ELECTRONIC MECHANIC

COMPETENCY BASED CURRICULUM
(Duration: 2 Yrs.)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 5

SECTOR – ELECTRONICS

सत्यमेव जयते

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

Directorate General of Training

Skill India
कौशल भारत-कुशल भारत

ELECTRONIC MECHANIC

(Revised in 2018)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL - 5

Developed By

Ministry of Skill Development and Entrepreneurship
Directorate General of Training
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
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Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

Co-ordinator for the course: Shri. LK Mukherjee, DDT, CSTARI, Kolkata

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1.			Chairman
2.			Member
3.	C Ramasubramanian	DDT, Apex hitech Institute, Bangalore	Member
4.			Member
5.			Member
6.			Member
7.			Member
8.			Member
9.			Member
10.			Member
11.			Member

CONTENTS

1. BACKGROUND

1.1 Apprenticeship Training Scheme under Apprentice Act 1961

The Apprentices Act, 1961 was enacted with the objective of regulating the programme of training of apprentices in the industry by utilizing the facilities available therein for imparting on-the-job training. The Act makes it obligatory for employers in specified industries to engage apprentices in designated trades to impart Apprenticeship Training on the job in industry to school leavers and person having National Trade Certificate(ITI pass-outs) issued by National Council for Vocational Training (NCVT) to develop skilled manpower for the industry**.** There are four categories of apprentices namely**; trade apprentice, graduate, technician and technician (vocational) apprentices.**

Qualifications and period of apprenticeship training of **trade apprentices** vary from trade to trade. The apprenticeship training for trade apprentices consists of basic training followed by practical training. At the end of the training, the apprentices are required to appear in a trade test conducted by NCVT and those successful in the trade tests are awarded the National Apprenticeship Certificate.

The period of apprenticeship training for graduate (engineers), technician (diploma holders and technician (vocational) apprentices is one year. Certificates are awarded on completion of training by the Department of Education, Ministry of Human Resource Development.

1.2 Changes in Industrial Scenario

Recently we have seen huge changes in the Indian industry. The Indian Industry registered an impressive growth during the last decade and half. The number of industries in India have increased manifold in the last fifteen years especially in services and manufacturing sectors. It has been realized that India would become a prosperous and a modern state by raising skill levels, including by engaging a larger proportion of apprentices, will be critical to success; as will stronger collaboration between industry and the trainees to ensure the supply of skilled workforce and drive development through employment. Various initiatives to build up an adequate infrastructure for rapid industrialization and improve the industrial scenario in India have been taken.

1.3 Reformation

The Apprentices Act, 1961 has been amended and brought into effect from 22nd December, 2014 to make it more responsive to industry and youth. Key amendments are as given below:

- Prescription of number of apprentices to be engaged at establishment level instead of trade-wise.
- Establishment can also engage apprentices in optional trades which are not designated, with the discretion of entry level qualification and syllabus.
- Scope has been extended also to non-engineering occupations.
- Establishments have been permitted to outsource basic training in an institute of their choice.
- The burden of compliance on industry has been reduced significantly.

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. The vocational training programmes are delivered under aegis of National Council of Vocational Training (NCVT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of NCVT for propagating vocational training.

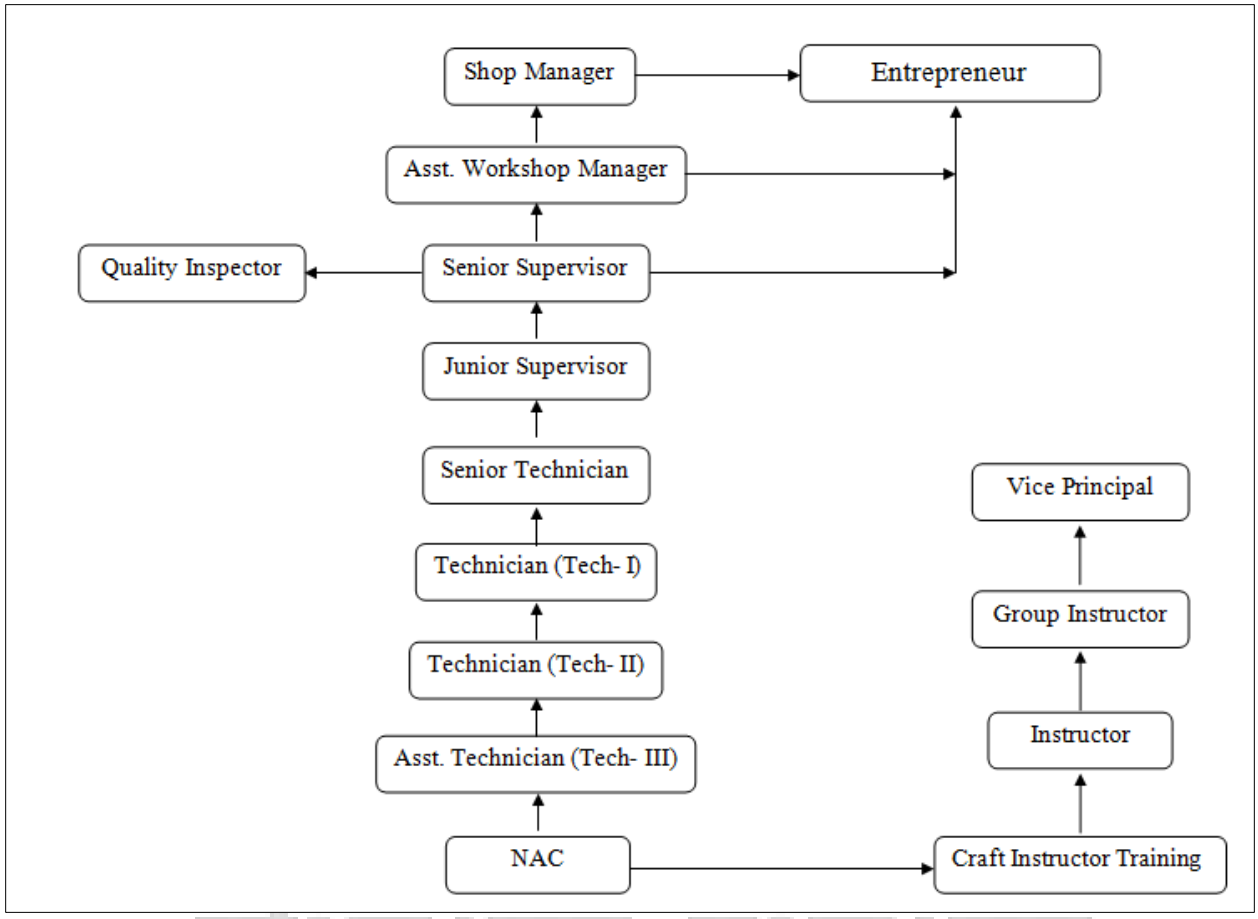
Electronic Mechanic trade under ATS is one of the most popular courses delivered nationwide through different industries. The course is of two years (02 Blocks) duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional - skills and knowledge, while Core area - Workshop Calculation and science, Engineering Drawing and Employability Skills imparts requisite core skills & knowledge and life skills. After passing out the training programme, the trainee is being awarded National Apprenticeship Certificate (NAC) by NCVT having worldwide recognition.

Broadly candidates need to demonstrate that they are able to:

- Read & interpret technical parameters/document, plan and organize work processes, identify necessary electrical and electronic materials and related tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional skill, knowledge, core skills & employability skills while performing jobs and solve problem during execution of electronic equipment manufacturing, testing and maintenance.
- Check the job/assembly as per drawing for functioning, identify and rectify errors in circuit/equipment/assembly.
- Document the technical parameters related to the task undertaken.

2.2 CAREER PROGRESSION PATHWAYS:

- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Indicative pathways for vertical mobility.



2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two years (*Basic Training and On-Job Training*) : -

Total training duration details: -

Time (in months)	1-3	4-12	13-15	16-24
Basic Training	**Block– I**	**-----**	**Block – II**	**------**
Practical Training (On - job training)	**----**	**Block – I**	**------**	**Block – II**

A. Basic Training

For 02 yrs. course (Engg. :- (**Total 06 months:** 03 months in 1st yr. + 03 months in 2nd yr.)
For 01 yr. course (Engg.) :- (**Total 03 months:** 03 months in 1st yr.)

S No.	Course Element	Total Notional Training Hours	
		For 02 Yrs. course	**For 01 Yr. course**
1.	Professional Skill (Trade Practical)	550	275
2.	Professional Knowledge (Trade Theory)	240	120
3.	Workshop Calculation & Science	40	20
4.	Engineering Drawing	60	30
5.	Employability Skills	110	55
	Total (Including internal assessment)	**1000**	**500**

B. On-Job Training:-

For 02 yrs. Course (Engg.) :-(**Total 18 months:** 09 months in 1st yr. + 09 months in 2nd yr.)

Notional Training Hours for On-Job Training: 3120 Hrs.

For 01 yr. course (Engg.) :-(**Total 12 months**)

Notional Training Hours for On-Job Training: 2080 Hrs.

C. Total training hours:-

Duration	Basic Training	On-Job Training	Total
For 02 yrs. course (Engg.)	1000 hrs.	3120 hrs.	4120 hrs.
For 01 yr. course (Engg.)	500 hrs.	2080 hrs.	2580 hrs.

2.4 ASSESSMENT & CERTIFICATION:

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

a) The **Internal assessment** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the template (Annexure – II).

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

2.4.1 PASS REGULATION

The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%. The candidate pass in each subject conducted under all India trade test.

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 assessment. Due consideration should be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude, sensitivity to 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-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work

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

Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • Below 70% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b) Weightage in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Weightage in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Brief description of Job roles:

Electronic Mechanic

Electronics Mechanic; Electronic Equipment Mechanic repairs electronic equipment, such as computers, industrial controls, radar systems, transmitters, and telemetering control systems following blueprints and manufacturer's specifications and using hand tools and test instruments. Tests faulty equipment and applies knowledge of functional operation of electronic units and systems to diagnose cause of malfunction. Tests electronic components and circuits to locate defects, using instruments, such as oscilloscopes, signal generators, ammeters and voltmeters. Replaces defective components and wiring and adjusts mechanical parts, using hand tools and soldering iron. Aligns, adjusts and calibrates testing instruments. Maintains records of repairs, calibrations and test. May install equipment in industrial or military establishments and in aircraft.

Electronics Fitter, General

Electronics Fitter, General fits, assembles and repairs various kinds of electronic equipment in factory or workshop or at place of use. Examines drawings and wiring diagrams; checks parts for accuracy of fit and minor adjustments; assembles parts or mounts them on chassis or panels with aid of hand tools; installs and connects wiring, soldering joints equipment, diagnoses faults with aid of electronic testing equipment; dismantles equipment if required and replaces faulty parts or wiring.

Electrical and Electronic Equipment Mechanics and Fitters and Related Workers, Other

Electrical and Electronic Equipment Mechanics and Fitters and Related Workers, Other include all other workers engaged in fitting, assembling, repairing and maintaining electronic and electrical equipment, machinery, appliances, etc., not elsewhere classified

Television Installation Man

Television Installation Man installs and adjusts television receivers and antennas, using hand tools. Selects antenna according to type of set and location of transmitting station. Bolts cross arms and dipole elements in position to assemble antenna. Secures antenna in place with bracket and guy wires, observing insurance codes and local ordinances to protect installation from lighting and other hazards. Drills and waterproofs holes in building to make passage for transmission line. Connects line between receiver and antenna and fastens it in place. Tunes receiver on all channels and adjusts screws to obtain desired density, linearity, focus and size of

picture. Orients antenna and installs reflector to obtain strongest possible reception. May operate radio broadcasting unit.

Cable Television Installer

Cable Television Installer installs cable television cables and equipment on customer's premises, using electrician's tools and test equipment: Measures television signal strength at utility pole, using electronic test equipment. Computes impedance of wire from pole to house to determine additional resistance needed for reducing signal to desired level. Installs terminal boxes and strings lead-in wires, using electrician's tools. Connects television set to cable system and evaluates incoming signal. Adjusts and repairs cable system to ensure optimum reception. May collect installation fees and explain cable service operation to subscriber. May communicate with SUPERVISOR, using two-way radio or telephone, to receive instructions or technical advice and to report problems to be repaired. May report unauthorized use of cable system to SUPERVISOR. May clean and maintain tools, test equipment.

Television Service and Repairman

Television Service and Repairman repairs and adjusts radios and television receivers, using hand tools and electronic testing instruments. Tunes receiver on all channels and observes audio and video characteristics to locate source of trouble. Adjusts controls to obtain desired density, linearity, focus and size of picture. Examines chassis for defects. Tests voltages and resistance of circuits to isolate defect following schematic diagram and using voltmeter, oscilloscope, signal generator and other electronic testing instruments. Tests and changes tubes, solders loose connections and repairs or replaces defective parts, using hand tools and soldering iron. Repair radios and other audio equipment. May install television sets.

Electrical and Electronic Equipment Assemblers, Other

Electronic Equipment Assemblers, Other include workers who assemble the components or parts of electronic equipment, according to strictly laid down procedures not elsewhere classified.

Reference NCO: NCO-2015:

i) 7421.0300 - Electronic Mechanic
ii) 7421.0100 - Electronics Fitter, General
iii) 7419.9900 - Electrical and Electronic Equipment Mechanics and Fitters and Related Workers, Other
iv) 7422.1100 - Television Installation Man
v) 7422.1200 - Cable Television Installer
vi) 7422.1300 - Television Service and Repairman
vii) 8212.9900 - Electrical and Electronic Equipment Assemblers, Other

4. NSQF LEVEL COMPLIANCE

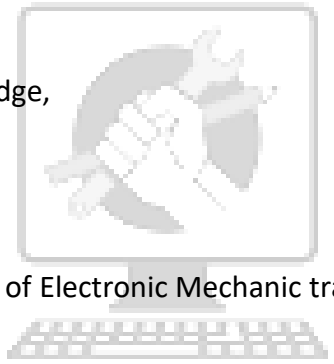
NSQF level for Electronic Mechanic trade under ATS: **Level 5**

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 and
e. Responsibility.



The Broad Learning outcome of Electronic Mechanic trade under ATS 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.

5. GENERAL INFORMATION

Name of the Trade	**ELECTRONIC MECHANIC**
NCO - 2015	7421.0300, 7421.0100, 7419.9900, 7422.1100, 7422.1200, 7422.1300, 8212.9900
NSQF Level	Level – 5
Duration of Apprenticeship Training (Basic Training + On-Job Training)	Two years (02 Blocks each of one year duration).
Duration of Basic Training	a) Block –I : 3 months b) Block – II : 3 months **Total duration of Basic Training: 6 months**
Duration of On-Job Training	a) Block–I: 9 months b) Block–II : 9 months **Total duration of Practical Training: 18 months**
Entry Qualification	Passed 10th Class with Science and Mathematics under 10+2 system of Education or its equivalent
Selection of Apprenticeship	The apprentices will be selected as per Apprenticeship Act amended time to time.
Instructors Qualification for Basic Training	As per ITI instructors qualifications as amended time to time for the specific trade.
Infrastructure for basic training	As per related trade of ITI
Examination	The internal examination/ assessment will be held on completion of each block. Final examination for all subjects will be held at the end of course and same will be conducted by NCVT.
Rebate to Ex-ITI Trainees	01 year
CTS trades eligible for Electronic Mechanic Apprenticeship	1. Electronic Mechanic

Note:

- *Industry may impart training as per above time schedule for different block, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However the flexibility should be given keeping in view that no safety aspects is compromised.*
- *For imparting Basic Training the industry to tie-up with ITIs having such specific trade and affiliated to NCVT.*

6. LEARNING OUTCOME

6.1 GENERIC LEARNING OUTCOME

The following are minimum broad Common Occupational Skills/ Generic Learning Outcome after completion of the Electronic Mechanic course of 02 years duration under ATS.

Block I & II:-

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Understand and explain different mathematical calculation & science in the field of study including basic electrical. *[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]*
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

Block – I

9. Practice and understand precautions to be followed while working in fitting jobs.
10. Prepare different types of documentation as per industrial need by different methods of recording information.
11. Perform basic mechanical workshop operation using suitable tools for fitting riveting, drilling etc., with suitable care & safety.
12. Carry out routine testing of various electrical/electronic components using proper measuring instruments where choices are clear
13. Configure, install, troubleshoot, upgrade, interconnect given computer system(s) and demonstrate &utilize application packages for different application.
14. Plan and organise the work to Simulate, monitor and analyze analog and digital circuits using Electronic simulator software and check the result.

15. Understand, Assemble, test and troubleshoot various analog circuits and apply this knowledge to troubleshoot AF amplifier of PA system, fan regulator, light dimmer circuit where choices are clear
16. Assemble various electronic circuits using SMD components and test them using suitable test equipment and perform the repair work on the PCB tracks.
17. Prepare, crimp, terminate and test various cables used in different electronics industries
18. Explain and apply working principle and demonstrate the proficiency in the constructional features of AM/FM communication receiver circuits and devices and trouble shoot them.
19. Apply appropriate rules/methods and tools to execute the work of Dismantle, trouble shoot and replace the modules of a cell phone/smart phone and assemble

Block – II

20. Understand, Assemble, test and troubleshoot the various digital circuits and apply this knowledge to troubleshoot display systems, digital clock, digital timer and Event counter
21. Flash a program into a programmable system, perform functionality test & troubleshoot the various components of it and apply the knowledge to service different domestic programmable systems
22. Explain and apply the working principle and wire various sensors of different industrial processes, test and trouble shoot by selecting appropriate test instruments and check for the accuracy
23. Plan, organize and construct various projects using analog and digital ICs and check for effectiveness of the project
24. Explain and apply working principles of SMPS, UPS and inverters and perform day to day to repair and maintenance
25. Plan and organize Installation solar panel using appropriate tools and instruments and perform day to day repair and maintenance and check for quality standard
26. Understand and explain the assembly features and working principles of various stages of LCD/LED TV, controls, trouble shoot and replace modules of the LCD/LED TV and troubleshoot the system for fault finding and check for the functionality
27. Apply appropriate rules and tools to execute the speed control of AC motors/servo motors to the drive, configure and monitor various vital motor parameters

NOTE:

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

7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
Learning Outcomes	**Assessment Criteria**
1. Recognize & comply safe working practices, environment regulation and housekeeping.	1. 1. Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	1. 2. Recognize and report all unsafe situations according to site policy.
	1. 3. Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1. 4. Identify, handle and store / dispose off dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.
	1. 5. Identify and observe site policies and procedures in regard to illness or accident.
	1. 6. Identify safety alarms accurately.
	1. 7. Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.
	1. 8. Identify and observe site evacuation procedures according to site policy.
	1. 9. Identify Personal Productive Equipment (PPE) and use the same as per related working environment.
	1. 10. Identify basic first aid and use them under different circumstances.
	1. 11. Identify different fire extinguisher and use the same as per requirement.
	1. 12. Identify environmental pollution & contribute to avoidance of same.
	1. 13. Take opportunities to use energy and materials in an environmentally friendly manner
	1. 14. Avoid waste and dispose waste as per procedure
	1. 15. Recognize different components of 5S and apply the same in the working environment.
2. Understand, explain different mathematical calculation & science in the field of study including basic electrical	2.1 Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure, heat treatment, centre of gravity, friction.
	2.2 Measure dimensions as per drawing

and apply in day to day work. *[Different mathematical calculation & science - Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]*	2.3 Use scale/ tapes to measure for fitting to specification. 2.4 Comply given tolerance. 2.5 Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials. 2.6 Ensure dimensional accuracy of assembly by using different instruments/gauges. 2.7 Explain basic electricity, insulation &earthing.
3. Interpret 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]*	3. 1. Read & interpret the information on drawings and apply in executing practical work. 3. 2. Read & analyse the specification to ascertain the material requirement, tools, and machining /assembly /maintenance parameters. 3. 3. Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
4. Select and ascertain measuring instrument and measure dimension of components and record data.	4.1 Select appropriate measuring instruments such as micrometers, vernier calipers, dial gauge, bevel protector and height gauge (as per tool list). 4.2 Ascertain the functionality & correctness of the instrument. 4.3 Measure dimension of the components & record data to analyse the with given drawing/measurement.
5. Explain the concept in productivity, quality	5.1 Explain the concept of productivity and quality tools and apply during execution of job.

tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.	5.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws. 5.3 Knows benefits guaranteed under various acts
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	6.1 Explain the concept of energy conservation, global warming, pollution and utilize the available recourses optimally & remain sensitive to avoid environment pollution. 6.2 Dispose waste following standard procedure.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	7. 1. Explain personnel finance and entrepreneurship. 7. 2. Explain role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme. 7. 3. Prepare Project report to become an entrepreneur for submission to financial institutions.
8. Plan and organize the work related to the occupation.	8. 1. Use documents, drawings and recognize hazards in the work site. 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 execution of the task effectively and monitor the same.
SPECIFIC OUTCOME	
<u>Block-I & II</u>	
*Assessment Criteria i.e. the standard of performance, for each specific learning outcome mentioned under **block – I & block – II** (section: 10) must ensure that the trainee achieves well developed skill with clear choice of procedure in familiar context. Assessment criteria should broadly cover the aspect of **Planning** (Identify, ascertain, estimate etc.); **Execution** (perform, illustration, demonstration etc. by applying 1) a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information 2) Knowledge of facts, principles, processes, and general concepts, in a field of work or study 3)Desired Mathematical Skills and some skill of collecting and organizing information, communication) and **Checking/ Testing** to ensure functionality during*	

the assessment of each outcome. The assessments parameters must also ascertain that the candidate is responsible for own work and learning and some responsibility for other's work and learning.

8. SYLLABUS

BASIC TRAINING (Block – I)

Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1.	1. Importance of trade training, List of tools & Machinery used in the trade. 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). 3. First Aid Method and basic training 4. Safety signs for Danger, Warning, caution & personal safety message 5. Preventive measures for electrical accidents & steps to be taken in such accidents. 6. Use of Fire extinguishers 7. Identification of tools &equipments as per desired specifications for marking & sawing.	All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. Job area after completion of training. Importance of safety and general precautions observed in the in the industry/shop floor. Introduction of First aid. Operation of electrical mains 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. Bench vice types, uses, care & maintenance, vice clamps. Measuring standards (English, Metric Units), Linear & angular measurements- their units. Try square, ordinary depth gauge, protractor- description, uses and cares.
2.	**Hand Tools and their uses** 8. Demonstration and uses of hand tools- screw drivers, pliers, tweezers, tester, wire stripper, electrician knife, steel rule, scriber, punches, hack saw, hammer, files, bench vice and drilling machine. 9. Simple mechanical fixtures 10. Identification of types of screws,	Identification, specifications, uses and maintenance of commonly used hand tools.

	bolts, nuts, washers, rivets, clamps, connectors 11. Fix screws of different sizes on wooden boards 12. Cutting of wooden blocks using hand/hack saw 13. Simple fitting practice and drilling practice	
3.	**Basics of AC and Electrical Cables** 14. Identify the Phase, Neutral and Earth on power Socket. 15. Use a Tester to monitor AC power. 16. Measure the voltage between phase and ground and rectify earthing. 17. Identify and test different AC mains cables. 18. Skin the electrical wires /cables using the wire stripper and cutter. 19. Prepare the mains cable for termination.	Basic terms such as electric charges, Potential difference, Voltage, Current, Resistance. Basics of AC & DC. Terms such as +ve cycle, -ve cycle, Frequency, Time period, RMS, Peak, P-P, Instantaneous value. Single phase and Three phase supply. Terms like Line and Phase voltage/ currents. Insulators, conductors and semiconductor properties. Different type of electrical cables and their Specifications. Types of wires & cables, standard wire gauge(SWG). Classification of cables according to gauge(core size), number of conductors, material, insulation strength, flexibility etc.
4.	**AC & DC measurements** 20. Identify the meter for measuring AC & DC parameters 21. Use the multi meter to measure the various functions (AC V, DC V, DC I, AC I, R) 22. Identify the different controls on the CRO front panel and observe the function of each controls 23. Identify the different controls on the function generator front panel and observe the function of each controls 24. Connect the function generator to CRO and observe the different wave forms	Introduction to electrical measuring instruments, Importance of meter, classification of meters, forces necessary to work a meter. MC and MI meter, range extension, need of calibration, characteristics of meters and errors in meters. Multi meter, use of meters in different circuits. Care and maintenance of meters. Use of CRO, Function generator, LCR meter
5	**Soldering & De-soldering and switches**	Different types of soldering guns, related to Temperature and wattages, types of

	25. Identify different types of soldering guns and practice soldering of different electronic active and passive components and IC bases on lug boards and PCBs 26. Join the broken PCB track and test 27. Demonstrate soldering and de-soldering using soldering and de-soldering stations 28. Identify and use SPST, SPDT, DPST, DPDT, tumbler, push button, toggle, piano switches used in electronic industries	tips. Solder materials and their grading. Use of flux and other materials. Selection of a soldering gun for specific requirement. Soldering and De-soldering stations and their specifications. Different switches and their specification, uses.
6 - 7	**Passive Components** 29. Identify the different types of resistors 30. Measure the resistor values using colour code and verify the reading by measuring in multi meter 31. Verify ohms law 32. Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter 33. Identify different inductors 34. Identify the different capacitors and measure capacitance of various capacitors using LCR meter 35. Dismantle and identify the different parts of a relay. 36. Connect a relay in a circuit and test for its working	Ohm's law and its variables. Resistor-definition, types of resistors, their construction & specific use, color-coding, power rating. Equivalent Resistance of series parallel circuits. Distribution of V & I in series parallel circuits. KVL& KCL with applications. Principles of induction, inductive reactance, Capacitance and Capacitive Reactance, Impedance. Types of capacitors, construction, specifications and applications. Dielectric constant. Significance of Series parallel connection of capacitors. Electromagnetic Relays, types, construction, specifications- coil voltage and contact current capacity.
8 to 10	**Computer Hardware, OS, MS office Networking** 37. Identification of various indicators, Connectors, ports on the computer cabinet 38. Identify drives and their capacity. 39. Identify various connectors and cables inside the cabinet & Identify connections to rear side and front panel of the cabinet 40. Identify various parts of the system unit and motherboard	Basic blocks of a computer, Hardware and software, I/O devices, keyboard, types of mouse and their working, Different types of printers, their function and inter-connection and their advantages HDD, CDD, DVD. Various ports in the computer. POST Booting concept.

	41. Configuring and troubleshooting display problems 42. Practice various features of OS 43. Install a Printer driver software and test for print outs 44. Install MS office software 45. Explore different Menu/Tool/ Format/status bars of MS word and practice the options: Editing the text, saving the text, changing the font and size of text. 46. Prepare a power point presentation on any three known topics with various design features 47. Invoke excel sheet from MS WORD and vice versa 48. Identify the cables and network components. 49. Making UTP cross cables and testing, Making straight cables and testing, Making cable layout drawing	
11 to 12	**Electronic circuit simulation software** 50. Prepare simple digital and electronic circuits using the software 51. Simulate and test the prepared digital and analog circuits 52. Convert the prepared circuit into a layout diagram. 53. Explore various troubleshooting and fault finding resources provided in the simulation software.	Study the library components available in the circuit simulation software. Various resources of the software.
13	**Assessment/Examination 03days**	

NOTE: -

- *More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.*

BASIC TRAINING (Block – II)

Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1 - 2	**Basic Gates and combination circuits** 54. Identify different Logic Gates (AND, OR, NAND, NOR, X-OR, X-NOR, NOT ICs) by the number printed on them and draw I/O pin-out numbers. 55. Verify the truth tables of all Logic Gate ICs by connecting switches and LEDs. 56. Construct and verify the truth table of all the gates using NAND and NOR gates 57. Use digital IC tester to test the various digital ICs (TTL and CMOS) 58. Construct Half Adder/Full adder circuit and verify the truth table. 59. Construct the Adder cum Subtractor and verify the result	Introduction to Digital Electronics. Difference between analog and digital signals, Logic families and their comparison, Logic levels of TTL and CMOS. Number systems (Decimal, binary, octal, Hexadecimal) BCD code, ASCII code and code conversions. Logic Gates and their truth tables. Combinational logic circuits such as Half Adder, Full adder, Parallel Binary adders, 2-bit and four bit full adders. Magnitude comparators. Half adder, full adder ICs and their applications for implementing arithmetic operations
3 - 5	**Flip Flops and Counters** 60. Identify different Flip-Flop (ICs) by the number printed on them 61. Verify the truth tables of Flip-Flop ICs (RS, D, T, JK, MSJK) by connecting switches and LEDs 62. Construct and test a four bit asynchronous binary counter using 7493. 63. Construct and test synchronous Decade counter. 64. Identify and test common anode and common cathode seven segment LED display using multi meter 65. Display the two digit count value on seven segment display using decoder/driver ICs. 66. Construct a shift register using RS/D/JK flip flop and verify the result 67. Construct and test four bit SIPO register 68. Construct and test four bit PIPO	Introduction to Flip-Flop. S-R Latch, Gated S-R Latch, D- Latch. Flip-Flop: Basic RS Flip Flop, edge triggered D Flip Flop, JK Flip Flop, T Flip Flop, Master-Slave flip flops and Timing diagrams, Basic flip flop applications like data storage , data transfer and frequency division. Basics of Counters, types of counters, two bit and three bit Asynchronous binary counters and decade counters with the timing diagrams. Types of seven segment display, BCD display, BCD to decimal decoder. BCD to 7 segment display circuits,

	register 69. Construct and test bidirectional shift registers	
5 - 6	**Op – Amp & Timer 555 Applications:** 70. Use analog IC tester to test the various analog ICs 71. Construction and testing of various Op-Amp circuits Inverting, Non-inverting and Summing Amplifiers 72. Construct and test Differentiator and Integrator 73. Construct and test a zero crossing detector 74. Construct and test Instrumentation amplifier 75. Construct and test a Binary weighted and R-2R Ladder type Digital-to-Analog Converters. 76. Construct and test Astable timer circuit using IC 555. 77. Construct and test mono stable timer circuit using IC 555. 78. Construct and test VCO (V to F Converter) using IC 555. 79. Construct and test 555 timers as pulse width modulator.	Block diagram and Working of Op-Amp, importance, Ideal characteristics, advantages and applications. Schematic diagram of 741, symbol, Non inverting voltage amplifier, inverting voltage amplifier, summing amplifier, Comparator, zero cross detector, differentiator, integrator and instrumentation amplifier, other popular Op-Amps. Block diagram of 555, functional description w.r.t. different configurations of 555 such as mono stable, Astable and VCO operations for various application
7 - 9	**Microcontroller (8051)** 80. Identify various ICs & their functions on the given Microcontroller Kit 81. Identify the address range of RAM & ROM. 82. Write data into RAM & observe its volatility 83. Measure the crystal frequency, connect it to the controller. 84. Identify the port pins of the controller & configure the ports for Input & Output operation 85. Connect an input switch & control a lamp using necessary program 86. Demonstrate the initialization, load & turn on a LED with delay using Timer. 87. Demonstrate the use of a Timer as an Event counter to count external events.	Introduction to 8051 Microcontroller, architecture, pin details & the bus system. Function of different ICs used in the Microcontroller Kit. Differentiate microcontroller with microprocessor. Interfacing of memory to the microcontroller. Internal hardware resources of microcontroller. I/O port pin configuration. Different variants of 8051 & their resources. Register banks & their functioning. SFRs & their configuration for different applications. Utilization of on chip resources such as ADC. Availability of assembly software & complier for 8051. Application of microcontroller in domestic, consumer & industries. Comparative study of 8051 with 8052.

	88. Demonstrate entering of simple programs, execute & monitor the results	Introduction to PIC Architecture.
10 - 12	**Sensors ,Transducers and Applications** 89. Identify sensors used in process industries such as RTDs, Temperature ICs, Thermocouples, proximity switches (inductive, capacitive and photo electric), load cells, strain gauge. LVDT by their appearance 90. Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart. 91. Measure temperature of a lit fire using RTD and record the readings referring to data chart. 92. Measure the strain of a given material using strain gauge 93. Measure the DC voltage of a LVDT 94. Detect different objectives using capacitive, inductive and photoelectric proximity sensors	Basics of passive and active transducers. Role, selection and characteristics. Working principles of RTD, PT-100 Thermocouple, Sensor voltage and current formats. Thermistors – salient features –operating range, composition, advantages and disadvantages. Thermocouples – basic principle – commonly used combinations, operating range, advantages and disadvantages. Strain gauges – principle, gauge factor, types of strain gauges. Load cell –definition, uses, working of strain gauge load cell Principle of operation of capacitive transducers,- advantages and disadvantages Principle of operation of inductive transducers,- advantages and disadvantages Principle of operation of LVDT-its advantages and disadvantages Proximity sensors – applications, working principles of eddy current , capacitive and inductive proximity sensors
13.	**Assessment/Examination 03days**	

NOTE: -

- *More emphasis to be given on video/real-life pictures during theoretical classes. Some real-life pictures/videos of related industry operations may be shown to the trainees to give a feel of Industry and their future assignment.*

DETAIL SYLLABUS OF PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

Block – I
On-Job Training

Week No.	Professional Skills
1	**Rectifiers** 1. Identify diodes, diode bridges 2. Record the specifications of different diodes using data book/ web site 3. Test the given diode using multi meter 4. Construct and test Diode as a half wave, full wave and Bridge rectifier. 5. Construct a rectifier with capacitor filter circuit and measure the output voltage 6. Use CRO to observe the ripple from rectifiers for different load and filter capacitors 7. Identify and Test Zener diode. 8. Construct and test Zener based voltage regulator circuit.
2-3	**IC Regulators** 9. Identify the different types of fixed +ve and –ve regulator ICs and the different current ratings (78/79 series) 10. Construct a fixed voltage regulator as a variable one by floating the reference 11. Observe the output voltage of different IC regulators by varying the input voltage 12. Construct a dual power supply by using the fixed IC regulators with current limiting and short circuit protection features
4-6	**Amplifier** 13. Construct and test voltage divider bias 14. Construct and Test a common emitter amplifier with and without bypass capacitors 15. Construct and Test common base amplifier 16. Construct and Test common collector/emitter follower amplifier 17. Construct and Test Darlington amplifier 18. Construct and test a two stage RC Coupled amplifier 19. Construct and test a Class B complementary push pull amplifier 20. Construct and test class C Tuned amplifier
7-8	**Oscillator :** 21. Demonstrate Colpitts oscillator, Hartley oscillator circuits 22. Construct and test a RC phase shift oscillator circuits 23. Construct and test a crystal oscillator circuits 24. Demonstrate Astable, monsotable, bistable circuits using transistors.
9-12	**Power Electronic Components** 25. Identify FET transistors and record main parameters from the Data book 26. Test the given FET using multi meter 27. Construct and test a FET Amplifier 28. Identify SCRs of different ratings and the packages

	29. Test different SCRs using a Multi meter and component tester 30. Construct a test circuit to test SCRs 31. Construct a test circuit of SCR using UJT triggering 32. Identify different heat sinks used with SCRs. 33. Construct a snubber circuit for protecting SCR use freewheeling diode to reduce back e.m.f. 34. Construct and test solid state relay. 35. Construct a jig circuit to test DIAC 36. Identify and test a TRIAC using multi meter 37. Construct a simple dimmer circuit using TRIAC 38. Identify and Test a UJT using multi meter 39. Construct UJT based free running oscillator and change its frequency.
13-14	MOSFET & IGBT: 40. Identify MOSFET by its number 41. Identify different heat sinks used with various power MOSFET devices. 42. Construct MOSFET test circuit with a small load 43. Identify IGBT by its number 44. Construct IGBT test circuit with a small load
15	**Basic SMD (2,3,4 terminal components):** 45. Identification of 2,3,4 terminal SMD components 46. De-solder the SMD components from the given PCB 47. Solder the SMD components in the same PCB 48. Check for cold continuity of PCB 49. Identification of loose /dry solder, broken tracks on printed wired assemblies
16-19	**SMD Soldering and De-soldering:** 50. Identify various connections and the setup required for SMD Soldering station 51. Identification of crimping tools for various IC packages. 52. Make the necessary settings on SMD soldering station to de-solder various ICs of different packages (at least four) by choosing proper crimping tools. 53. Make the necessary settings on SMD soldering station to solder various ICs of different packages (at least four) by choosing proper crimping tools.
20-23	**PCB Rework:** 54. Prevention of Static charges, Handling of static sensitive devices 55. Construction of Printed Circuit Boards (single, Double, multi-layer), Important tests for PCBs 56. Identify different types of soldering guns and practice soldering of different electronic active and passive components and IC bases on lug boards and PCBs

	57. Join the broken PCB track and test 58. Demonstrate soldering and de soldering using soldering and de-soldering stations 59. Familiarizations of soldering technology, use of materials like solder, flux and cleaning solvents, Usage of correct tools, Component mounting, Solderability testing, 60. Practical on Rework of through hole and surface mount soldered joints
24-38	**Electronic Cables & Connectors** 61. Identify various types of cables used for various applications viz. insulation, gauge, current capacity, flexibility etc. used in various electronics products. 62. Identify suitable connectors, solder/crimp /terminate & test the cable sets. 63. Read & follow markings on the connectors for testing the continuity of the prepared cable sets 64. The set of cables prepared should cover applications like computer, audio, video products, RF,DATA Transmission, IDE etc
29-34	**Communication electronics:** 65. Modulate and Demodulate various signals using AM and FM on the trainer kit and observe waveforms 66. Construct and test IC based AM Receiver 67. Construct and test IC based FM transmitter 68. Construct and test IC based FM Receiver 69. Dismantle the given FM receiver set and identify different stages (AM section, audio amplifier section etc) 70. Modulate and Demodulate a signal using PAM, PPM, PWM Techniques
35-38	**Cell phones** 71. Dismantle, identify the parts and assemble different types of smart phones 72. Dismantle the cell phone/smart phone replace the display 73. Dismantle the cell phone/smart phone remove the key pad and clean it, test for the continuity of the matrix/tracks 74. Interface the cell phone/smart phone to the PC and transfer the data 75. Enhance the memory capacity of the cell phone/smart phone 76. Connect internet on cell phone and browse popular web sites 77. Flash the various brands of cell phone/smart phone (at least 3) 78. Upgrade the OS 79. Format the cell phone/smart phone for virus(approach the mobile repair shop/service centre) 80. Unlock the handsets through codes and software 81. Identify the defective parts and rectify 82. Clean the water damage sets using CTC with vibrator tubs 83. Replace various faulty parts like mic, speaker, data/charging/audio jack etc.

Block – II
On-Job Training

Week No.	Professional Skills
1-4	**<u>Analog IC Applications</u>** 84. Make simple projects/Applications using ICs 741, 723, 555, 7106, 7107 Sample projects: • Laptop protector • Mobile cell phone charger • Battery monitor • Metal detector • Mains detector • Lead acid battery charger • Smoke detector • Solar charger • Emergency light • Water level controller • Door watcher (Instructor will pick up any five of the projects for implementation)
5-8	**<u>Digital IC Applications</u>** 85. Make simple projects/Applications using various digital ICs (digital display, event counter, stepper motor driver etc) • Duty cycle selector • Frequency Multiplier • Digital Mains Resumption Alarm • Digital Lucky Random number generator • Dancing LEDs • Count down timer • Clap switch • Stepper motor control • Digital clock • Event counter • Remote jammer (Instructor will pick up any five of the projects for implementation)
9-11	**<u>SMPS:</u>** 86. Dismantle the given stabilizer and find major sections/ ICs components. 87. Measure voltages at vital test points. 88. Identify various input and output sockets / connectors of the given SMPS. 89. Apply input and measure outputs using a multi meter.

	90. Test capacity of the given SMPS. 91. Identify major sections/ ICs/components of SMPS. 92. Measure / Monitor major test points of computer SMPS. 93. Identify and replace the faulty components. 94. ***Use SMPS used in TVs and PCs for Practice*** 95. Construct and test IC Based DC-DC converter for different voltages 96. Construct and test a switching step down regulator using LM2576 97. Construct and test a switching step up regulator using MC 34063
12-15	**UPS** 98. Make individual connections between batteries of battery stack and test for healthiness of batteries on stack. 99. Connect battery stack to the UPS. 100. Identify front panel control & indicators of UPS 101. Identify & practice on the use of back panel sockets & connections. 102. Connect Battery & load to UPS & test on battery mode 103. Measure battery current UPS is working on Battery Mode & measure load current 104. Open Top cover of UPS & identify isolator transformer & UPS transformer & additional circuit other than inverter 105. Identify various circuit boards in UPS and monitor voltages at various test points 106. Perform load test to measure backup time. 107. Test UPS under Fault condition & rectify fault 108. Perform all above experiment for three phase UPS
16-20	**Solar Power (Renewable Energy System)** 109. Install a solar panel to a roof. 110. Wire a solar panel to a solar controller. 111. Wire a solar controller to a battery storage station. 112. Connect storage batteries to a power inverter 113. Wire a power inverter to an electrical service panel. 114. Connect and test solar panel to the Inverter and run the load. 115. Test circuits for voltages. 116. Installation of Solar Inverter. 117. Take the trainees to the nearest solar power installation and demonstrate various aspects to cover skills as specified above.
21-26	**LCD and LED TV** 118. Identification and operate different Controls on LCD, LED TV 119. Identify various connectors provided on a LCD TV and test the healthiness. 120. Identification of components and different sector of LCD and LED TV. 121. Dismantle, Identify the parts of the remote control 122. Trace and rectify the faults of a various remote controls 123. Identify various connectors and connect the cable operator's external decoder

	(set top box) to the TV.
27-28	**Protection devices and Electrical control circuits:** 124. Identify different types of fuses along with fuse holders. 125. Wire an MCB to a motor and run it 126. Test and rectify defects associated with MCBs. 127. Connect an ELCB and test the leakage of an electrical motor control circuit. 128. Measure the coil winding resistance of the given motor 129. Prepare the setup and Control an induction motor using a DOL Starter 130. Construct a direction control circuit to change direction of an induction motor 131. Connect an overload relay and test for its proper functioning.
29-32	**AC Drives** 132. Study the AC Drive set up and its connections 133. Identify different cables and connectors used in the AC DRIVE setup 134. Identify various input and output terminals of the DRIVE unit, Operator panel and display unit. 135. Familiarization with PMU & different terminals of Micro – Master AC Drive 136. Demonstration – Access parameter number & values 137. Familiarization with parameters 138. Parameter values for various operation 139. Commissioning parameter numbers and values 140. Installation of AC Drive(similar to SIEMENS MM-420/440) 141. Familiarization with:- Commissioning & Quick Commissioning(similar to SIEMENS MM-420/440) 142. Reset to default value / Factory setting values 143. MM Drive Programming /Parameterization for different control operations- 144. ON/OFF, Forward/Reverse, Jog (R)/Jog (L), braking and speed control
33-36	**Servo Motor** 145. Construct a simple circuit to control servo motor using IC 555. 146. Connect servo motor with drive & control its parameters. 147. Connect servo motor to computer for monitoring & controlling of various parameters. 148. Parameter programming of servo motor 149. Various control method for controlling velocity & torque.
37-38	150. Identify an area within the Industry where IoT concepts can be applied . 151. Identify the components of Raspberry Pi micro computer and learn the differences with regular desktops. 152. Wire a Raspberry Pi components, set up ,log-in, and load the graphical user interface. 153. Open and Close some applications 154. Design, Estimate cost and construct a simple IoT project (eg. Weather station)

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

Block – I		
Sl. No.	**Workshop Calculation and Science (Duration: - 20 hrs.)**	**Engineering Drawing (Duration: - 30 hrs.)**
1.	**Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units	**Engineering Drawing: Introduction and its importance** - Viewing of engineering drawing sheets. - Method of Folding of printed Drawing Sheet as per BIS SP:46-2003
2.	**Fractions**: Fractions, Decimal fraction, Addition, Subtraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Calculator.	**Drawing Instruments : their uses** Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.
3.	**Properties of Material** : properties - Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous Alloys.	**Lines :** - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line Methods of Division of line segment
4.	**Average :** Problems of Average. **Ratio &Proportion** : Simple calculation on related problems.	**Drawing of Geometrical Figures:** Drawing practice on: - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.
5.	**Mass, Weight and Density**: Mass, Unit of Mass, Weight, difference between mass and weight, Density,	**Dimensioning:** - Definition, types and methods of dimensioning (functional, non-functional

	unit of density.	and auxiliary) - Types of arrowhead - Leader Line with text
6.	**Percentage**: Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	**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.
7.	- Forces definition. - Definition and example of compressive, tensile, shear forces, axial and tangential forces. Stress, strain, ultimate strength, factor of safety for MS. **Speed and Velocity**: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation.	**Method of presentation of Engineering Drawing** - Pictorial View - Orthogonal View - Isometric view
8.	**Mensuration:** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle. Volume of solids – cube, cuboids, cylinder and Sphere. Surface area of solids – cube, cuboids, cylinder and Sphere. - Area of cut-out regular surfaces: circle and segment and sector of circle. - Volume of cut-out solids: hollow cylinders, frustum of cone, block section. - Volume of simple solid blocks.	**Symbolic Representation (as per BIS SP:46-2003) of :** - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints. - Electrical and electronics element - Piping joints and fittings
9.	**Algebra** : Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables). - Circular Motion: Relation between circular motion and Linear motion, Centrifugal force, Centripetal force.	**Dimensioning practice:** - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance.
10.	**Work, Power and Energy**: work, unit of work, power, unit of power, Horse	**Construction of Geometrical Drawing Figures:** - Polygons and their values of included

	power, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	angles. Conic Sections (Ellipse)
11.		**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. Drawing of Orthographic projection from isometric/3D view of blocks

Block – II		
Sl. No.	**Workshop Calculation and Science (Duration: - 20 hrs.)**	**Engineering Drawing (Duration: - 30 hrs.)**
1.	**Trigonometry:** Trigonometric ratios, Trigonometric tables. - Finding the value of unknown sides and angles of a triangle by Trigonometrical method. - Finding height and distance by trigonometry.	- Machined components; concept of fillet & chamfer; surface finish symbols.
2.	**Friction** and its application in Workshop practice.	- Screw thread, their standard forms as per BIS, external and internal thread, conventions on the features for drawing as per BIS.
3.	**Heat & Temperature**: Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.	- Reading & interpretation of assembly drawing and detailing.
4.	**Basic Electricity**: Introduction, use of electricity, Types of current_ AC, DC, their comparison, voltage, resistance, their units. Conductor, insulator, Types of connections – series, parallel, electric power, Horse power, energy, unit of electrical energy. Concept of earthing.	- Reading of drawing. Simple exercises related to missing lines, dimensions and views. How to make queries.
5.	**Heat treatment** – Necessity, different common types of Heat treatment.	- Simple exercises related to trade related symbols. - Solution of NCVT test papers.
6.	**Graph:** - Read images, graphs, diagrams bar chart, pie chart. - Graphs: abscissa and ordinates, graphs of straight line, related to two sets of varying quantities.	
7.	**Transmission of power:** By belt, pulleys & gear drive.	
8.	**Concept of pressure** – units of pressure, atmospheric pressure, gauge pressure – gauges used for measuring pressure. **Introduction to pneumatics & hydraulics systems.** Solution of NCVT test papers	

9.2 EMPLOYABILITY SKILLS

(DURATION: - 110 HRS.)

Block – I (Duration – 55 hrs.)	
1. English Literacy	Marks : 09 Duration : 20 Hrs.
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. I.T. 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
Block – II **Duration – 55 hrs.**	
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, Vibroacoustic Hazards, 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.

10. DETAILS OF COMPETENCIES (ON-JOB TRAINING)

The **competencies/ specific outcomes** on completion of On-Job Training are detailed below: -

Block – I

1. Practice and understand precautions to be followed while working on Electronics related jobs.
2. Prepare different types of documentation as per industrial need by different methods of recording information.
3. Identify and test Diode, Diode bridge & Zener diode
4. Construct and test rectifier and voltage rectifier circuits using multimeter and CRO
5. Identify, construct and test IC based voltage regulators
6. Construct, test and compare various types of amplifiers
7. Construct, test and compare various types of oscillators
8. Identify and test power electronic components and construct circuits
9. Identify and test MOSFET & IGBT and construct circuits
10. Identify, test and construct circuits using SMD components
11. Assemble components, solder, de-solder, wire and rework on PCBs
12. Identify and connect electronic cable and connectors
13. Construct and test communication transmitters and receivers
14. Dismantle, repair and reconstruct cell phones

Block – II

15. Identify, test and construct circuits using analog ICs
16. Construct, test and service SMPS used in TVs and PCs
17. Install and test UPS along with Battery & loads; troubleshoot and rectify faults
18. Install, test, troubleshoot and rectify faults in a Solar Power renewable energy system
19. Install, test, troubleshoot and rectify faults in LCD an d LED TVs
20. Identify, test, connect and troubleshoot Protection devices and electrical control devices
21. Install, test and troubleshoot AC drives
22. Identify, test and construct circuit to control Servomotors
23. Identify components of IoT, construct and test its application circuits

Note:

- Industry must ensure that above mentioned competencies are achieved by the trainees during their on job training.
- In addition to above competencies/ outcomes industry may impart additional training relevant to the specific industry.

ANNEXURE – I

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

ELECTRONIC MECHANIC			
LIST OF TOOLS AND EQUIPMENT for Basic Training (For 20 Apprentices)			
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-18 is required additionally)			
Sl. no.	**Name of the Tool &Equipments**	**Specification**	**Quantity**
1	Connecting screwdriver	100 mm	10 Nos
2	Neon tester	500 V	6 Nos
3	Screw driver set	set of 5	10 Nos
4	Insulated combination pliers	150 mm	6 Nos
5	Insulated side cutting pliers	150 mm	8 Nos
6	Long nose pliers	150 mm	6 Nos
7	Soldering iron	25 W. 240 V	10 Nos
8	Electrician knife		6 Nos
9	Tweezers	100mm	10 Nos
10	Digital Multimeter	3 ½ digit	10 Nos
11	Soldering Iron Changeable bits	10 W	6 Nos
12	De- soldering pump		10 Nos
B : INSTRUMENTS & GENERAL SHOP OUTFIT			
13.	Steel rule	300mm	4 Nos
14.	Steel measuring tape-	3 m	4 Nos
15.	Tools makers vice	100mm (clamp)	1 Nos

ELECTRONIC MECHANIC

16.	Tools maker vice	50mm (clamp)	1 Nos
17.	Crimping tool (pliers)		2 Nos
18.	Magneto spanner set		2 Nos
19.	File flat bastard	200mm	2 Nos
20.	File flat second cut	200mm	2 Nos
21.	File flat smooth	200mm	2Nos
22.	flat pliers	100mm	4 Nos
23.	Round Nose pliers	100mm	4 Nos
24.	Scriber straight	150mm	2 Nos
25.	Hammer ball pen	0.5Kg	1 No
26.	Allen key set (set of 9)		1 No
27.	Tubular box spanner (set of 6Nos)		1 set
28.	Magnifying lenses	75mm	2 Nos
29.	Continuity tester		6 Nos
30.	Hacksaw frame adjustable		2 Nos
31.	Cold chisel	20mm	1 No
32.	Scissors	200mm	1 No
33.	Handsaw	450mm	1 No
34.	Hand Drill Machine		2 Nos
35.	First aid kit		1 No
36.	Fire Extinguisher		2 Nos
37.	Bench Vice		1 No
38.	Dual DC regulated power supply	30-0-30 V, 2 Amps	4 Nos

ELECTRONIC MECHANIC

39.	DC regulated variable power supply	0-24 V, 1Amp	2 Nos
40.	LCR meter (Digital)		1 No
41.	CRO	Dual Trace 20 MHz (component testing facilities)	2 Nos
42.	Signal Generator,	0-100 KHz	2 Nos
43.	Analog multimeter		4 Nos
44.	Function generator (Triangular, square and sine wave)		2 Nos
45.	Or ELECTRONIC WORK BENCH Instead of sl no's (26,27,29,31,34)		2 Nos
46.	Dimmer start	3 Amps	2 Nos
47.	Analog Component Trainer		4 Nos
48.	Op Amp trainer		3 Nos
49.	Digital IC Trainer		4 Nos
50.	Digital IC Tester		1 No
51.	Digital and Analog Bread Board Trainer		6 Nos
52.	Rheostats various values and ratings		2 Nos
53.	Computers in the assembled form (including cabinet, motherboards, HDD, DVD, SMPS, Monitor, KB, Mouse, LAN card, Blu-Ray drive and player), MS Office education version.		4 Nos
54.	Laptops latest configuration		1 No
55.	Laser jet Printer		1 No
56.	INTERNET BROADBAND CONNECTION		1 No
57.	Electronic circuit simulation software with 6 user licenses		1 No

ELECTRONIC MECHANIC

58.	Different types of Analog electronic components, digital ICs, power electronic components, general purpose PCBs, bread board, MCB, ELCB etc		As required
59.	Digital ICs, analog ICs, general purpose PCBs, bread board		As required
60.	8051 micro controller kit with any 6 application module		4 nos
61.	Sensors trainer kit		2 nos
62.	POWER ELECTRONICS TRAINER with at least 6 no's of onboard applications		4 Nos
63.	Different types of electronic and electrical cables, connectors, sockets, terminations.		As required
64.	Tacho meter		4Nos
65.	Soldering station for SMD soldering with different bits		2 Nos
66.	Induction motor with DOL starter 0.5 hp		2 Nos
67.	UPS trainer kit		2 Nos
68.	Solar panel with solar inverter and battery	1 KVA	1 set
69.	AC drive		2 Nos
70.	Servo drive with motor		2 Nos
71.	Raspberry Pi B+ complete kit		1 No
72.	Fibre optic trainer kit		1 No
73.	Meggar		1 No
74.	Various crimping tools for cable harness		1 No each

75.	LCD/LEDTV	32”	1 No each
76.	LCD/LED TV trainer		1 no
C : WORKSHOP FURNITURE			
77.			
78.	Instructor’s table		1 No
79.	Instructor’s chair		2 Nos
80.	Metal Rack,	100cm x 150cm x 45cm	4 Nos
81.	Lockers with 16 drawers	standard size	2 Nos
82.	Steel Almirah,	2.5 m x 1.20 m x 0.5 m	2 Nos
83.	Black board/white board	1	2 No

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: ELECTRONIC MECHANIC
LIST OF TOOLS& EQUIPMENTS FOR -20APPRENTICES

1) **Space Norms** : 45 Sq. m.(For Engineering Drawing)

2) Infrastructure:

A : TRAINEES TOOL KIT:-			
Sl. No.	**Name of the items**	**Specification**	**Quantity**
1.	Draughtsman drawing instrument box		20+1 set
2.	Set square celluloid 45^o (250 X 1.5 mm)		20+1 set
3.	Set square celluloid 30^o-60^o (250 X 1.5 mm)		20+1 set
4.	Mini drafter		20+1 set
5.	Drawing board (700mm x500 mm) IS: 1444		20+1 set
B : Furniture Required			
Sl. No.	**Name of the items**	**Specification**	**Quantity**
6.	Drawing Board		20
7.	Models : Solid & cut section		as required
8.	Drawing Table for trainees		as required
9.	Stool for trainees		as required
10.	Cupboard (big)		01
11.	White Board (size: 8ft. x 4ft.)		01
12.	Trainer's Table		01
13.	Trainer's Chair		01

ELECTRONIC MECHANIC

TOOLS & EQUIPMENTS FOR EMPLOYABILITY SKILLS		
Sl. 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**	**10 Nos.**
2.	**UPS - 500VA**	**10 Nos.**
3.	**Scanner cum Printer**	**1 No.**
4.	**Computer Tables**	**10 Nos.**
5.	**Computer Chairs**	**20 Nos.**
6.	**LCD Projector**	**1 No.**
7.	**White Board 1200mm x 900mm**	**1 No.**
Note: - Above Tools & Equipments not required, if Computer LAB is available in the institute.		

ANNEXURE-II

FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor :			**Year of Enrollment :**
Name & Address of ITI (Govt./Pvt.) :			**Date of Assessment :**
Name & Address of the Industry :			**Assessment location: Industry / ITI**
Trade Name :	**Semester:**		**Duration of the Trade/course:**
Learning Outcome:			

Sl. No	**Candidate Name**	**Father's/Mother's Name**	Safety consciousness	Workplace hygiene	Attendance/ Punctuality	Ability to follow Manuals/ Written instructions	Application of Knowledge	Skills to handle tools & equipment	Economical use of materials	Speed in doing work	Quality in workmanship	VIVA	**Total internal assessment Marks**	**Result (Y/N)**
Maximum Marks (Total 100 Marks)			**15**	**5**	**10**	**5**	**10**	**10**	**5**	**10**	**15**	**15**		
1														
2														