 Plan and select the type & size of electrode, welding current, nozzle size, working pressure type of flame, filler rod and flux as per requirement as per process requirement.
	12.6 Clean the welded joint thoroughly.
	12.7 Prepare, set SMAW machine/Gas welding plant andtack the pieces as per drawing.
	12.8 Set-up gas welding unit in accordance with standard procedure.
	12.9 Carry out brazing work using weld rod and flux with utmost safety.
13. Carryout different computer operation and trouble shoot. [Different computer operations: setting of computer & MS Office operation]	13.1 Collect relevant information to operate and troubleshoot computer& Conduct basic trouble shooting of PC.
	13.2 Set the computer and carryout basic computer related operation using MS Office
14. Produce components involving different operations on Lathe, Milling and Grinding machines observing standard procedure and check for accuracy. (Different Operations –facing, plain turning, step turning, parting, chamfering, shoulder turn, grooving, knurling, threading (external 'V' only), plain milling, step milling, grooving, slot milling, profile milling, surface grinding and cylindrical grinding (internal and external))	14.1 Ascertain basic working principles and safety aspects of machines.
	14.2 Understand functional application of different levers, stoppers, adjustment etc.
	14.3 Identify different lubrication points and lubricants, their usage for application in machines as per machine manual.
	14.4 Identify different work and tool holding devices and collect information for functional application of each device.
	14.5 Mount the work and tool holding devices with required alignment and check for its functional usage to perform machining operations.
	14.6 Solve problem by applying basic methods, tools, materials and information during setting.
	14.7 Observe safety procedure during mounting as per standard norms.
	14.8 Produce components observing standard procedure.

	14.9 Check accuracy/ correctness of job using appropriate quipment/gauge.
	14.10 Identify unused materials and components for storing in an appropriate environment and prepare for disposal.
15. Define electricity and construct different electrical sub- systems and measure parameters. [Different electrical sub-systems: - AC/DC Motors, DC machine, DC motors, DC motor starter, Universal motor, Induction motor, AC drive, Servo drive, transformer.]	15.1 Plan and identify tools, instruments and equipmentfor the work and make it available timely.
	15.2 Set up workplace/ assembly location with dueconsideration to operational stipulation.
	15.3 Plan work in compliance with standard safety normsand collecting desired information.
	15.4 Demonstrate possible solutions and testing withinthe team.
	15.5 Trouble shoot & test different electrical sub system.
16. Explain basic electronics and construct different electronics sub system and test electronic devices and sub system. [Different sub system: - Diodes, rectifier circuit, voltage regulator, transistor power electronic devices, op-amp circuit, LED circuit, SCR etc.]	16.1 Plan and identify tools, instruments and equipment for the work and make it available timely.
	16.2 Set up workplace/ assembly location with due consideration to operational stipulation.
	16.3 Plan work in compliance with standard safety norms and collecting desired information
	16.4 Demonstrate possible solutions and agree tasks within the team
	16.5 Construct different electronics subsystem test electronics devices and subsystems.
17. Construct and verify different Digital Logic Circuits. [Different DLC:- Logic Gates, half & full adder, binary & outer, P/ down counter.]	17.1 Plan and identify tools, instruments and equipment for the work and make it available timely.
	17.2 Construct and verify digital logic circuits.
18. Trouble shoots and repairs different Electrical, Electronic systems/	18.1 Plan and identify tools, instruments and equipmentfor the work and make it available timely.

devices. [Different Electrical, Electronic systems/ devices:- Fuse, MCB, Power circuit, Control panel, Circuit Breaker, AC/DC drives, SMPS, Relay etc.].	18.2 Plan work in compliance with standard safety normsand collecting desired information.
	18.3 Demonstrate part replacement and fault finding..
	18.4 Trouble shoot and repair electrical & electronicsSystem/ devices observing safety procedure..
	18.5 Check the functionality of the system.
19. Recognize various types of conveyor systems, their components, their utility, common defects occurs in different types of conveyors in industry and perform overhauling and repairing of each type of conveyors..	19.1 Describe different type of conveyors and their utility and common defects develops in conveyor system..
	19.2 Plan and estimate material requirement for conyeyor overhauling and maintenance.
	19.3 Identify tools equipment for the work and make itavailable timely.
	19.4 Set up workplace/ assembly location with due consideration to operational stipulation.
	19.5 Plan work in compliance with standard safety normsand collecting desired information.
	19.6 Perform conveyor overhauling and repairing / maintenance.
20. Demonstrate function of different types of measuring, monitoring & control system devices / instruments, i.e. sensors, solenoid, relays, switches, fuses etc.	20.1 Explain control system devices function and working mechanism..
	20.2 Identify tools & equipment for the fitting of sensors, solenoid, relays, switches, fuses etc.
	20.3 Set up workplace/ assembly location with due consideration to operational stipulation.
	20.4 Plan work in compliance with standard safety norms and collecting desired information.
	20.5 Perform fitting of instruments, devices..
21. Perform Infra-red thermography of electrical motors and identify faults	21.1 Plan and set-up infra-red camera and computer / printer for the conditions survey work.

by interpreting thermograph.	21.2 Conduct infra-red thermography as per specified procedure.
	21.3 Download thermographs.
	21.4 Interpret thermograph as per defined guidelines.
	21.5 Prepare report .
22. Explain piping and tubing. Plan & organize to make jobs in piping and tubing using all types of fittings.	22.1 Plan and estimate material requirement for piping work..
	22.2 Identify tools equipment for the work and make it available timely.
	22.3 Set up workplace/ assembly location with due consideration to operational stipulation.
	22.4 Plan work in compliance with standard safety normsand collecting desired information.
	22.5 Perform piping work.
23. Demonstrate functioning of different mechanical elements in plant and perform connections, removal, re-fitting, servicing of fastners, fittings, hoses, valves, bearings, ball screw, LM guides & rails, spindles, belts, chains & sprockets, drive belts, pulleys, couplings, gears, pumps, pressure gauges and gauge indicators..	23.1 Plan and estimate material requirement for maintenance / fitting of mechanical elements.
	23.2 Identify tools equipment for the work and make it available timely.
	23.3 Set up workplace/ assembly location with due consideration to operational stipulation.
	23.4 Plan work in compliance with standard safety normsand collecting desired information.
	23.5 Perform maintenance / fitting of mechanical elements.
24. Explain Power pack & power locks - Types of Power pack & power locks, Uses of different types of Power pack & power locks, common	24.1 Describe different types of Power packs and Power locks.
	24.2 Plan and estimate material requirement for removal / refitting / replacement of Power packs and Power locks.

defects & maintenance activities in Power pack & power locks	24.3 Identify tools equipment for the work and make it available timely.
	24.4 Set up workplace/ assembly location with due consideration to operational stipulation.
	24.5 Plan work in compliance with standard safety normsand collecting desired information.
	24.6 Perform removal / refitting / replacement of Power packs and Power locks.
25. Identify & explain the Seals & O-Rings - Types of Seals & O-Rings, Uses of different types of Seals & O-Rings, common maintenance activities in Seals & O-Rings.	25.1 Plan and estimate material requirement for removal / replacement of seals and O-rings.
	25.2 Identify tools equipment for the work and make it available timely.
	25.3 Set up workplace location with due consideration to operational stipulation.
	25.4 Plan work in compliance with standard safety norms and collecting desired information.
	25.5 Perform removal / replacement of seals and O-rings.
Second Year	
26. Explain Maintenance planning basic and prepare Maintenance - Schedules for mechanical, electrical and control system maintenance under supervisors guidance.	26.1 Define maintenance planning.
	26.2 Identify maintenance requirements of pant electrical mechanical and control systems.
	26.3 Develop maintenance schedule in detail with instructions and guidance of supervisor.
	26.4 Review maintenance schedule with seniors and get approval.
27. Prepare & update Maintenance documents - Charts, reports and register.	27.1 Prepare documents related to maintenance activities and update maintenance register.
	27.2 Prepare reports after carrying out maintenance works.

28. Explain concepts of all Mechanical systems, components, and functions in plant viz Hydraulic system, Lubrication system, Coolant system, Pneumatic system. Perform preventive maintenance of mechanical systems.	28.1 Describe mechanical systems and their components & functioning in a manufacturing plant such as Hydraulic system, Lubrication system, Coolant system, and Pneumatic system.
	28.2 Plan and identify tools, instruments and equipment for the work and make it available timely.
	28.3 Set up workplace/ assembly location with due consideration to operational stipulation.
	28.4 Plan work in compliance with standard safety norms.
	28.5 Perform repair and maintenance work of mechanical systems s per design/application requirement.
29. Explain Basic Pneumatic system and elements. Capable to designing of pneumatic circuit. Construct simple pneumatic circuit and check functionality.	29.1 Plan and identify tools, instruments and equipmentfor the work and make it available timely.
	29.2 Set up workplace/ assembly location with dueConsideration to operational stipulation.
	29.3 Plan work in compliance with standard safety norms (LOTO and Shutoff valve)
	29.4 Construct pneumatic control system as per design/application requirement.
	29.5 Construct electro-pneumatic circuit as per design/application requirement.
	29.6 Check the functioning of processes as per desired requirement.
30. Explain Basic Hydraulic system and elements. Capable to designing of pneumatic circuit. Demonstrate installation of accessories in hydraulic system and trouble shoot and defects.	30.1 Plan and identify tools, instruments and equipmentfor the work and make it available timely.
	30.2 Set up workplace/ assembly location with dueconsideration to operational stipulation.
	30.3 Plan work in compliance with standard safety normsand collecting desired information.

	30.4 Understand use and application of hydraulic elements e.g. pump, motor, suction filter, valve, flow regulator and pressure regulator.
	30.5 Verify processes to ascertain functioning of valves and auxiliaries.
31. Construct hydraulic circuit and verify various processes to assess functioning of valves and auxiliaries. [Various processes: - speed control, lubrication system, press control etc.].	31.1 Plan and identify tools, instruments and equipment for the work and make it available timely.
	31.2 Set up workplace/ assembly location with due consideration to operational stipulation.
	31.3 Plan work in compliance with standard safety norms and collecting desired information.
	31.4 Construct hydraulic control system as per design/application requirement.
	31.5 Construct hydraulic circuit as per design/application requirement.
	31.6 Verify processes to ascertain functioning of valves and auxiliaries.
32. Plan and organize the work and carryout service and maintenance activities in various mechanical assemblies (Ball screws and LM guides) using standard procedure and proper tools, tackles and consumables.	32.1 Plan and identify tools, instruments and equipment for the work and make it available timely.
	32.2 Set up workplace/ assembly location with due consideration to operational stipulation.
	32.3 Plan work in compliance with standard safety normsand collecting desired information.
	32.4 Perform service and maintenance work of Ball screw & LM guide assemblies as per application requirement.
	32.5 Check the functioning of assemblies as per desired requirement.
33. Plan & Organize work to Instal hydraulic pump, motors and	33.1 Plan and identify tools, instruments and equipmentfor the work and make it available timely.

carryout maintenance of these components.	33.2 Set up workplace/ assembly location with due consideration to operational stipulation.
	33.3 Plan work in compliance with standard safety norms and collecting desired information.
	33.4 Install hydraulic pump & motors as per design/application requirement.
	33.5 Check the functioning of system as per desired requirement.
	33.6 Carryout maintenance of these components during non-functioning.
34. Construct different hydraulic system and operate to achieve desired functions. [Different hydraulic system: - Clamp control, injection control, reciprocating screw, oil filtration, hydraulic press control, accumulator control.].	34.1 Plan and identify tools, instruments and equipmentfor the work and make it available timely.
	34.2 Set up workplace/ assembly location with due consideration to operational stipulation.
	34.3 Plan work in compliance with standard safety norms and collecting desired information.
	34.4 Demonstrate the possible solution and agree tasks with in the team.
	34.5 Construct hydraulic system as per design/ application requirement.
	34.6 Operate to verify functioning of hydraulic system.
35. Program PLC and interface With input and outputs of machine.	35.1 Program a PLC as per application requirement.
	35.2 Interface PLC with field elements observing standardprocedure and safety.
	35.3 Check the functionality of device as per program.
36. Explain robot anatomy and perform programming robot using teach box, software.	36.1 Explain anatomy of robot.
	36.2 Collect relevant information to programme robot via teach box, software

	36. 3 Programme robot via teach box, software
	36.4 Test functionality.
37. Simulate the electrical circuits on simulation software and detect fault as per diagnostic procedure for Electrical system design.	37.1 Develop electrical circuit as per desired application.
	37.2 Assemble and test Electrical Circuit on simulation software
	37. 3 Detect fault observing diagnostic procedure and rectify using simulation software
	37.4 Rectify by resetting errors using simulation software
38. Simulate the electronic circuits on simulation software and detect fault as per diagnostic procedure for Electronics system design.	38.1 Develop electronic circuit as per desired application.
	38.2 Assemble and test Electronic Circuit on simulation software
	38. 3 Detect fault observing diagnostic procedure and rectify using simulation software
	38.4 Rectify by resetting errors using simulation software
39. Simulate the Hydraulic and Pneumatic circuit on simulation software and detect fault as per diagnostic procedure for Hydraulics and Pneumatics system design.	39.1 Develop Hydraulic and Pneumatic circuit as per desired application.
	39.2 Assemble and test Hydraulic and Pneumatic circuit on simulation software
	39. 3 Detect fault observing diagnostic procedure and rectify using simulation software
	39.4 Rectify by resetting errors using simulation software
40. Perform project work on Plant Maintenance (Projects- involving Fitting, Drilling, Turning, Milling, Grinding, Electrical wiring, programming, Hydraulic circuit	40.1 Manufacture and assemble Mechanical sub system.
	40.2 Prepare Pneumatic circuit and interface.
	40.3 Prepare Electrical/Electronic circuit and interface.

assembly, Pneumatic circuit assembly, Conveyor or Drives system assembly and Interfacing, functional testing, trouble shooting and repair. Safety measures in each stage)	40.4 Develop and download PLC program.
	40.5 Integrate, Test and Repair for functionality.
	40.6 Energy saving project by avoid idle running of coolant and Hydraulic power pack pumps. (PLC Based)
	40.7 Pneumatic cylinder movement control (Electro Pneumatic based)
	40.8 Design & develop conveyor control system
	40.9 5 Upgrade obsolete PLC program

8. Syllabus

SYLLABUS FOR TECHNICIAN – PLANT MAINTENANCE TRADE			
First Year			
Week No.	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hrs.**	**Professional Knowledge (Trade Theory)**
1 - 2	Recognize & comply safe working practices, environment regulation and housekeeping.	1. Introduction of trade skill and work application. (02hrs.) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE)/Behavior based safety. (05hrs.) 3. First Aid Method and basic training.(02hrs.) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (02hrs.) 5. Hazard identification and avoidance. (02 hrs.) 6. Identification of safety signs for Danger, Warning, caution & personal safety message.(01hr.) 7. Preventive measures for electrical accidents & steps to be taken in such accidents.(02hrs.) 8. Use of Fire extinguishers.(07hrs.) 9. Practice and understand precautions to be followed while working in fitting jobs. (02hrs.) 10. Importance of trade training, List of tools & Machinery used in the trade.(01hr.) 11. Safe use of tools and equipments used in the trade. (01hr.) 12. Practice memory training and games. (15hrs.) 13. Type & Use of LOTO. (05hrs.) 14. 5S training. (03hrs.)	All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. Safe working practices Soft Skills, its importance and Job area after completion of training. Importance of safety and general precautions observed in the industry/shop floor. Introduction of First aid. Operation of electrical mains and electrical safety. 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.

3	Understand & explain maintenance, purpose & types of maintenance in general, requirement of maintenance in manufacturing industry.	1. Visit to plant assembly shop and list out different mechanical and electrical equipments. (04 hrs) 2. Visit to plant tool room and list out different machines and tools available and their uses. (04 hrs) 3. Visit Utility plant and list out various equipment and piping installed (04 hrs) 4. List out the different hand & power tools and equipment available with maintenance department. (04 hrs)	Definition of maintenance. Purpose and importance of maintenance. Types of maintenance i.e. Preventive, Protective & Repair maintenance. Shutdown maintenance. Job description of a Technician – Plant Maintenance. Broad maintenance activities in a plant. Reading and analyzing the specification to ascertain the material requirement, tools, and machining /assembly /maintenance parameters.
4 - 5	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 – Filing, Marking, Hack sawing, Drilling, Taping, chipping and Grinding etc. Accuracy: ± 0.1mm]	1. Identification of tools & equipment as per desired specifications for filing and marking, visual inspection of raw material for rusting, scaling, corrosion etc.(03 hrs.) 2. Familiarization of bench vice. (01 hr) 3. Filing- File top of the "U" channel, check and measure with steel rule.(10hrs.) 4. Mark with scriber and steel rule (01 hr.) 5. Familiarization of Vernier Height Gauge. (08hrs.) Measuring practice with steel rule, Vernier Height Gauge.(02 hrs.) 6. File, mark straight and parallel lines with scriber and steel rule/Vernier Height Gauge as per drawing. (05hrs.) 7. Dot punching and letter and number punching. (05hrs.) *8.* File "U" channel to size and by	Bench work – Metal working hand tools and devices –Work bench – vices – files – hacksaw – hammer – chisels – spanners – screw drivers – scrapers. Linear measurements- its units, steel rule dividers, calipers – types and uses, Punch – types and uses. Description, use and care of marking table. Vernier caliper – its parts, principles, reading, uses and care. Outside micrometer – its parts, principles, reading, uses and care, Vernier height gauge. Marking tools – scriber, Dividers, Dot punch, Centre punch. Marking out – Coordinates system, Rectangular – Polar – Rules for marking

		using straight edge, try-square and Verniercaliper measure and check- Accuracy +/-0.1mm. (25 hrs.) *(Note down all dimensions and submit to instructor for verification)* 9. Sawing different types of metals of different sections- round piece and Angle Iron. (10hrs.) 10. Prepare mushroom head on round bar by hammering. (05 hrs.) 11. Make "S" bend by Hammering on flat piece. (06hrs.) 12. Grinding of center punch, dot punch, flat chisel and scriber. (08 hrs.) 13. Drill grinding practice. (05hrs.) 14. Drill Centering Practice.(06hrs.) 15. Chain drilling practice. (08hrs.) 16. Practice on measuring instruments. (08 hrs.) 17. Job setting and tool settingon drilling machine. (04hrs.)	Marking media, marking blue, Prussian blue, chalk and their special application, description. Surface plate and auxiliary marking equipment, 'V' block, angle plates, parallel block, description, types, uses, accuracy, care and maintenance. Drill, Tap, Die-types & application. Determination of tap drill size. Reamer- material, types (Hand and machine reamer), parts and their uses, determining hole size for reaming, Reaming procedure. Drilling machines-types &their application, construction of Pillar & Radial drilling machine. Countersunk, counter bore and spot facing-tools and nomenclature. Cutting Speed, feed, depth of cut and Drilling time calculations. Measuring Instruments – purpose – Function- types – Calculation of Least count of :-Vernier Caliper, Micro meter, height gauge, Spirit Level Gauge, Vernier bevel protector and Sine bar. Bevel protractor, combination set- their components, uses and cares. Pedestal grinder, star wheel dresser, safety precautions, care and maintenance.

6 - 7	Make different fit of components for assembling as per required tolerance observing principle of interchangeability and check for functionality. [Different Fit – Open & Square Fit; Required tolerance: ±0.05 mm]	1. Make Male & Female 'Open' fitting with accuracy ±0.05 mm. (35hrs..) 2. Make Male & Female 'Square' 3. Fitting with accuracy ±0.05 mm. (38hrs.) 4. Scraping practice. (02 hrs.)	Introduction about metals, difference between Metal and Non Metal, properties of metal, Classification of metals and its applications, pig – iron, cast iron, wrought iron, steel-plain carbon steel(Low carbon steel, medium and high carbon steels, high speed steel, stainless steel, carbides, etc..) Limit and Fits – Limit, Fits -Types and Tolerances and allowances with IS 919(ISO System)
8 - 11	Plan and organize to prepare jobs for sheet metal brazing, electric resistance welding, and structure steel, plates, piping for welding work using power tools such as abrasive cutter and grinder. Perform perfect V joint for weld filling. Perform joining of metals by welding and brazing observing standard procedure.	1. Cut 1.2 mm M.S. sheets in different sizes for brazing lap joint and T-joint. (8 hrs) 2. Take two numbers of 100 x 50 x 10mm M.S. plates and prepare edges by grinding, filing for Butt welding. (16 hrs) 3. Take two numbers of 100 mm long 50 x 50 x 5mm Angles and prepare for T-joint welding. (8 hrs) 4. Take two number 4 inch dia x 100 mm long pipes and prepare edges for Butt welding. (16 hrs) 5. Identify different parts of gas welding / arc welding / MIG welding equipment and demonstrate their functioning. (08 hrs.) 6. Simple welding and brazing practice.(32hrs.)	Welding process definition, types of welding i.e. Oxy-acetylene brazing, Metal arc welding, MIG, TIG, Plasma welding. Welding electrodes. Preparation for welding. PPE for welding. Welding joints type. Base metal preparation for welding. Explanation of gas welding, arc welding and MIG welding techniques description of welding equipments and welding joints. Knowledge about flux, filler rod material.

12-13	Carry Out Different Computer Operations & troubleshoot { Different Computer operations , Settings of Computer &MS Office Operations)	**Practice of Basic Computer Operations, MS Word & Excel** 1. Create, save, rename, move, copy and delete files and folders. Transfer files and folders from/to external storage devices. (10 hrs) **2.** Practice on different menus and editing options of MS-Word. (06 hrs.), MS Excel (06Hrs) **Basic Trouble Shooting PC** 3. Check PC Power Supply, SMPS cables and connections (08 hrs)	Introduction to Computer Learning Functions of Computer, Functions of MS Word, Functions of MS Excel Basics of Computer Trouble shooting
14-19	Produce components / jobs involving different operations on Lathe, Milling ,Drilling, Tapping, Chamfering, Facing and Grinding machines observing standard procedure and check for accuracy. *(Different Operations – facing, plain turning, step turning, parting, chamfering, plain milling, surface grinding and cylindrical grinding (internal and external))*	1. Basic Lathe Operation Familiarization (04hrs) • Identify different parts of lathe and demonstrate the operation of the machine. (04hrs.) • Job setting and tool setting. (04 hrs.) • Lathe Operation Practice (02 Hrs.) 2. Basic Turning , Milling , Facing & Grinding Operation Familiarization • Identify different parts of lathe and demonstrate the operation of the machine. (04hrs.) • Job setting and tool setting. (04 hrs.) • Turning , Milling & Grinding Operation Practice (02 Hrs Each) 3. Basic Drilling , Tapping & Chamfering Operation Familiarization • Identify different parts of lathe and demonstrate the operation of the machine. (04hrs.) • Job setting and tool setting. (04 hrs.) • Drilling , Tapping & Chamfering Operation Practice (06 Hrs)	Features, Functions & Importance, Working Principle, Purpose & Function- Uses and applications of different operations 1. Lathe Operation 2. Milling Operation 3. Grinding Operation 4. Drilling & Tapping Operation 5. Facing, Centering & Turning Operation 6. Chamfering Operation Operational Parameters Setting & Importance 1. Cutting speed 2. Feed 3. Depth of cut Time calculations

20-23	Define electricity and construct different electrical sub-systems and measure parameters. [Different electrical sub-systems: - AC/DC Motors, DC machine, DC motors, DC motor starter, Universal motor, Induction motor, AC drive, Servo drive, transformer.]	1. Measures to rescue a person from live wires. (03hrs.) 2. Perform exercise to find out relationship between V, I, R and analyze the effect of short and open circuit in a circuit. (03hrs.) 3. Check/Test the line, neutral and earth wires before connecting cable in to plugs. (02hrs.) 4. From the given Electrical circuit/board familiarization with different types of plugs, sockets, switches, fuses and fuse holder. (03 hrs.) 5. Construct different DC sources by serial and parallel connection of batteries. (03 hrs.) 6. Ascertain different electrical instruments as per the drawings. (02hrs.) 7. Measure the voltage and current in AC/DC Circuits using ammeter, voltmeter, and multi meter. (03 hrs.), Tong Tester (03 Hrs) 8. Measure different parameters in poly- phase circuit using ammeter, voltmeter and wattmeter readings. (03hrs.) 9. Construct series and parallel combination circuits and verify them. (03hrs.) 10. Construct a simple circuit to test the operation of a Relay. (03hrs.) 11. Measure input and output voltages in stabilizers, power supply unit in the control panel. (03hrs.) 12. Application of test lamp and multi meter for identifying single and three phase supply. (03 hrs.) 13. Physical identification of	**<u>Basic electrical concepts</u>** Concepts of current, voltage, resistance, electric charge, current density and Power and energy. Ohms law and Kirchhoff's Laws. Primary and secondary cells. Measurement of voltage and current in Networks. AC parameters for sine and Square wave forms. **Electromagnetic theory: -** Flux, density, magnetic effect, magnetic field, electromagnetic force, concepts of coil (electromagnetic). Solenoids and relays. **Instrument used for Measuring Electrical parameters:-** Measurements of electrical quantities using voltmeter Ammeter, Multimeter, Megger, Power supply units and Stabilizers Electromagnetic induction, Motor and Generator effect. Types of AC and DC Motors, Construction and its working principles, Speed control of AC/DC Motors. Principle and Operation of servo motor, Stepper motor and its applications. Concepts of AC/DC Drives Principle and operation of single phase, Three phase transformer and Auto transformer. Winding details of three phase transformer.

		Mechanical parts and winding details of AC/DC Motors. (03 hrs.) 14. Develop work plan to test AC Machine winding continuity and insulation resistance. (04hrs.) 15. Construct and perform forward and Reverse operation of AC Motors. 16. (06hrs.) 17. Construct and perform speed control of AC Motors. (03hrs.) 18. configuring AC Drive for it (03Hrs) 19. Connect, start, run and reverse of AC, single phase motor (inductive-start and capacitive- start). (05hrs.) 20. Control the speed of AC motor. (03hrs.) 21. Connect, Start, Run and reverse universal motor. (03hrs.) 22. Selections of accessories of a DOL starter& Star Delta Starter to Start and run 1-Phase & 3- Phase induction motor. (04hrs.) 23. Check the Motor speed and its line current using Tacho Generator and Clamp on meter. (03hrs.) 24. Configure AC drive for controlling induction motor. (03hrs.) 25. Construct a simple circuit to test positional and velocity control using Servo Drive. (04hrs.) 26. Exercise on positional accuracy using encoder. (03hrs.) & Linear Scale (04Hrs) 27. Verify the terminals of 3-phase transformer HT and LT side. measure Phase Sequence(03 hrs.) 28. Measure Voltage and current of 1-Φ,3-Φ Auto transformer & power factor. (03 hrs.)	

24-25	Explain basic electronics and construct different electronics sub system and test electronic devices and sub system. [Different sub system: - Diodes, rectifier circuit, voltage regulator, transistor power electronic devices, op-amp circuit, LED circuit, SCR etc.]	1. Test the Electronic components using component tester and Multi meter, CRO and Test ICs using IC Tester. (04hrs.) 2. Measure AC/DC parameters using CRO. (03hrs.) 3. Construct Diode circuit and draw V-I characteristics. 4. (03hrs.) 5. Construct and test Half-wave, Full-wave and Bridge rectifier. (07hrs.) 6. Construct Transistor Switch. (03 hrs.) , 7. Transistor Amplifier circuit. (04hrs.), 8. **Zener** regulator. (03hrs.) 9. Transistor Amplifier circuit. (04hrs.) 10. Construct Zener regulator. (03 hrs.) 11. Construct transistor voltage regulator circuit. (04hrs.) 12. Construct a 12/5 V DC power supply circuit. (04hrs.) 13. Construct variable DC Regulated power supply. (07hrs.) 14. Construct and verify basic op- amp circuits (Inverting, Non- inverting). (05hrs.) 15. Capacitor & Resistors identification & circuit usage 16. Construct comparator and Instrumentation Amplifier using Op-Amp. (07hrs.) 17. Construct and Verify Photo LED circuit.(04hrs.) 18. Construct and verify the operation of LDR and Photo diode. (04hrs.) 19. Construct isolation circuit using up to-isolator. (05 hrs.) 20. Testing of SCR, MOSFET, DIAC, TRIAC, IGBT and UJT using Multimeter and component tester. (06 hrs.) 21. Construct a phase control rectifier	**Electronic components:** Basic Electronic components (active and passive) and its symbols. Reading of electronic circuit drawing. Types of Resistors, capacitors and its identification. Working and operation of Diodes. Rectifier circuits. Zener voltage Regulator. Transistors and its applications. CRO-Block diagram and its functions. DC Regulated power supplies. Introduction to Op-Amp, characteristics, Configuration and its applications. Introduction to Opto-electronics, LED, LDR, Photo diode, opto-coupler. Introduction of Resistors & capacitors concept – Functioning & usage **Study of Power Electronic Devices:** Power diodes, power transistors, SCR, DIAC, TRIAC, UJTIGBT, phase control rectifiers, Converters. **Soldering Techniques: -**. Describe Soldering and De- soldering process, Do and Don'ts of soldering. Concepts of SMD. **Electrical cables and connectors:** Colour code of cables, cable joints (straight joints and T-Joints), wiring layout diagrams, Types of cables and its specifications: co-axial

		circuits using SCRs. (08 hrs.) 22. Construct and test UJT Relaxation oscillator. (03 hrs.) 23. Construct and test universal motor speed control by using SCR. (04 hrs.) 24. Practice Soldering and De-soldering on the PCBs for a given circuit(s). (12hrs.) 25. Perform Termination of wires, cables and electronic components. (04hrs.) 26. Perform Skinning, dressing, and joining for different types of cables.(06hrs.) 27. Perform Crimping practice on RJ45, BNC, Audio, D-shell and Edge connectors. (07hrs.) 28. Measure Insulation Resistance by using Megger. (03hrs.) 29. Perform wiring in PVC conduit for power sockets controlled independently. (04hrs.) 30. Perform wiring to control one lamp from different places. (04 hrs.) 31. Perform wiring to install buzzer, buttons, and protection alarm. (04hrs.) 32. Prepare panel mains board with switch and distribution fuse box. (04hrs.) 33. Estimate the materials for a given panel board connection plan. (04 hrs.) 34. Perform Wiring of power and control circuits in the panel board. (12hrs.) 35. Measure earth resistance using earth tester. (03hrs.) 36. Test the switches, pushbuttons,	cables, Fiber optical cables. Types of connectors and its specifications: Power connectors, Flat cables, RJ45 Connector, BNC, TNC, Audio Video, D-Shell and Edge connector. Cable termination methods, cable layout diagrams, electrical control panel wiring and electrical bussystems Purpose of using protective devices, Fuses, Contactor ,Relays, Timers, Circuit Breakers, MCBs, ELCBs, DOL ,Star – Delta Starters, Push buttons, Limit switches, Micro switches, Float switches, Solenoids, Float switch, OLRs, Photo electric relay Importance of earthing, Types of earthing techniques. Importance on electrical safety, safetymarking and symbols, Risk management, Electric hazards, Prevention of accidents and Personal safety aspects. Environment safety and safety precautions while handling electrical equipments. Classification of fires, Different type of fire-fighting equipments

		limit switches, Foot pedal switch, Micro switches for its operation (08hrs.) 37. Practice on working of protective elements such as MCB, OLR, ELCBs and fuses in power circuits. (08hrs.) 38. Ascertain different safety symbols and signs used in workshop. (04hrs.)	
26-27	**First year Mid-term Revision**		
28-33	Construct and verify different Digital Logic Circuits.	1. Verify the truth table of AND, OR, NOT, NAND, NOR, XOR gates. (06hrs.) 2. Construct and verify SR, JK, T and D Flip-Flops. (12hrs.) 3. Construct and verify Binary counter, UP/DOWN counter circuits. (08hrs.) 4. Construct and verify encoder and decoder circuits. (08hrs.) 5. Construct Multiplexer and De multiplexer circuits. (04hrs.) 6. Construct on Analog to Digital Converter (R-2R). (04hrs.) **a.** Digital to Analog converter *(Comparator, Dual slope, Successive approximation.)* (08hrs.)	**<u>Number System:</u>** Binary, Decimal, Octal, Hexa Decimal Number systems and its Conversions. Binary Arithmetic and logical operations. **<u>Digital Logic:</u>** Boolean algebra. Logic gates: AND, OR, NOT, NAND, NOR, XOR. Encoder and Decoders. Concepts of Flip-Flop: SR, JK,T, D. Counters, Multiplexers and De-Multiplexers. Memories: Discs, RAM, ROM, Semiconductor memories
34-35	Trouble shoots and repairs different Electrical, Electronic systems/ devices. *[Different Electrical, Electronic systems/*	1. Replacement of fuses, Locating OLR and its resetting practice (02 Hrs.) 2. Locating faults in power circuit such as fuse blown, MCB Tripped, control fuse blown etc. (04hrs.) 3. General checking of loose contacts in the control panel wirings. (04	Introduction to maintenance, Importance of maintenance and types. Guidelines for trouble shooting of electrical, electronic systems and PLC.

	devices:- Fuse, MCB, Power circuit, Control panel,Circuit Breaker, Stabilizer, AC/DCdrives	hrs.) 4. Troubleshoot and Service a circuit breaker. (06hrs.) 5. Service and troubleshoot the AC motor starter. (04hrs.) 6. Maintain, Service, and troubleshoot AC Machine. (06 hrs.) 7. Identify controls, trace the circuit and test the function of stabilizer. (06hrs.) 8. Trouble shoot and maintenance of UPS and stabilizer. (08hrs.) 9. Trouble shooting of AC/DC Drives. Check the feedback sensors. (10hrs.) 10. Trouble shooting of Motors & Insulation Resistance Testing	
36-37	Recognize various types of conveyor systems, their components, their utility, common defects occurs in different types of conveyors in industry and perform overhauling and repairing of each type of conveyors.	1. Visit plant and make a list of types of conveyors. (08 hrs) 2. Dismantle conveyors, observe components and list their functions and re-assemble after servicing. (16 hrs) 3. Repair or replace any damaged or faulty component (08 hrs) 4. Lubricate movable parts of conveyors. (08 hrs)	Defining conveyors, purpose and utility of conveyors in assembly line, types of conveyors, overhead conveyors, drive and speed setting. Common defects or faults occur in conveyor system of plant and procedure to repair / replace them.
38-39	Demonstrate function of different types of measuring, monitoring & control system devices / instruments, i.e. sensors, solenoid, relays, switches, fuses etc.	1. Identify different control system devices in plant. (08 hrs) 2. Check circuits and observe functioning of these devices. (08 hrs) 3. Remove / re-fit or replace these devices. (08 hrs)	Understanding of control systems in plant, control system devices, working principle and functioning of control system devices.

40	Perform Infra-red thermography of electrical motors and identify faults by interpreting thermograph.	1. Check the functioning of Infra-red camera. (0 hrs) 2. Practice taking infrared pics of 5 to 6 electric motors and bus bars. (08 hrs) 3. Download thermographs in computer and interpret to identify condition of equipment. (16 hrs)	What is infra-red and how it works. Principles of Infra-red thermography. Functioning of Infra-red camera. Fault identification in thermographs.
41-42	Explain piping and tubing. Plan & organize to make jobs in piping and tubing using all types of fittings.	1. Identify pipes and tubes and fittings. 2. Assemble models of piping and tubing from isometric drawings.	Difference between pipes and tubes. Uses of pipes and tubes. Classification of pipes and tubes. Pipe fitting i.e. elbow, socket, T, reducer, flanges, gasket, valves etc. Tube fittings and quick couplings.
43-46	Demonstrate functioning of different mechanical elements in plant and perform connections, removal, re-fitting, servicing of fastners, fittings, hoses, valves, bearings, ball screw, LM guides & rails, spindles, belts, chains & sprockets, drive belts, pulleys, couplings, gears, pumps, pressure gauges and gauge indicators.	1. Identify basic mechanical elements in a plant • Fasteners (4Hrs) • Fittings (4Hrs) • Hoses (4Hrs) • Valves (4Hrs) • Bearings (4 Hrs) • Linear & Rotary Movements • Ball Screw (2Hrs) • LM Guides & Rails (2Hrs) • Spindles(2Hrs) • Belts (4Hrs) • Chain , Pulley (4Hrs.) • Couplings, Gears & Sprockets (6Hrs) • Pumps (2 Hrs) 2. Types, Functions, Purpose & Usage for the basic Mechanical Elements 3. Demonstrate Connection of 4. Steel pipes & Hose 5. Pressure gauge/Indicator 6. Fitment of gaskets, seals and strainer 7. Troubleshooting of Hydraulic System	Concepts of Controlling the Fluids 1. Transfer 2. Joints 3. Pressure Generation & Distribution Concepts of Movements 1. Linear Motion 2. Rotary Motion 3. Inter-conversion of Movements 4. Concept of Friction & Force Concepts of Power Transmission 1. Energy Transmission 2. Engagement 3. Concepts for Transmissions

47	Explain Power pack & power locks - Types of Power pack & power locks, Uses of different types of Power pack & power locks, common defects & maintenance activities in Power pack & power locks.	1. Identify different types of power packs and power locks fitted in different equipment in plant. (08 hrs) 2. Practice removal, service & refit the power packs and power locks. (08 hrs)	Define power packs and power locks and their functional utility. Procedure of servicing and maintenance of power packs & power locks.
48	Identify & explain the Seals & O-Rings - Types of Seals & O-Rings, Uses of different types of Seals & O-Rings, common maintenance activities in Seals & O-Rings.	1. Identify different types of seals and O-rings. (04 hrs) 2. Observe fitting of seals and O-rings in pneumatic and hydraulic systems. (08 hrs) 3. Practice removal and replacement of seals and O-rings using special purpose tools. (04 hrs)	Difference between seals and O-rings, function of seals and O-rings, materials of seals & O-rings. Special purpose tools and procedure to remove and fitting of seals and O-rings.
49-51	**Revision**		
52	**First Year Examination**		

SYLLABUS FOR TECHNICIAN – PLANT MAINTENANCE TRADE			
Second Year			
Week No.	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hrs.**	**Professional Knowledge (Trade Theory)**
53-54	Explain Maintenance planning basics and prepare Maintenance - Schedules for mechanical, electrical and control system maintenance under supervisors guidance.	1. Study maintenance planning of each and every machine or device and system in plant. (08 hrs) 2. Prepare maintenance plan for one machine or device. (08 hrs)Study maintenance schedule of plant. Analyze and note down maintenance schedule of cycle of different systems. (08 hrs) 3. Prepare maintenance schedule for one shop. (08 hrs)	What is planning and basics of maintenance planning. Different maintenance plan for different system or machine. Define maintenance schedule and its importance. Why periodic maintenance in schedule.
55	Prepare & update Maintenance documents - Charts, reports and register.	1. Study existing maintenance documents and reports. (08 hrs) 2. Prepare maintenance chart, maintenance report for five machines. (08 hrs)	Documentation required for plant maintenance. Importance of documents in maintenance. Understanding maintenance documents. Documents to prepare and update by Technician – Plant Maintenance.
56-58	Explain concepts of all Mechanical systems, components, and functions in plant viz Hydraulic system, Lubrication system, Coolant system, Pneumatic system. Perform preventive maintenance of mechanical systems.	1. Concepts of Hydraulic System (24 hrs) • Hydraulic Oil • Hydraulic Power Pack • Hydraulic Pump • Motor • Radiator • Filters • Hydraulic Directional Valves • Hydraulic Cylinders • Accumulator 2. Concepts of Lubrication Systems (24 hrs) • Lubrication Oil • Grease • Usage & Application • Need & Advantages 3. Concepts of Coolant System (24 hrs) • Types of Coolant • Different Operating Conditions • Usage & Functions	• Hydraulic Power pack description, parts details and uses. Function of each parts. • Pump description, function, types and uses. Pump parts and understanding of each parts and method of flow and pressure checking and adjusting • Description, function and types of Hydraulic valves , Cylinders & Accumulators • Lubrication description, property of oil – viscosity – types – function and uses. • Property of grease, types and uses. • Coolant description, types and uses • Pneumatic system description, parts and uses.

		• Need & Advantages 4. Concepts of Pneumatic Systems (24 hrs) • Compressed Air • Filters & regulators • Pneumatic Valves • Pneumatic Cylinders	
59-62	Explain Basic Pneumatic system and elements. Capable to designing of pneumatic circuit. Construct simple pneumatic circuit and check functionality.	1. Identify various parts of pneumatic system 2. Practice on selection of pneumatic element for given circuit 3. Practice on preparing pneumatic circuit 4. Measure pneumatic pressure, temperature, flow level of pneumatic system 5. Select appropriate air compressor, receiver for given application. 6. Use and maintain of FRL unit in pneumatics. (02 hrs) 7. Describe piping layout. (02 hrs) 8. Select and maintain appropriate pneumatic elements (actuators, motors and cylinders). (08 hrs) 9. Select and maintain appropriate pneumatic control valves. (08 hrs) 10. Use logic valves in pneumatic circuit. 20. Describe ISO symbols and guiding rules for designing pneumatic system. (08 hrs) 21. Describe various components of pneumatic circuit based on given system requirements. (08 hrs) 22. Design pneumatic logic circuit based on given system requirements (08 hrs) 23. Use logic valves and construct in pneumatic circuit.(08hrs.) 24. Construct and perform the	• Definition and history of Pneumatic. Pneumatic system: i. Basic components ii. Comparison to pneumatic systems. iii. Advantages and limitations. iv. Application of pneumatics. • Basic pneumatic system. • Types, construction, working, specifications and selection criteria of following air preparation and conditioning elements: i. Air compressors ii. Air receivers iii. Air dryers iv. Air filters, regulators and lubricators (FRL unit). • Pneumatic pipes- materials, BIS, ASME and DIN designations, standards, properties and selection criteria. • Piping layout-important considerations, precautions and route optimization. • Pneumatic cylinders- types, construction, working, materials, specifications, mounting & cushioning. • Types, constructions, designations, working, applications and selection criteria of following: i. Directional control valves. ii. Flow control valves.

		operation of Pressure control valves.(08hrs.) 25. Using Time Delay valves perform the operation of pneumatic actuator.(06hrs.)	iii. Pressure control valves. iv. Special valves- quick exhaust valve and time delay valve. v. Logic valves- shuttle valve • ISO symbols used in pneumatic circuits • Circuit diagram, components, working and application of following pneumatic circuits: i. Control of single acting cylinder. ii. Control of double acting cylinder. iii. Speed control circuit. iv. Automatic cylinder reciprocation circuit. v. Quick exhaust circuit. vi. Two step feed control circuit vii. Time delay circuit. viii. Two hand safety control circuit. • Pneumatic logic circuit design: Classic method, cascade method, step counter method, • Components of electrical controls- switches, relays, solenoids, timers. • Electro-pneumatic circuits: i. Reciprocation of cylinder using pressure switches. ii. Control of a cylinder using a single limit switch. iii. Automatic dual cylinder sequencing circuits. iv. Pneumatic cylinders- types, construction, working, materials, specifications, mounting and cushioning.

63-66	Explain Basic Hydraulic system and elements. Capable to designing of pneumatic circuit. Demonstrate installation of accessories in hydraulic system and trouble shoot and defects.	1. Check of pressure built up and setting relief valve pressure in hydraulic system and checking of Line filter.(03hrs.) 2. Tabulate the selection criteria of different grades of Hydraulic oil for the system.(02hrs.) 3. Construct simple hydraulic circuit (16hrs.) a. Pressure Regulating Circuit (02 hrs) b. Safety Circuit (02 hrs) c. Dual Pressure Regulating Circuit (02 hrs) d. Sequence Control Circuit (02 hrs) e. Pressure Counterbalancing Circuit (02 hrs) f. Pressure Reducing Circuit (02 hrs) g. Meter-In Flow Control Circuit (02 hrs) h. Meter-Out Flow Control Circuit (02 hrs) i. Bleed-Off Control Circuit (02 hrs) j. Pressure Keeping Circuit (02 hrs) k. Differential Circuit (02 hrs) l. Synchronizing Circuit (02 hrs) m. Accumulator Control Circuit (02 hrs) n. Hydraulic Motor Control Circuit (02 hrs) 4. Practice on Hydraulic and Pneumatic (04 hrs.).	Introduction and Definitions of important terms like Hydraulics, Pressure, Force, Vacuum etc. i. Pascal's Law and its Application of hydraulics ii. Bernoulli's Principle iii. Hydraulic Jacks iv. Hydraulic Symbols and Circuit Building as per Standards DIN/ISO. v. Advantages and Disadvantages of Hydraulic System. vi. Hydraulic Oil and Types. vii. Importance of Hydraulic Oil. viii. Ideal Characteristics of Hydraulic Oil ix. Properties of hydraulic oil e.g. viscosity, ageing stability x. Grades of hydraulic oil xi. Maintenance of Hydraulic Oil Reading, understanding of Hydraulic Symbols for construction of circuit diagrams. **Types and Function of Components and Connectors** i) Steel pipe ii) Tubing iv) Hose Gauges v) Packing and Seals vi) Filters and Strainers vii) Hydraulic Tank
67-68	Construct hydraulic circuit and verify various processes to assess functioning of valves and auxiliaries. [Various processes: - speed	5. Construct and perform the operation of Speed control of Hydraulic cylinder through Throttle valve.(03hrs.) 6. Construct and verify the functionality of Flow control valve	Construction, Types and working of : • Directional Control Valves • Pressure Control Valves • Flow Control Valves • Pressure Intensifiers • Accumulators

	control, lubrication system, press control etc.].	in Meter-in and Meter-out circuit. (03 hrs.) 7. Construct and check the function of cartridge valves in Lubrication system. (10hrs.) 8. Construct Electro Hydraulic circuit –Speed and Pressure control of double acting cylinder for hydraulic Press.(10 hrs.) 9. Construct control based hydraulic circuit for operation of double acting cylinder through 5/2 solenoid operated D.C. valve and PLC Controller (Counter based circuit).(10hrs.) 10. Practice on Hydraulic and Pneumatic Simulation software (08 hrs.)	• Cartridge Valves and Cylinder • Relief Valve
69-70	Plan and organize the work and carryout service and maintenance activities in various mechanical assemblies (Ball screws and LM guides) using standard procedure and proper tools, tackles and consumables.	1. Ball Screw: Pitch, lead, dimension checking, preload, backlash and play checking, Assembly of ball screw, replacement and repairing, uses, care and maintenance (12 Hrs) 2. LM Guide: Dimension checking, preload, backlash and play checking, Assembly of LM guide, replacement and repairing, uses, care and maintenance (12 Hrs)	Principle and understanding of Ball screw and parts, types, application, use and care – maintenance- nomenclature – preload – backlash - dimension Principle and understanding of LM guide and parts, types, application, use and care –maintenance- nomenclature – preload – backlash - dimension
71-72	Plan & Organize work to Install hydraulic pump, motors and carryout maintenance of these components.	1. Demonstrate the different types and working of Pumps using cut-section Models.(03hrs.) 2. Install Hydraulic Pump and Motor and verify its function in hydraulic power pack.(10hrs.) 3. Maintenance of Hydraulic Motor and Pump.	**Construction and Working, Specifications :** • Gear Pump • Vane Pump • Radial Piston Pump • Pump Maintenance and Trouble Shooting , Hydraulic Motor Specifications

73-74	Construct different hydraulic system and operate to achieve desired functions. [Different hydraulic system:- Clamp control, hydraulic press control]	1. Construct and verify One-Cycle Cylinder Reciprocation using limit switches, timer, Pushbutton and Single-Solenoid Valve and double solenoid valve. (06 hrs.) 2. Construct a hydraulic control circuit for clamping and de-clamping operation of part handling system.(10hrs.) 3. Construct and perform the operation of Hydraulic press control using hydraulic elements.(10hrs.)	Construction of circuits and operation of hydraulic circuit i.e. clamp unclamp circuit, hydraulic press
75-76	**Second year Mid-term Revision**		
77-80	Program PLC and interface with other devices to check its Applications.	1. Ascertain various modules, controls, and indicators of given PLC. (09 hrs.) 2. Program and configure the PLC to perform a simple start/stop routine. (08hrs.) 3. Program the PLC using Timer and Counter instructions. (15hrs.) 4. Program the PLC to perform Move, Arithmetic, and Logical operations. (03hrs.) 5. Program the PLC for performing comparator operations. (3hrs.) 6. Practice on PLC wiring. (09hrs.) 7. Program PLC for controlling analog parameter(s). (03hrs.) 8. Program a PLC for Traffic Light Control. (06hrs.) 9. Program PLC to generate different patterns for a given set of lights.(03hrs.) 10. Program a PLC for Reverse Forward Control of a Motor. (03 hrs.) 11. Program a PLC for Conveyor Belt	**PLC:** Overview of different control systems. Introduction about PLC. Block diagram of PLC. Different types of PLC, PLC Architectures (Fixed and Modular).Selection of PLC. Advantages of PLC. Applications of PLC. Various types of modules used in PLC. Familiarization of AND, OR and NOT logics with examples. Registers Basics. Timer Functions. Counter Functions. Introduction and importance of Sequential Control Systems. Communication protocols used in PLC: RS-232, RS-485, Ethernet, Profibus. Different programming languages of PLC: LDR, STL, FBD, CSF. Basic ladder programming, configuration & wiring of PLC

		Motor Control.(05hrs.) 12. Program a PLC for parking system of 100 Cars. (04hrs.) 13. Program a PLC for motor Star-Delta Control. (03hrs.) 14. Program PLC for simple elevator control. (03 hrs.) 15. Configuration of HMI.(05hrs.) 16. Interface I/O with PLC using Profibus system/ Ethernet. (02hrs.) 17. Interface PLC to pneumatic and hydraulic circuits.(04hrs.) 18. Resetting of major and minor errors in PLC. (06hrs.) 19. Troubleshooting of power supply and IO modules in PLC. (06hrs.)	Interfacing of PLC with other devices. Safety aspects. Introduction to HMI configuration.
81-82	Explain robot anatomy and perform programming robot using teach box, software.	1. Basic Functions of Teach Box (04 hrs.) 2. Repositioning of Workpieces using Teach box.(09hrs.) 3. Basic knowledge of Yamaha , IAI and Yaskawa controllers (14hrs). 4. Simulation - Programming a Work cell and Downloading (08hrs.) 5. Teaching Mode in Programming software. (05 hrs.) 6. On Line Mode in Programming software. (06 hrs.) 7. Continuous Motion. (08hrs.) 8. Palletizing. (06hrs.)	Anatomy of robots: Overview of a robot manipulator system – basic components of robot, overview of robot applications in industrial automation. Types of end effectors: Grippers and tools. Robot Drives & Control, Robot Programming Languages, Robot application in Manufacturing
83-85	Simulate the electrical circuits on simulation software and detect fault as per diagnostic procedure for Electrical system design.	1. Familiarization with various features and components of Simulation software.(07hrs.) 2. Using and Testing of different types of Electrical components using Simulator.(08hrs.) 3. Develop Electrical circuit using simulator as per the drawing and test for its functionality.(20hrs.) 4. Develop Electrical circuit for any Industrial application using simulator software. (20hrs.)	Advantages of Simulator Software. Develop simple Electrical circuit Develop Industrial application based Electrical circuit Trouble shooting techniques and mechanism.

		5. Test the Electrical circuit developed in simulator, diagnose the fault, rectification, resetting of errors. (20hrs.)	
86-88	Simulate the electronic circuits on simulation software and detect fault as per diagnostic procedure for Electronics system design.	1. Familiarization with various features and components of Simulation software.(7hrs.) 2. Using and testing of different types of Electronics components using Simulator.(8hrs.) 3. Develop Electronics circuit using simulator as per the drawing and test for its functionality.(20hrs.) 4. Develop Electronics circuit for any Industrial application using simulator software.(20hrs.) 5. Test the Electronics circuit developed in simulator, diagnose the fault, rectification, resetting of errors. (20hrs.)	Advantages of Simulator Software. Develop simple Electronics circuit Develop Industrial application based Electronics circuit Trouble shooting techniques and mechanism.
89-92	Simulate the Hydraulic and Pneumatic circuit on simulation software and detect fault as per diagnostic procedure for Hydraulics and Pneumatics system design.	1. Practice Pneumatics fundamentals using simulation software. (12hrs.) 2. Practice Electrical control of pneumatic system using simulation software. (14hrs.) 3. Practice Hydraulic fundamentals using simulation software. (13 hrs.) 4. Practice Electrical control of hydraulic system using simulation software. (18 hrs.) 5. Develop Pneumatic circuit using simulator as per the drawing and test for its functionality. (18hrs.) 6. Test the Hydraulic and Pneumatic circuit developed in simulator, diagnose the fault, rectification, resetting of errors. (25hrs.)	Advantages of Simulator Software. Develop simple Hydraulic circuit Develop simple pneumatic circuit Troubleshooting techniques and mechanism.
93-100	Perform project work on Plant Maintenance (Projects- involving Fitting, Drilling, Turning, Milling,	1. Preparation of mechanical drawing for picks and place project. (25 hrs.) 2. Preparation of Hydraulic and Pneumatic circuit diagram. (25 hrs.)	(Mechanical, Hydraulic, Pneumatic, Electrical) Assembling Techniques Safety precautions in each stage Testing procedure. Common faults and their

	Grinding, Electrical wiring, programming, Hydraulic circuit assembly, Pneumatic circuit assembly, Conveyor or Drives system assembly and Interfacing, functional testing, trouble shooting and repair. Safety measures in each stage)	3. Preparation of Electrical wiring diagram. (25hrs.) 4. Preparation of Electronics circuit diagram. (25hrs.) 5. Prepare bill of material.(10hrs.) 6. Perform Filing operation. (9hrs.) 7. Perform drilling operation.(8hrs.) 8. Perform Turning operation. (18 hrs.) 9. Perform Milling operation. (18 hrs.) 10. Perform surface finish operation. (04 hrs.) 11. Assemble the Mechanical components as per drawing. (10Hrs.) 12. Assemble Hydraulic and Pneumatic circuit and interface. (13hrs.) 13. Assembling and wiring of Electrical and Electronic system integration.(10hrs.) 14. Develop, download PLC program and Integrate. (25hrs.) 15. Testing, Trouble shooting and Repairing. (25 hrs.)	rectification
	Projects: **1.** Conveyor Control System **2.** Panel Retrofitment **3.** Obsolete PLC upgaradation **4.** Energy saving project by avoid idle running of coolant and Hydraulic power pack pumps. (PLC Based) **5.** Pneumatic cylinder movement control (Electro Pneumatic based)		
100-103	**Revision**		
104	**Second (Final) Year Examination**		

1. *Some of the sample project works (indicative only) are given at the mid and end ofyear.*
2. *Instructor may design their own project and also inputs from local industry may be taken for designing such newproject.*
3. *The project should broadly covered maximum skills in the particular trade and must involve some problem solving skill. 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 Projectreport.*
4. *If the instructor feels that for execution of specific project more time is required then he may plan accordingly in appropriate time during the execution of normal tradepractical.*
5. *More emphasis to be given on video/real-life pictures during theoreticalclasses.*

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERINGDRAWING

First Year		
S No.	**Workshop Calculation and Science**	**Engineering Drawing**
1.	**Units**: Physical quantities and types, Fundamental and Derived units, Systems of units- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units.	Engineering Drawing: Introduction and its importance. Drafting Tools, Drawing Instruments - standards and uses. Drawing board, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scales), Pencils of different Grades, Drawing pins / Clips.**(1 session)**
2.	**Fractions**: Fractions, Decimal fraction, L.C.M., H.C.F., Addition, Subtraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal & vice versa. Simple problems.	Lettering and Numbering as per BIS SP46-2003: Single Stroke, Inclined letters and numbers, Upper case and Lower case letters.**(3 sessions)**
3.	**Square Root**: Square and Square Root, method of finding out square roots, Simple problems.	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). **(2 sessions)**
4.	**Ratio and Proportion**: Ratio, Proportion – types- direct and indirect. Simple calculation on related problems.	Lines: - Definition, types and applications in Drawing as per BIS SP:46-2003. Classification of lines (Object line, Hidden, centre, construction, Extension, Dimension, Section).Drawing lines of given length (Straight, curved),

		Drawing of parallel lines, perpendicular line. curved), Drawing of parallel lines,perpendicular line. Methods of Division of line segment. **(3 sessions)**
5.	**Percentage:** Introduction, Conversion of percentage to decimal and fraction and vice-versa. Loss and Profit. Simple and Compound interest. Simple calculations.	Drawing of Geometrical Figures: Practice of Angle-Measurement and method of bisecting. Triangle -different types.Rectangle, Square, Rhombus, Parallelogram.Circle. **(3 sessions)**
6.	**Material Science : Properties :-** Physical and Mechanical, Metal Types –Ferrous and Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction to Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals and Non-Ferrous Alloys.	Drawing of Geometrical Figures: Practice of Angle-Measurement and method of bisecting. Triangle -different types. Rectangle, Square, Rhombus, Parallelogram. Circle. **(3 sessions)**
7.	**Mass, Weight and Density :** Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals. Archimedes' principle.	Dimensioning: Definition, Systems of Dimensioning and methods of dimensioning (functional, non-functional and auxiliary) Types of arrowhead Leader Line with text **(1 session)**
8.	**Speed and Velocity:** Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation, equations of motions, Newton's laws of motion. Simple related problems.	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. **(2 sessions)**
9.	**Work, Power and Energy**: Work, unit of work, power, unit of power, Horse power, mechanical efficiency, energy, use of energy, potential and kinetic energies, examples of potential energy and kinetic energy. Simple related problems.	Symbolic Representation (as per BIS SP:46-2003) of : Conversional representation of threads - Fastener (Rivets, Bolts and Nuts) - Construction of scales (enlarged andreduced) **(2 sessions)**

10.	**Algebra**: Addition, Subtraction, Multiplication, Division, Algebraic formula, Simple equations, Quadratic equations, Simultaneous equations (with two variables). Simple problems.	Drawing of Solid figures (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions. **(3 sessions)**
11.	**Mensuration :** Plane and Solid. Area and perimeter of triangle, square, rectangle, parallelogram, trapezium, polygons.Simple problems on regular and combined plane figures.	Construction of Different Polygons-Pentagon, Hexagon, Heptagon, Octagon. Inscribed and Circumscribed polygons. Conic section s (Circle, Ellipse, Parabola and Hyperbola) **(4 sessions)**
12.	**Trigonometry:** Trigonometrical ratios, measurement of angles. Value of trigonometric function for frequently used angles. Compound, multiple and submultiple angles. Use of Trigonometric tables.	Method of presentation of Engineering Drawing - Pictorial View - Orthogonal View - Isometric view **(2 sessions)**
13.	**Heat and Temperature**: Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scales of temperature measurement, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat. Methods of heat transmission - conduction, convection, radiation. Simple problems.	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. **(2 sessions)**
14.	**Simple Machines:** lever and types with examples. Simple Machine, Effort and Load, input, output, Mechanical Advantage, Velocity Ratio, Efficiency of machine and Relationship. Simple problems.	- Construction of Isometric drawings from the given orthographic views **(3 sessions)**

15.	**Lubricants:** Function, theories of friction, mechanism of lubrication - thick film, thin film and extreme pressure. Classification - solid, liquid and semisolid, Properties - viscosity, flash point and fire point, cloud and pour point, aniline point, corrosion stability.	Drawing of Orthographic projection from isometric/3D view of blocks in third angle projection method **(2 sessions)**
16.	**Basic Electricity:** Introduction, use of electricity, how electricity is produced, Electric current - AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Ohm's Law. Types of connections – series, parallel and combined. Electric power, Horse power, energy, unit of electrical energy- kWh. Simple problems.	Drawing of Orthographic projection from isometric/3D view of blocks in first angle projection method **(2 sessions)**
17.	**Basic electronics:-** Electron theory, Semiconductors, diodes, Transistors: PNP, NPN, Triode**.**	Sectional Views – Full section- half section – exercises **(2 sessions)** Drawing details of two simple mating blocks and assembled view. (**1 session)**
18.	**Number system:-** Introduction, Decimal, binary, octal, hexadecimal BCD code, ASCII code, Bit, Byte, KB, MB, GB conversion.	Missing views of simple solid objects **(1 session)**
Second Year		
S No.	**Workshop Calculation and Science**	**Engineering Drawing**

1.	Revision of first year topics. Heat treatment processes.	ELECTRONICS SYMBOLS (6 hrs.) 1) Basic Symbols 2) Diode ,Rectifiers, Thyristors PRACTICING CIRCUITS USING SYMBOLS(6hrs.) 1) Regulator Circuit 2) Combinational Clipper Circuit 3) Timer circuit **(4 sessions)**
2.	Area of cut-out regular surfaces: circle and segment and sector of circle.	ELECTRICAL SYMBOLS(3 hrs.) 1) Inductor symbol 2) Meter symbol 3) Lamp/light symbol PRACTICING CIRCUITS USING SYMBOLS (6 HRS.) 1) Open circuit test for single phase transformer 2) Working of DCmotor **(3 sessions)**
3.	Area of irregular surfaces. Application related to shop problems.	DIGITAL ELECTRONICS SYMBOLS (3 hrs.) 1) Logic Gates Symbols PRACTICING CIRCUITS USING SYMBOLS (3 hrs.) 1) Flip flop Circuit **(2 sessions)**
4.	Volume, Lateral surface area and total surface area of solids – cube, cuboid, prism, cylinder, cone, Sphere. Simple problems on regular and combined solids Volume of cut-outsolids: Hollow cylinders, frustum of cone, block section.Volume of simple machine blocks.	1 SENSOR SYMBOLS (3 hrs.) 2 PRACTICING CIRCUITS USING SYMBOLS (3 hrs.) **(2 sessions)**
5.	Area of triangle. Sine rule and Cosine rules. Finding the value of unknown sides and angles of a triangle by Trigonometrical method. Angle of Elevation and Angle of Depression. Heights and distances. Simple problems.	PNEUMATICS(9HRS.) 1. Pneumatic symbols 2. Actuation of SAC 3. Speed control of SAC 4. Actuation of DAC 5. AND

		6. OR operation 7. Combination Circuit- (3 sessions)
6.	Finding height and distance by trigonometry.	ELECTRO PNEUMATICS(9HRS.) 1. Electrical symbols in Pneumatics 2. Direct actuation of cylinders 3. Indirect actuation of cylinders 4. Sequencing (3 sessions)
7.	Application of trigonometry inshop problems. (viz. taper angle calculation).	1. HYDRAULIC AND ELECTRO HYDRAULIC(SYMBOLS 3HRS.) 2. PRACTICING HYDRAULIC CIRCUITS (6HRS) **(3 sessions)**
8.	**Forces definition.** -Compressive, tensile, shear forces and simple problems. Stress, strain, ultimate strength, factor of safety. Basic study of stress-strain curve for ductile metal. -Simple problems.	
9.	Temperature measuring instruments. Specific heats of solids and liquids. Thermal Conductivity, Heat loss and heat gain.	
10.	**Circular Motion:-** Relation between circular motion and Linear motion, Centrifugal force, Centripetal force	
11.	**Graph:** - Read images, graphs, diagrams – bar chart, pie chart. - Graphs: abscissa and ordinates, graphs of straight line, related to two sets of varying quantities.	1. Detailed part drawings of the project (Pick and Place) indicating surface roughness values, tolerances and relevant fits. 2. Assembly drawing of the project. 3. Prepare the bill of material. 4. Functional drawing (line drawing) 5. Circuit drawing for pneumatic system.

		6. PLC program sheet
12.	Simple problem on Statistics: - Frequency distribution table - Calculation of Mean value. - Examples on mass scale productions. -Cumulative frequency -Arithmetic mean	
13.	Acceptance of lot by sampling method (within specified limit size) with simple examples (not more than 20 samples).	
14.	Friction- co-efficient of friction, application and effects of friction in Workshop practice. Centre of gravity and its practical application.	
15.	- Magnetic substances- natural and artificial magnets. - Method of magnetization. Use of magnets.	
16.	- Electrical insulating materials. - Basic concept of earthing.	
17.	- Transmission of power by belt, pulleys and gear drive. - Calculation of Transmission of power by belt pulley and gear drive.	
18.	Concept of pressure – units of pressure, atmospheric pressure, absolute pressure, gauge pressure – gauges used for measuring pressure	

19.	Estimation and costing:- Calculationof weight ofmaterial,material cost , machining cost, labour cost and total cos	

9.2 EMPLOYABILITY SKILLS

CORE SKILL – EMPLOYABILITY SKILL		
Duration – 110 hrs.		
1. English Literacy		**Duration : 20 Hrs.** **Marks : 09**
Pronunciation	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)	
Functional Grammar	Transformation of sentences, Voice change, Change of tense, Spellings.	
Reading	Reading and understanding simple sentences about self, work and environment	
Writing	Construction of simple sentences Writing simple English	
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.	
2. IT Literacy		**Duration : 20 Hrs.** **Marks : 09**
Basics of Computer	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
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.	
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.	

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. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.
3. Communication Skills	**Duration: 15 Hrs.** **Marks : 07**
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.
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.
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.
Facing Interviews	Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview.
Behavioral Skills	Problem Solving Confidence Building Attitude
4. Entrepreneurship Skills	**Duration : 15 Hrs.** **Marks: 06**
Concept of Entrepreneurship	Entrepreneur - Entrepreneurship - Enterprises:-Conceptual issue 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.

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.
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.
Investment Procurement	Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.
5. Productivity	**Duration : 10 Hrs.** **Marks 05**
Benefits	Personal / Workman - Incentive, Production linked Bonus, Improvement in living standard.
Affecting Factors	Skills, Working Aids, Automation, Environment, Motivation - How improves or slows down.
Comparison with developed countries	Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.
Personal Finance Management	Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.
6. Occupational Safety, Health and Environment Education	**Duration : 15 Hrs.** **Marks: 06**
Safety & Health	Introduction to Occupational Safety and Health importance of safety and health at workplace.
Occupational Hazards	Basic Hazards, Chemical Hazards, VibroacousticHazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.

Accident & safety	Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.
First Aid	Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person.
Basic Provisions	Idea of basic provision legislation of India. safety, health, welfare under legislative of India.
Ecosystem	Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.
Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
Energy Conservation	Conservation of Energy, re-use and recycle.
Global warming	Global warming, climate change and Ozone layer depletion.
Ground Water	Hydrological cycle, ground and surface water, Conservation and Harvesting of water.
Environment	Right attitude towards environment, Maintenance of in -house environment.
7. Labour Welfare Legislation	**Duration : 05 Hrs. Marks 03**
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.
8. Quality Tools	**Duration : 10 Hrs. Marks : 05**
Quality Consciousness	Meaning of quality, Quality characteristic.

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.
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of House-keeping, Practice of good Housekeeping.
Quality Tools	Basic quality tools with a few examples.

ANNEXURE-I

LIST OF TOOLS AND EQUIPMENT			
TECHNICIAN PLANT MAINTANCE (For batch of 24 Candidates)			
A. TRAINEES TOOL KIT			
Sr. No	**Name of the Tool &Equipments**	**Specification**	**Quantity**
1	Rule steel 15cm with metric graduations.	150 mm English and Metric combined	4 Nos.
2	Square try 10cm. blade.		4 Nos.
3	Caliper outside 15cm. spring.		4 Nos.
4	Caliper inside 15cm. spring.		4 Nos.
5	Divider 15cm. spring.		4 Nos.
6	Straight Scriber 15cm.		4 Nos.
7	Punch Centre 10cm.		4 Nos.
8	Screw Driver 15cm.		4 Nos.
9	Chisel cold flat 10cm.		4 Nos.
10	Hammer ball peen 0.45 kg. with handle.		4 Nos.
11	Hammer ball peon 0.22 kg. with handle.		4 Nos.
12	File flat 25cm. second cut.		4 Nos.
13	File flat 25cm. smooth.		4 Nos.
14	File half round second cut 15cm.		4 Nos.
15	Hacksaw frame fixed 30cm.		4 Nos.
16	Safety goggles.		4 Nos.
17	Dot slot punch 10 cm.		4 Nos.
18	Plier insulated 150 mm		4 Nos.
19	Plier side cutting 150 mm		4 Nos.
20	Screw driver 100 mm		4 Nos.
21	Screw driver 150 mm		4 Nos.
22	Electrician connector, screw driver 100 mm insulated handle thin stem		4 Nos.
23	Heavy duty screw driver 200 mm		4 Nos.
24	Electrician screw driver 250 mm thin stem insulated handle		4 Nos.
25	Knife double bladed electrician		4 Nos.
26	Neon tester		4 Nos.
27	Pincre 150 mm		4 Nos.
28	Blow lamp 0.5 litre		4 Nos.
29	Melting pot		4 Nos.

30	Electric drill machine portable 6 mm capacity		4 Nos.
31	Pillar electric drill machine 12 mm capacity		4 Nos.
32	Allen key		4 nos.
33	Oil can 0.12 litre		4 nos.
34	Bench grinder motorized		2 nos.
35	Pulley puller		2 Nos
36	Bearing puller		2 nos
37	Hygrometer		2 nos
38	Thermometer 0 to 100 Deg. Centigrade		2 nos
39	Scissors blade 150 mm		2 nos
40	Crimping tool		8 nos.
41	Wire stripper 20 cm		8 nos.
42	Plier flat nose 100 mm		4 nos.
43	Plier gas round nose 100 mm		4 nos.
44	Plier gas 150 mm		4 nos.
45	Iron, soldering 25 watt, 65 watt, 125 watt		4 nos.
46	Copper bit soldering iron 0.25 Kg.		4 nos.
47	Desoldering gun		4 nos.
48	Vice hand 50 mm jaw		4 nos.
49	Vice table jaw 100 mm		4 nos.
50	Vice hand 50 mm jaw		4 nos.
51	Pipe cutter to cut pipes upto 5 cm dia.		4 nos.
52	Pipe cutter to cut pipes above 5 cm dia.		4 nos.
53	Stock and die set for 20 mm to 50 mm G.I. pipe		4 nos.
54	Stock and dies conduit		4 nos.
55	Multi meter 0-1000 M Ohms, 2.5 to 500 Volts		4 nos.
56	Digital Multi meter (3 ½ digits)		4 nos.
57	A.C. Voltmeter M.I. 0-500V A.C.		4 nos.
58	Milli Voltmeter centre zero 100-0-100 m Volt		4 nos.
59	D.C. Milli ammeter 0-500mA		4 nos.
60	D.C. ammeter MC 0-1A		4 nos.
61	Ammeter MC 0-5A		4 nos.
62	Ammeter MC 0-15-25A		4 nos.

63	A.C. Ammeter M.I. 0-5A		4 nos.
64	A.C. Ammeter M.I. 0-15-25A		4 nos.
65	K.W. Meter 0-1-3 kW		4 nos.
66	Frequency Meter		4 nos.
67	Tacho meter with stop watch		4 nos.
68	Current Transformer		4 nos.
69	Tong Tester/Clamp Meter 0-100 Amps A.C		4 nos.
70	Megger 500 Volts		4 nos.
71	Relays – over Current, Under Voltage, etc. 3 Volts, 100 amps		4 nos.
72	Contactor 3-f, 440V, 16 amps. 2 NO & 2 NC auxiliary contacts		4 nos.
73	Contactor 3-f, 440V, 32 amps. 32 amps. 2 NO & 2 NC auxiliary contacts		4 nos.
74	Limit switch		4 nos.
75	Rotary switch 16 A		4 nos.
76	Load band 5 kW (Lamp/Heater type)		4 nos.
TOOLS INSTRUMENTS & GENERAL SHOP OUTFIT			
78	Rule steel 30cm. to read metric.		4 nos.
79	Rule steel 60cm.		4 nos.
80	Straight edge 45cm steel.		4 nos.
81	Plat surface 45 x 45cm.CI/Granite.		4 nos.
82	V-Block pair 7cm and 15cm with clamps.		4 nos.
83	Square adjustable 15cm blade.		4 nos.
84	Angle plate 10 x 20cm.		4 nos.
85	Level Spirit 15cm metal.		4 nos.
86	Punch letter 3mm. set.		4 nos.
87	Punch number set of 3mm.		4 nos.
88	Punch hollow 6mm to 19mm set of 5.		4 nos.
89	Punch round 3 x 4mm set of 2.		4 nos.
90	Portable hand drill (Electric) 0 to 6mm.		4 nos.
91	Taps and dies complete set in box B.A.		4 nos.
92	Taps and dies complete set in box with-worth.		4 nos.
93	Taps and dies complete set in box 3-18 mm set of 10		4 nos.
94	File knife edge 15cm. smooth.		4 nos.

95	File triangular 15cm smooth.		4 nos.
96	File round 20cm. second cut.		4 nos.
97	File square 15cm. second cut.		4 nos.
98	File square 25cm. second cut.		4 nos.
99	Feeler gauge 10 blades.		4 nos.
100	File triangular 20cm. second cut.		4 nos.
101	File flat 30cm. second cut.		4 nos.
102	File flat 20cm. bastard.		4 nos.
103	File flat 30cm. bastard.		4 nos.
104	File Swiss type needle set of 12.		4 nos.
105	File half round 25cm. second cut.		4 nos.
106	File half round 25cm. bastard.		4 nos.
107	File round 30cm. bastard.		4 nos.
108	File hand 15cm. second cut.		4 nos.
109	Stone oil 15 x 5 x 2.5cm.		4 nos.
110	Stone carborandum 15 x 5 x 5 x 4cm.		4 nos.
111	Can oil 0.25 liters.		4 nos.
112	Pliers combination 15cm.		4 nos.
113	Iron soldering 350gm.		4 nos.
114	Lamp blow 0.55 liters.		4 nos.
115	Spanner whit-worth D.E. 6 to 26mm set of 10 pcs.		4 nos.
116	Spanner adjustable 15cm.		4 nos.
117	Interchangeable ratchet socket set with a 12mm driver, sized 10-32 mm set of 18 socket & attachments.		4 nos.
118	Box spanner set 6 – 25mm in mm set of 8 with Tommy bar.		4 nos.
119	Glass magnifying 7cm.		4 nos.
120	Clamp tool maker 5cm and 7.5cmset of 2.		4 nos.
121	Clamp ''C'' 5cm.		4 nos.
122	Clamp ''C''10cm.		4 nos.
123	Hand Reamer adjustable max. 9mm, 12mm, 18mm, set of 3.		4 nos.
124	Hand Reamer taper 4 – 9 mm set of 6 OR 4 -7 mm set of 4.		4 nos.
125	Reamer parallel 12mm to 16mm set of 5.		4 nos.
126	Scraper flat 15cm.		4 nos.

127	Scraper 3 corner 15cm.		4 nos.
128	Scraper half round 15cm.		4 nos.
129	Chisel cold 9mm cross cut 9mm diamond.		4 nos.
130	Chisel cold 19mm flat		4 nos.
131	Chisel cold 9mm round noze.		4 nos.
132	Extractor stud EZY- out.		4 nos.
133	Set combination 30cm.		4 nos.
134	Micrometer 0 – 2.5cm outside.		4 nos.
135	Micrometer 25 – 50 mm outside.		4 nos.
136	Micrometer 0 – 25 mm outside.		4 nos.
137	Micrometer 50 – 75 mm outside.		4 nos.
138	Micrometer inside 25-50mm with 25 mm test pcs.		4 nos.
139	Vernier caliper 20cm.		4 nos.
140	Vernier height gauge 30cm.		4 nos.
141	Vernier bevel protractor.		4 nos.
142	Screw pitch gauge.		4 nos.
143	Wire gauge, metric standard.		4 nos.
144	Drill twist T/S 6 to 25mm x 1.5mm		4 nos.
145	Drill chuck 12mm.		4 nos.
146	Pipe wrench 40cm.		4 nos.
147	Pipe wrench 30cm.		4 nos.
148	Pipe vice 100mm.		4 nos.
149	Adjustable pipe tap set BSP with die set cover pipe size 15,20,25,32, 38, 50 mm.		4 nos.
150	Wheel dresser (One for 4 units).		4 nos.
151	Machine vice 10cm.		4 nos.
152	Machine vice 15cm.		4 nos.
153	Sleeve drill Morse 0-1, 1-2, 2-3.		4 nos.
154	Vice bench 12cm jaws.		4 nos.
155	Vice leg 10cm jaw.		4 nos.
156	Bench working 240 x 120 x 90cm.		4 nos.
157	Fire buckets		4 nos.
158	Machine vice 100mm.		4 nos.
159	Hand hammer 1 kg. with handle.		4 nos.
160	apron.		24 nos.
161	Prick punch.		4 nos
162	Mallet.		4 nos.

Machines & Accessories Required			
163	Drilling machine pillar sensitive 0-20mm. cap. with swivel table motorised with chuck & key.		nos
164	Drilling machine bench sensitive 0-12mm. cap. motorised with chuck and key.		2 nos.
165	Forge portable hand blower 38cm to 45cm.		2 nos.
166	Grinding machine (General purpose) D.E. pedestal with 2cm. dia. wheels rough and smooth with twist drill grinding attachment.		2 nos.
167	*CNC Milling Trainer with all accessories and consumables in duplicate.		2 nos.
168	Gauge snap Go and Not Go 25 to 50mm by 5mm set of 6 pcs.		2 nos.
169	Gauge plug single 3 ended 5 to 55 by 5mm. set pf 11 pcs.		2 nos.
170	Gauge telescopic upto 150mm.		2 nos.
171	Dial test indicator .01mm on stand.		2 nos.
172	Sine bar 125mm.		2 nos.
173	Sine bar 250mm.		2 nos.
174	Lathe tools H.S.S. tipped set.		2 nos.
175	Lathe tools bit 6mm x 75mm.		2 nos.
176	Lathe tools bit 7mm x 75mm.		2 nos.
177	Lathe tools bit 9mm x 85mm.		2 nos.
178	Arm strong type tool bit holder R.H.		2 nos.
179	Arm strong type tool bit holder L.H.		2 nos.
180	Arm strong type tool bit holder straight.		2 nos.
181	Stilson wrenches 25cm.		2 nos.
182	Water pump plier 250mm..		2 nos.
183	Pipe cutter 6mm to 50mm wheel type.		2 nos.
184	Pipe bender spool type up to 25mm. with stand manually operated.		2 nos.
185	Adjustable pipe chain tonge to take pipes up to 300mm.		2 nos.
186	Adjustable spanner 38cm. long.		2 nos.

187	Dial vernier caliper 0-200mm L.C. 0.05mm (Universal type).		2 nos.
188	Screw thread micrometer with interchangeable 0 – 25 mm. Pitch anvils for checking metric threads 60.		2 nos.
189	Depth micrometer 0–100mm 0.01mm.		2 nos.
190	Verniercaliper with thumb block 0 – 130 mm L.C. 0.02mm.		2 nos.
191	Comparator stand with dial indicator LC 0.01mm.		2 nos.
192	Engineer's try square (Knife-wedge) 150 mm blade.		2 nos.
193	Electric Furnace with capacity 600°C to 1400° C.		2 nos.
194	Lathe all geared head stock S.S. and S.C. height of centre over bed 15cm. gap head complete with accessories e.g. pump, all fittings and splash guard driving plate with drives, face plate 3 jaw and 4 jaw chucks fixed and traveling steady compound turret tool post, taper turning attachment, fixed and running centers, driving dogs straight and bent tails.		2 nos.
195	Transformer welding set 300 amps. continuous welding current, with all accessories and electrode holder.		2 nos.
196	Welding cable to carry 400 amps with flexible rubber cover.		2 nos.
197	Lugs for cable.		2 nos.
198	Earth clamps.		2 nos.
199	Arc welding table (all metal top) 122cm.x12cm.x60cm with positioner.		2 nos.
200	Oxy-acetylene gas welding set equipment with, regulator and other accessories.		2 nos.
201	Gas welding table with positioner.		2 nos.
202	Welding torch tips of different sizes.		2 nos.
203	Gas lighter.		2 nos.
204	Trolley for gas cylinders.		2 nos.
205	Chipping hammer.		2 nos.

206	Spindle key for cylinder valve.		2 nos.
207	Welding torches 5 to 10 nozzele		2 nos.
208	Welding goggles.		4 nos.
209	Welding helmet with colored glass.		4 nos.
210	Brake test arrangement with two spring balance of 0 to 25 Kg. rating		2 nos
211	DC power supply 0-100 volts, 5 Amps		2 nos
212	Inverter 1 KVA, Input 12 Volts DC, Output 220 Volts AC, 12 battery		2 nos
213	Voltage stabilizer – Input 150 – 230 Volts AC, Output 220 Volts AC		2 nos
214	Flux meter		2 nos
215	Laboratory type induction coil 6 Volts to 800 – 10000 Volts		2 nos
216	3 – point DC Starters		2 nos
217	Motor – Generator Set (AC to DC)		2 nos
218	Motor – Generator Set (DC to AC)		2 nos
219	Used DC Generators – Series, Shunt and Compound type for overhauling practice.		2 nos
220	DC Shunt Generator, 2.5 kW, 220 Volts with Control Panel		2 nos
221	DC Compound Generator, 2.5 kW, 250 Volts, with Control Panel including field Rheostat, Voltmeter, Ammeter and Circuit Breaker.		2 nos
222	Motor Series DC, 220 Volts, 0.5 to 2 H.P. coupled with Mechanical Load		2 nos
223	Motor Shunt DC, 220 Volts, 2 to 3 H.P.		2 nos
224	Motor DC Compound wound, 220 Volts, 2 to 3 H.P. with Star/Delta Starter and triple Pole Iron Clad Switch Fuse		2 nos
225	Motor AC Squirrel cage, 3-f , 400 Volts, 50 Cycles, 2 to 3 H.P. with Star/Delta starter and Triple Pole Iron Clad Switch Fuse.		2 nos
226	Motor AC phase-wound slip ring type 5 H.P., 400 Volts, 3-f, 50 Cycles with Starter & Switch		2 nos
227	Motor AC Series type 230 Volts, 50 Cycles, ¼ H.P. with Mechanical Load		2 nos

228	Motor AC 1-f, 230 Volts, 50 Cycles, 1 H.P. capacitor type with Starter Switch. 1 H.P.		2 nos
229	Motor Universal 230 Volts, 50 Cycles, ¼ H.P. with Starter/Switch		2 nos
230	Stepper Motor with Digital Controller		2 nos
231	Fan AC, 230 Volts, 1200 mm		2 nos
232	Transformer 1-f, 1 KVA, 230 / 115-50-24-12 Volts, 50 cycles core type, Air cooled.		2 nos
233	Transformer 3-f, 5 KVA, 440/230 Volts, 50 Cycles, Delta/Star, Shell type Oil Cooled		2 nos
234	Variable Auto Transformer 0-250 Volts, 8 Amps		2 nos
235	Oscilloscope – Dual trace, 10 MHz		2 nos
236	Oil Testing Kit		2 nos
237	Battery Charger with Variable output 1 kW		2 nos
238	Hydrometer		2 nos
239	A.C.B. (Air Circuit Breaker) 5 KVA		2 nos
240	M.C.B. (Miniature Circuit Breaker) 16 amps		2 nos
241	Thyristor/IGBT controlled DC motor drive. 1 H.P. with Tacho Generator feedback arrangement		2 nos
242	Thyristor/IGBT controlled AC motor drive with VVVF, 3-f, 2 H.P.		2 nos
243	Bench Working 2.5 x 1.20 x 0.75 meter		2 nos

TOOLS & EQUIPMENT FOR EMPLOYABILITY SKILLS		
S No.	**Name of the Equipment**	**Quantity**
1.	Computer (PC) with latest configurations and Internet connection with standard operating system and standard word processor and worksheet software	#12 nos.
2.	UPS - 500VA	#12 nos.
3.	Scanner cum Printer	1 no.
4.	Computer Tables	#12 nos.
5.	Computer Chairs	#24 nos.
6.	LCD Projector	1 no.
7.	White Board 1200mm x 900mm	1 no.
Note: Above Tools & Equipment not required, if Computer LAB is available in the institute.		

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:			**Examination:**									**Duration of the Trade/course:**		
Learning Outcome:														
Sr. No.	**Candidate Name**	**Father's/ Mother's Name**	Safety Consciousness, COVID Precautions	PM & Predictive maintenance approach	Attendance/ Punctuality	Ability to follow Manuals/ Written instructions	Ability to learn	Skills to Handle Tools/ Equipment/ Instruments/ Devices	Economical use of Materials	Teamwork/ Behaviour	Quality in Workmanship/ Performance	VIVA	**Total Internal Assessment Marks**	**Result (Y/N)**
Maximum Marks (Total 100 Marks)			**15**	**5**	**10**	**5**	**10**	**10**	**5**	**10**	**15**	**15**		
1														
2														