CURRICULUM

FOR THE TRADE OF

ELECTRONICS MECHANIC

UNDER

APPRENTICESHIP TRAINING SCHEME (ATS)

सत्यमेव जयते
Government of India

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

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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. RATIONALE

(Need for Apprenticeship in Electronics Mechanic trade)

The Indian Electronics and IT Hardware sector has 6 key segments, namely Consumer Electronics, Industrial Electronics, IT Hardware, Telecommunication Equipment, Electronic Components, and Strategic Electronics. Consumer Electronics and Telecom Equipments are the largest segments with about 27% share each in total production. Electronic Manufacturing Services (EMS) and R&D based exports will also be a major driver of growth in the industry. Increased value-addition in these areas will further drive demand for production as well as sales, services, and after-sales support, which will have major implications on the demand for skilled human resources. It is expected that the Indian Electronics and IT Hardware manufacturing industry can target up to US $ 155 billion in revenues in the next 8 to 10 years. This would translate to the overall employment in the industry increasing from the current level of 0.9 million to over 4 million by 2022. That is, an incremental human resource requirement of about 3 million to 3.2 million. Therefore it is necessary that youth should be trained on the relevant skills to take advantage of this opportunity.

3. JOB ROLES: REFERENCE NOS & NCO

Brief description of job roles:

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.

Electronics Fitter, other include all other workers engaged in fitting, assembling, repairing and maintaining electronic equipment, machinery, appliances, etc., not elsewhere classified.

Electronics Mechanic; Electronic Equipment Mechanic repairs electronic equipment, such as computers, industrial controls, radar systems, transmitters and tele-metering 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.

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 ordnances 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 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 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.

Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and productivity.

Reference NCO & NOS:

1. 7242.10
2. 7242.90
3. 7243.10
4. 7243.40
5. 7243.45
6. 8283.90

Qualification Pack (QP) with no of NOS and NSQF Level:-

ELE/Q0115,ELE/ N0115, ELE/N9911, ELE/N9921
ELE/Q0111, ELE/ N0111, ELE/N9912, ELE/N9919, ELE/N9920,
ELE/Q0105, ELE/N0103,ELE/N9919,ELE/N9920
ELE/Q4601, ELE/N4601,ELE/N4602,ELE/N4603,ELE/N0009
ELE/Q8104, ELE/N8106, ELE/N8107, ELE/N9901,,ELE/N9910
ELE/Q5101, ELE/ N0115, ELE/N99110, ELE/N9921
ELE/Q7201, ELE/N6301,ELE/N9971,ELE/N9972
ELE/Q 7303, ELE/ N7306, ELE/N9962, ELE/N9963
ELE/Q7403, ELE/N7407, ELE/N9963, ELE/N9962, E/N9963
ELE/Q3701, ELE/ N7306, ELE/N9962, ELE/N9963
ELE/Q5901, ELE/ N5901, ELE/N5902, ELE/N9952, ELE/N9953
ELE/Q 3101, ELE/N3101, ELE/N 001, ELE/N 0002
ELE/Q 3502, ELE/N 3508, ELE/N 3509, ELE/N 0002, ELE/N 0003
ELE/Q 4606, ELE/N 4601, ELE/N 4602, ELE/N 4613, ELE/N 9909

4. LEARNING OUTCOMES

A. GENERIC OUTCOME

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Work in a team, understand and practice soft skills, technical English to communicate with required clarity.
3. Explain the concepts and principles of basic arithmetic, algebraic, trigonometric and apply knowledge of specific areas to perform practical operations which requires well developed skills
4. Understand and explain basic electrical and material sciences and apply the knowledge.
5. Read and apply engineering drawing for different application in the field of work.
6. Understand and explain the concept in productivity, quality tools, labour & welfare legislation and apply such in day to day work to improve productivity and quality.
7. Explain the general concept and process of energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
8. Explain personnel finance management, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
9. Apply the general concept of basic computer, basic operating system and uses of internet services to take benefit of IT developments in the industry.

SPECIFIC OUTCOME

Block I

10. Perform basic mechanical workshop operation using suitable tools for fitting riveting, drilling etc., with suitable care & safety.
11. Carry out routine testing of various electrical/electronic components using proper measuring instruments where choices are clear
12. Configure, install, troubleshoot, upgrade, interconnect given computer system(s) and demonstrate & utilize application packages for different application.
13. Plan and organise the work to Simulate, monitor and analyze analog and digital circuits using Electronic simulator software and check the result.
14. 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
15. Assemble various electronic circuits using SMD components and test them using suitable test equipment and perform the repair work on the PCB tracks.
16. Prepare, crimp, terminate and test various cables used in different electronics industries
17. 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.
18. 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

19. Understand, Assemble, test and troubleshoot the various digital circuits and apply this knowledge to troubleshoot display systems, digital clock, digital timer and Event counter
20. 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
21. 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
22. Plan, organize and construct various projects using analog and digital ICs and check for effectiveness of the project
23. Explain and apply working principles of SMPS, UPS and inverters and perform day to day to repair and maintenance
24. Plan and organize Installation solar panel using appropriate tools and instruments and perform day to day repair and maintenance and check for quality standard
25. 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
26. 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. Each learning outcome may include multiple assessment components. However assessment will be carried out as per assessable outcome and assessment criteria.

5. NSQF LEVEL COMPLIANCE

NSQF level for Electronics Mechanic 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 Electronics 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 problems 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. GENERAL INFORMATION

1. **Name of the Trade : ELECTRONICS MECHANIC**

2. **N.C.O. / N. O. S. Code No.** :7242.10,7242.90,7243.10,7243.40,7243.45,8283.90

ELE/Q0115,ELE/ N0115, ELE/N9911, ELE/N9921
ELE/Q0111, ELE/ N0111, ELE/N9912, ELE/N9919,
ELE/N9920,ELE/Q0105, ELE/N0103,ELE/N9919,ELE/N9920
ELE/Q4601, ELE/N4601,ELE/N4602,ELE/N4603,ELE/N0009,
ELE/Q8104, ELE/N8106, ELE/N8107, ELE/N9901,,ELE/N9910
ELE/Q5101, ELE/ N0115, ELE/N99110, ELE/N9921
ELE/Q7201, ELE/N6301,ELE/N9971,ELE/N9972
ELE/Q 7303, ELE/ N7306, ELE/N9962, ELE/N9963
ELE/Q7403, ELE/N7407, ELE/N9963, ELE/N9962, E/N9963
ELE/Q3701, ELE/ N7306, ELE/N9962, ELE/N9963
ELE/Q5901, ELE/ N5901, ELE/N5902, ELE/N9952, ELE/N9953
ELE/Q 3101, ELE/N3101, ELE/N 001, ELE/N 0002
ELE/Q 3502, ELE/N 3508, ELE/N 3509, ELE/N 0002, ELE/N 0003, ELE/Q 4606, ELE/N 4601, ELE/N 4602, ELE/N 4613, ELE/N 9909

3. **Duration of Apprenticeship Training (Basic Training + Practical Training):** 2 years

4. **Duration of Basic Training**: -

a) Block –I :3 months

b) Block – II :3 months

Total duration of Basic Training: 6 months

5. **Duration of Practical Training (On -job Training): -**

a) Block–I: 9 months

b) Block–II : 9 months

Total duration of Practical Training: 18 months

6. **Entry Qualification** : Passed 10th Class under 10+2 System of Education or its equivalent

7. **Selection of Apprentices:** The apprentices will be selected as per Apprenticeship Act amended time to time.

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.

7. COURSE STRUCTURE

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

Components of Training	Duration of Training in Months →																							
↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Basic Training Block - I																								
Practical Training Block - I																								
Basic Training Block - II																								
Practical Training Block - II																								

8. ASSESSABLE OUTCOME/ LEARNING OUTCOME WITH ASSESSMENT CRITERIA

Competencies after completion of 02 years ELECTRONICS MECHANIC trade:

GENERIC ASSESSABLE OUTCOME

ASSESSABLE OUTCOMES	REFERENCE SYLLABI	ASSESSMENT CRITERIA
1. Recognize & comply safe working practices, environment regulation and housekeeping.	• Basic training Block I Week. no 1 Basic Practical 9.1.2. Week no. 1	1.1 Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements and according to site policy.
		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 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 the avoidance of instances of environmental pollution.
		1.13 Deploy environmental protection legislation & regulations
		1.14 Take opportunities to use energy and materials in an environmentally friendly manner
		1.15 Avoid waste and dispose waste as per procedure
		1.16 Recognize different components of 5S and apply the same in the working environment.
2. Work in a team,	• Basic training	2.1 Obtain sources of information and recognize

understand and practice soft skills, technical English to communicate with required clarity.	(9.1.1.C) Employability skills Block I	information.
		2.2 Use and draw up technical drawings and documents.
		2.3 Use documents and technical regulations and occupationally related provisions.
		2.4 Conduct appropriate and target oriented discussions with higher authority and within the team.
		2.5 Present facts and circumstances, possible solutions & use English special terminology.
		2.6 Resolve disputes within the team
		2.7 Conduct written communication.
3. Explain the concepts and principles of basic arithmetic, algebraic, trigonometric and apply knowledge of specific areas to perform practical operations which requires well developed skills	• Basic training (9.1.1) Core skills Block I & II	3.1 Terminal examination to test basic skills on arithmetic, algebra and trigonometry.
		3.2Their applications will also be assessed during execution of assessable outcome and also tested during theory and practical examination.
4 Understand and explain basic electrical and material sciences and apply the knowledge.	• Basic training (9.1.1) Core skills Block I & II	4.1 Terminal examination to test basic skills on science in the field of study including basic electrical and hydraulics & pneumatics.
		4.2 Their applications will also be assessed during execution of assessable outcome and also tested during theory and practical examination.
5. Read and apply engineering drawing for different application in the field of work.	• Basic training (9.1.1) Core skills Block I & II	5.1 Terminal examination to test basic skills on engineering drawing.
		5.2 Their applications will also be assessed during execution of assessable outcome and also tested during theory and practical examination.
6. Explain the knowledge of general concept, principles of productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality..	• Basic training (9.1.1.C) Employability skills Block II	6.1 Terminal examination to test the concept in productivity, quality tools and labour welfare legislation.
		6.2 Their applications will also be assessed during execution of assessable outcome.
7. Explain the general concept and process of energy conservation, global	• Basic training (9.1.1.C) Employability skills	7.1 Terminal examination to test knowledge on energy conservation, global warming and pollution. 7.2 Their applications will also be assessed during execution of assessable outcome.

warming and pollution and contribute in day to day work by optimally using available resources.	Block II	
8. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	• Basic training (9.1.1.C) Employability skills Block II	8.1 Terminal examination to test knowledge on personnel finance, entrepreneurship. 8.2 Their applications will also be assessed during execution of assessable outcome.
9. Apply the general concept of basic computer, basic operating system and uses of internet services to take benefit of IT developments in the industry.	• Basic training (9.1.1.C) Employability skills Block II	9.1 Terminal examination to test knowledge on basic computer working, basic operating system and uses internet services. 9.2 Their applications will also be assessed during execution of assessable outcome.

SPECIFIC ASSESSABLE OUTCOME:

Block-I

ASSESSABLE OUTCOME	REFERENCE SYLLABI	ASSESSMENT CRITERIA
10. Perform basic mechanical workshop operation using suitable tools for fitting riveting, drilling etc., with suitable care & safety..	• Basic training (9.1.2) Block I Week No 1 -2	10.1 Identify basic hand tools for fitting, riveting, drilling etc. with due care and safety.
		10.2 Mark according to drawing
		10.3 File the job using different methods and perform filing in accordance with standard specification and tolerances
		10.4 Practice on fixing surface mounting type of accessories.
		10.5 follow relevant legislation, industry guidelines and enterprise polices/ procedures
		10.6 measure all dimensions in according to standard specification

11 Carry out routine testing of various electrical/electronic components using proper measuring instruments where choices are clear	• Basic training (9.1.2) Block I Week No 3 -7	11. 1 Ascertain and select tools and materials for the job and make this available for use in a timely manner
		11. 2 Plan work in compliance with standard safety norms.
		11. 3 Demonstrate and apply the connection of electrical accessories.
		11. 4 Wire up of a test board and test it.
		11.4 Measure the voltage between phase and ground and rectify earthing.
		11.5 Identify and test different AC mains cables.
		11.6 Select the proper tip of the soldering gun, clean the surface to which the component is to be soldered
		11.7 Apply flux to solder wire heat the contact points to be soldered and apply solder wire select program
		11.8 Use solder approved under restriction of hazardous substances (RoHS)
		11.9 Identify and use SPST, SPDT, DPST, DPDT, tumbler, push button, toggle, piano switches used in electronic industries
		11.10 Identify the different types of resistors and identify the power rating of the resistor
		11.11 Measure the resistor values using colour code and verify the reading by measuring in multi meter.
		11.12 Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter.
		11.13 Identify different inductors, capacitor and measure the values using LCR meter.
		11.14 Dismantle and identify the different parts of a relay.
		11.15 Connect a relay in a circuit and test for its working
12 Configure, install, troubleshoot, upgrade, interconnect given	• Basic training (9.1.2) Block I	12. 1 Ascertain, select tools and materials for the job and make this available for use in timely manner

computer system(s) and demonstrate & utilize application packages for different application.	Week No 8 -10	12. 2 Plan, work in compliance with standard safety norms
		12.3 Identification of various indicators, Connectors, ports on the computer rear and front side of the cabinet
		12.4 Identify drives and their capacity
		12.2 Identify various parts of the system unit and cables and connectors in the motherboard
		12.3 Practice various features of OS
		12.4 Install various driver software and take a print outs
		12.5 Install MS office software
		12.6 Explore different operation Tools of MS word and practice the options: Editing the text, saving the text, changing the font and size of text. And prepare a document using the above tools.
		12.7Rearrange the existing document as per the requirement
		12.8Prepare a power point presentation on
		12.9 any three known topics with various design features
		12.10 Rearrange the existing power point presentation as per requirement(template, animation, design)
		12.11 Import and export data's from various MS office package
		12.12 Identify the network cables, tools, testers and components.
		12.13 Make lay out drawing for network connection, make straight cable and UTP cross cables
		12.14 Prepare a network connection, configure the systems and communicate among them
		12.15 Avoid e- waste and dispose the waste as per the procedure
13. Plan and organise the work to Simulate, monitor and analyze analog and digital circuits using	• Basic training (9.1.2) Block I Week No 11 -12 • Basic training	13. 1 Plan the work incompliance with standard procedure 13. 2 Prepare simple analog and digital electronic circuits using the simulator software 13. 3 Simulate and test the prepared analog

Electronic simulator software and check the result.	(9.2.1) Block II Week No 1- 6	and digital circuits 13. 4 Understand and interpret the simulation tools for correct application 13. 5 Convert the prepared circuit into layout diagram 13. 6 Explore various trouble shooting and fault finding the resources provided in the simulation software
14. 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	• On job training (9.2.1) Block I Week No 1- 14	14.1 Ascertain and select tools and instruments for carrying out the jobs 14.2 Plan and work in compliance with standard safety norms 14.3 Practice on soldering components on lug board with safety. 14.4 Identify the passive /active components by visual appearance, Code number and test for their condition. 14.5 Identify diodes, diode bridges, zener diode and record the specifications of different diodes using data book/ web site 14.6 Test the given diode using multi meter 14.7 Construct and test Diode as a half wave, full wave and Bridge rectifier. 14.8 Construct a rectifier with capacitor filter circuit and measure the output voltage use CRO to observe the ripple from rectifiers for different load and filter capacitors 14.9 Construct and test Zener based voltage regulator circuit. 14.10 Identify the different types of fixed +ve and –ve regulator ICs and the different current ratings (78/79 series) 14.11 Construct a fixed voltage regulator as a variable one by floating the reference 14.12 Observe the output voltage of different IC regulators by varying the input voltage 14.13 Construct a dual power supply by using the fixed IC regulators with current limiting and short circuit protection features 14.14 Construct and test of Transistor and JFET amplifiers, 14.15 Construct and test LC oscillators circuits 14.16 Construct and test multivibators circuits .

		14.17 Construct and test a UJT as relaxation oscillator 14.18 Construct and test lamp dimmer using TRIAC/DIAC with safety. 14.19 Construct and test MOSFET, IGBT test circuit and apply for suitable operation with proper safety 14.20 Construct and test the universal motor speed controller using SCR with safety
15. Assemble various electronic circuits using SMD components and test them using suitable test equipment and perform the required repair work on the PCB tracks.	• On job training (9.2.1) Block I Week No 15- 23	15. 1 Ascertain and select tools and materials for the job and make this available for use in a timely manner. 15. 2 Comply with standard health and safety procedure followed in the company while handlings an equipment and hazardous materials and tools or situations 15. 3 Identification of crimping tools for various IC packages. 15. 4 Make the necessary settings on SMD soldering station to de-solder and solder various ICs of different packages (at least four) by choosing proper clamping tools. 15. 5 Solder and De-solder various SMD ICs on practice boards. 15. 6 Join the broken PCB track and test 15. 7 Familiarizations of soldering technology, use of materials like solder, flux and cleaning solvents, Usage of correct tools, Component mounting, Solderability testing 15. 8 Practice on Rework of through hole PCB's. 15. 9 Practice on surface mount soldered joints
16 Prepare, crimp, terminate and test various cables used in different electronics industries	• On job training (9.2.1) Block I Week No 24- 28	16.1 Ascertain and select tools and materials for the job and make this available for use in a timely manner. 16.2 Plan and work incompliance with standard safety norms 16.3 Prepare, terminate and test various electronics cable using proper crimping tools 16.4 Test the cable prepared by connecting them in the various electronics instruments

		16.5 Check accuracy/ correctness of job using appropriate equipment/gauge 16.6 Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
17.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.	• On job training (9.2.1) Block I Week No 29- 34	17.1 Ensure clean, neat , dust free and organized working environment 17.2 Ensure the selection of tools, equipment and testing devices in calibrated conditions 17.3 Modulate and Demodulate various signals using AM and FM on the trainer kit and observe waveforms 17.4 Construct and test IC based AM Receiver 17.5 Construct and test IC based FM transmitter and receiver 17.6 Modulate and Demodulate a signal using PAM,PPM,PWM Techniques 17.7 Troubleshoot modulator and demodulator circuits and replace the faulty components 17.8 Demonstrate possible solutions in case of defect and agree tasks within the team for repair or replacement.
18. 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	• On job training (9.2.1) Block I Week No 35- 38	18.1 Understand and interpret repair procedure as per manual of cell-phone and select appropriate tools & equipment for undertaking the job. 18.2 Take anti static precautions before work and wear ESD wrist straps or aprons 18.3 Maintain zero material defect during material handling by following standard operating procedure 18.4 Dismantle, identify the parts and assemble different types of smart phones 18.5 Dismantle the cell phone/smart phone replace the display 18.6 Dismantle the cell phone/smart phone remove the key pad and clean it, test for the continuity of the matrix/tracks 18.7 Replace various faulty parts like mic, speaker, data/charging/audio jack etc 18.8 Interface the cell phone/smart phone to the PC and transfer the data 18.9 Enhance the memory capacity of the

		cell phone/smart phone 18.10 Connect internet on cell phone and browse popular web sites 18.11 Flash the various brands of cell phone/smart phone (at least 3) 18.12 Format the cell phone/smart phone for virus(approach the mobile repair shop/service centre) 18.13 Unlock the handsets through codes and software 18.14 Clean the water damage sets using CTC with vibrator tubs

Block-II

ASSESSABLE OUTCOME	REFERENCE SYLLABI	ASSESSMENT CRITERIA
19. Understand, Assemble, test and troubleshoot the various digital circuits and apply this knowledge to troubleshoot display systems, digital clock, digital timer and Event counter	• Basic training (9.1.2) Block II Week No 1- 6	19.1 Ascertain and select tools and materials to perform the job and make this available for use in timely manner 19.2 Illustrate to practice the digital trainer kit with safety 19.3 Identify various digital ICs, test IC using digital IC tester and verify the truth table 19.4 Construct and verify the truth table of all gates using NOR and NAND gates 19.5 Construct a adder cum subtractor circuits and verify the truth table 19.6 Construct a decoder and encoder, multiplexer and de-multiplexer circuits and verify the truth table 19.7 Construct and verify the truth table of various flip flop and counters 19.8 Construct and verify the truth table of shift register circuits 19.9 Identify and test common anode and common cathode seven segment LED display using multi meter 19.10 Display the two digit count value on seven segment display using decoder/driver ICs. 19.11 Construct and test a Binary weighted and R-2R Ladder type Digital-to-Analog Converters. 19.12 Construct and test Astable timer circuit using IC 555. 19.13 Construct and test mono stable timer circuit using IC 555. 19.14 Construct and test VCO (V to F

		Converter) using IC 555. 19.15 Construct and test 555 timers as pulse width modulator. 19.16 Comply with safety rules when performing the above operations
20. 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	• Basic training (9.1.2) Block II Week No 7- 9	20.1 Understand and interpret the procedure as per manual of Micro controller 20.2 Identity various ICs & their functions on the given Microcontroller Kit 20.3 Write data into RAM & observe its volatility 20.4 Identify the port pins of the controller & configure the ports for Input & Output operation. 20.6 Connect an input switch & control a lamp using necessary program. 20.7 Demonstrate the initialization, load & turn on a LED with delay using Timer 20.8 Demonstrate the use of a Timer as an Event counter to count external events. 20.9 Demonstrate entering of simple programs, execute & monitor the results.
21. 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	• Basic training (9.1.2) Block II Week No 10- 12	21.1 Ascertain and select tools, material for the job and make this available for use in the timely manner 21.2 Plan work in compliance with safety norms 21.3 Demonstrate possible solution and agree task within the team 21.4 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 21.5 Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart. 21.6 Measure temperature of a lit fire using RTD and record the readings referring to data chart. 21.7 Measure the DC voltage of a LVDT

		21.8 Detect different objectives using capacitive, inductive and photoelectric proximity sensors
22. Plan, organize and construct various projects using analog and digital ICs and check for effectiveness of the project	• On job training (9.2.1) Block II Week No 1-8	22.1 Demonstrate entering of simple programs, execute & monitor the results 22.2 Plan, analyze and estimate the cost of the particular project 22.3 Identify the various tools required for the job 22.4 Prepare the simple digital/ analog electronic circuit 22.5 Simulate and test the prepared circuit 22.6 Assemble and test the circuit
23. Explain and apply working principles of SMPS, UPS and inverters and perform day to day to repair and maintenance	• On job training (9.2.1) Block II Week No 9-15	23.1 Identify the tools and equipments to perform the job with due care and safety. 23.2 Identify various input and output sockets / connectors of the given SMPS. 23.3 Apply input and measure outputs using a multi meter and test capacity of the given SMPS. 23.4 Identify major sections/ ICs/components of SMPS. 23.5 Identify major sections/ ICs/components of SMPS. 23.6 Identify and replace the faulty components. 23.7 Dismantle the given stabilizer and find major sections/ ICs components. 23.8 Identify various input and output sockets / connectors of the given SMPS. 23.9 Identify front panel control & indicators of UPS. 23.10 Connect Battery & load to UPS & test on battery mode. 23.11 Open Top cover of UPS & identify isolator transformer & UPS transformer & additional circuit other than inverter. 23.12 Identify various circuit boards in UPS and monitor voltages at various test points.

		23.13 Test UPS under Fault condition & rectify fault
24 Plan and organize Installation solar panel using appropriate tools and instruments and perform day to day repair and maintenance and check for quality standard	• On job training (9.2.1) Block II Week No 16-20	24.1 Select appropriate tools and equipment. 24.2 Install a solar panel to a roof. 24.3 Wire a solar panel to a solar controller. 24.4 Wire a solar controller to a battery storage station. 24.5 Connect storage batteries to a power inverter 24.6 Wire a power inverter to an electrical service panel. 24.7 Connect and test solar panel to the Inverter and run the load. 24.8 Installation of Solar Inverter. Demonstrate the installation with team.
25. 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	• On job training (9.2.1) Block II Week No 21- 26	25.1 Ascertain and select tools and materials for the job and make this available for use in a timely manner. 25.2 Plan to Dismantle and assemble modules as per circuit diagram. 25.3 Identification and operate different Controls on LCD, LED TV. 25.4 Identify the components and different sections of LCD and LED TV. 25.5 Identify various connectors provided on a LCD TV and test the healthiness. 25.6 Dismantle; identify the parts of the remote control. 25.7 Trace and rectify the faults of a various remote controls.

26 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	• On job training (9.2.2) Block II Week No 27- 36	26. 1 Wire an MCB to a motor and run it 26. 2 Test and rectify defects associated with MCBs. 26. 3 Connect an ELCB and test the leakage of an electrical motor control circuit. 26. 4 Prepare the setup and Control an induction motor using a DOL Starter 26. 5 Construct a direction control circuit to change direction of an induction motor 26. 6 Identify various input and output terminals of the DRIVE unit, Operator panel and display unit. 26. 7 Demonstration – Access parameter number & values 26. 8 Installation of AC Drive(similar to SIEMENS MM-420/440) 26. 9 Demonstrate:- Commissioning & Quick Commissioning(similar to SIEMENS MM-420/440) 26. 10 Demonstration of MM Drive Programming /Parameterization for different control operations 26. 11 Construct a simple circuit to control servo motor using IC 555. 26. 12 Demonstration of Various control method for controlling velocity & torque 26. 13 Connect servo motor to computer for monitoring & controlling of various parameters.

9. SYLLABUS

9.1 Basic Training
(Block – I&II)
Duration: 06 Months

GENERAL INFORMATION

1) **Name of the Trade** :**ELECTRONICS MECHANIC**
2) **Hours of Instruction** : 1040Hrs. (40 hrs./week x 26 weeks)
3) **Batch size** : 20
4) **Power Norms** : 4.04 KW for Workshop
5) **Space Norms** : 56 Sq. mtrs.
6) **Examination** : The internal examination/assessment will be held on completion of each block
7) **Relevant MES Course** : NIL
8) **Instructor Qualification** :

a) B.E./B. Tech in Electronics/Electornics & Telecommunication/Electronics & Communication with one year expreience in the relevent field.

OR

b) Diplome in Elctronics/Electronics & telecomunication/Electronics & Communication from recognized board of technical education with two years experience in the relevent field.

OR

c) NTC/NAC in the trade with three years' experience respective in the relevent field.

9) **Tools, Equipments & Machinery required** : - As per Annexure – I

9.1.1 DETAIL SYLLABUS OF CORE SKILL

Block– I
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
		30		**20**
1	**Engineering Drawing:** Introduction and its importance - Viewing of engineering drawing sheets. Method of Folding of printed Drawing Sheet as per BIS SP:46-2003 Drawing Instruments : their Standard and uses - Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips.		**Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units.	
2	**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		**Fractions & Simplification**: Fractions, Decimal fraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems Simplification using BODMAS.	
3	**Drawing of Geometrical Figures**: Definition, nomenclature and practice of - - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.		**Square Root** : Square and Square Root, method of finding out square roots, Simple problem using calculator	

4	**Lettering and Numbering** as per BIS SP46-2003: - Single Stroke, Double Stroke, inclined, Upper case and Lower case.		**Ratio & Proportion:** Simple calculation on related problems.	
5	**Free Hand sketch:** Hand tools and measuring instruments used in electronics mechanics trades		**Percentage:** Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	
6	**Free hand drawing :** - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension . - Transferring measurement from the given object to the free hand sketches.		**Material Science** : Properties - Physical & Mechanical, Types – Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.	

Block – II
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
		30		**20**
1	**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		**Mass,Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals	
2	**Construction of Scales and diagonal scale**		**Work, Power and Energy**: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	
3	LED, IRLED, photo diode, photo transistor, opto- coupler symbols symbols of Logic gates			

4	Half adder, full adder, multiplexer and de-multiplexer		**Algebra:** Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	
5	UJT, FET, MOSFET, DIAC, TRIC, SCR, IGBT symbols and circuits of FET Amplifier, SCR using UJT triggering, snubber circuit, light dimmer circuit using TRIAC, UJT based free running oscillator.		**Mensuration :** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle. Volume of solids – cube, cuboid, cylinder and Sphere. Surface area of solids – cube, cuboid, cylinder and Sphere.	
			Trigonometry: Trigonometrical ratios, measurement of angles. Trigonometric tables. Finding height and distance by trigonometry.	

c. Employability Skills

GENERAL INFORMATION

1) **Name of the subject** : **EMPLOYABILITY SKILLS**
2) **Applicability** : ATS- Mandatory for fresher only

3) **Hours of Instruction** : **110 Hrs.**

4) **Examination** : The examination will be held at the end of two years training by NCVT

5) **Instructor Qualification** :

i)MBA/BBA with two years experience or graduate in sociology/social welfare/Economics with two years experience and trained in Employability skill from DGET Institute.

And

Must have studied in English/Communication Skill and Basic Computer at 12th /diploma level

OR

ii) Existing Social Study Instructor duly trained in Employability Skill from DGET Institute.

Syllabus of Employability Skills
Block – I
Basic Training

Topic No.	Topic	Duration (in hours)
	English Literacy	**15**
1	**Pronunciation :** Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)	
2	**Functional Grammar** Transformation of sentences, Voice change, Change of tense, Spellings.	
3	**Reading** Reading and understanding simple sentences about self, work and environment	
4	**Writing** Construction of simple sentences Writing simple English	
5	**Speaking / Spoken English** Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.	
	I.T. Literacy	**15**
1	**Basics of Computer** Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
2	**Computer Operating System** Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.	
3	**Word processing and Worksheet** Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets	
4	**Computer Networking and INTERNET** Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet, Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication.	

	Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.	
	Communication Skill	**25**
1	**Introduction to Communication Skills** Communication and its importance Principles of Effective communication Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication -characteristics, components-Para-language Body - language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort. Case study/Exercise	
2	**Listening Skills** Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active Listening Skills.	
3	**Motivational Training** Characteristics Essential to Achieving Success The Power of Positive Attitude Self awareness Importance of Commitment Ethics and Values Ways to Motivate Oneself Personal Goal setting and Employability Planning. Case study/Exercise	
4	**Facing Interviews** Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview	
5	**Behavioral Skills** Organizational Behavior Problem Solving Confidence Building Attitude Decision making Case study/Exercise	

Block–II
Basic Training

Topic No.	Topic	Duration (in hours)
	Entrepreneurship skill	**10**
1	**Concept of Entrepreneurship** **Entrepreneurship**- 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.	
2	**Project Preparation & Marketing analysis** Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of Product Life Cycle (PLC), Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.	
3	**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.	
4	**Investment Procurement** Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.	
	Productivity	**10**
1	**Productivity** Definition, Necessity, Meaning of GDP.	
2	**Affecting Factors** Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.	
3	**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.	
4	**Personal Finance Management** Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
	Occupational Safety, Health & Environment Education	**10**
1	**Safety & Health** Introduction to Occupational Safety and Health importance of safety and health at workplace.	
2	**Occupational Hazards** Basic Hazards, Chemical Hazards, Vibro-acoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.	

3	**Accident & safety** Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.	
4	**First Aid** Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person	
5	**Basic Provisions** Idea of basic provision legislation of India. of safety, health, welfare under legislation of India.	
6	**Ecosystem** Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.	
7	**Pollution** Pollution and pollutants including liquid, gaseous, solid and hazardous waste.	
8	**Energy Conservation** Conservation of Energy, re-use and recycle.	
9	**Global warming** Global warming, climate change and Ozone layer depletion.	
10	**Ground Water** Hydrological cycle, ground and surface water, Conservation and Harvesting of water	
11	**Environment** Right attitude towards environment, Maintenance of in -house environment	
	Labour Welfare Legislation	**5**
1	**Welfare Acts** Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.	
	Quality Tools	**5**
1	**Quality Consciousness :** Meaning of quality, Quality Characteristic	
2	**Quality Circles :** Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.	
3	**Quality Management System :** Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.	
4	**House Keeping :** Purpose of Housekeeping, Practice of good Housekeeping.	
5	**Quality Tools** Basic quality tools with a few examples	
	Leadership and Team Building skills.	**5**
	Leadership Discipline and Morale Team Work Case Study/ Exercise	
	Meet the Mentor **Role - play as a Supervisor**	**5**
	Organizing and Planning.	**5**
	Time Management Group Dynamics Case Study/ Exercise	

9.1.2 Detail Syllabus of Professional Skills & Professional Knowledge

Block –I
Basic Training

Week No.	Professional Skills	Professional Knowledge
1.	Importance of trade training, List of tools & Machinery used in the trade. Health & Safety: Introduction to safety equipments and their uses. Introduction of first aid, operation of Electrical mains. **Occupational Safety & Health** **Importance of housekeeping & good shop floor practices.** Basic safety introduction, Personal protective Equipments(PPE):- Use of Fire extinguishers.	Importance of safety and general precautions observed in the in the industry/shop floor. All necessary guidance to be provided to the new comers to become familiar with the working of Industrial Training Institute system including stores procedures. **Soft Skills: its importance and Job area after completion of training.** Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept & its application. Response to emergencies eg; power failure, fire, and system failure.
2.	**Hand Tools and their uses** • 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. • Simple mechanical fixtures • Identification of types of screws, bolts, nuts, washers, rivets, clamps, connectors • Fix screws of different sizes on wooden boards • Cutting of wooden blocks using hand/hack saw • Simple fitting practice and drilling practice	Identification, specifications, uses and maintenance of commonly used hand tools.
3.	**Basics of AC and Electrical Cables** • Identify the Phase, Neutral and Earth on power Socket. • Use a Tester to monitor AC power. • Measure the voltage between phase and ground and rectify earthing. • Identify and test different AC mains cables. • Skin the electrical wires /cables using the wire stripper and cutter. • 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** • Identify the meter for measuring AC & DC parameters • Use the multi meter to measure the various functions (AC V, DC V, DC I, AC I, R) • Identify the different controls on the CRO front panel and observe the function of each controls • Identify the different controls on the function generator front panel and observe the function of each controls • 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** • Identify different types of soldering guns and practice soldering of different electronic active and passive components and IC bases on lug boards and PCBs • Join the broken PCB track and test • Demonstrate soldering and de-soldering using soldering and de-soldering stations • Identify and use SPST, SPDT, DPST, DPDT, tumbler, push button, toggle, piano switches used in electronic industries	Different types of soldering guns, related to Temperature and wattages, types of 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** • Identify the different types of resistors • Measure the resistor values using colour code and verify the reading by measuring in multi meter • Verify ohms law • Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter • Identify different inductors • Identify the different capacitors and measure capacitance of various capacitors using LCR meter • Dismantle and identify the different parts of a relay. • 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** • Identification of various indicators,	Basic blocks of a computer, Hardware and software, I/O devices, keyboard, types of

	Connectors, ports on the computer cabinet • Identify drives and their capacity. • Identify various connectors and cables inside the cabinet & Identify connections to rear side and front panel of the cabinet • Identify various parts of the system unit and motherboard • Configuring and troubleshooting display problems • Practice various features of OS • Install a Printer driver software and test for print outs • Install MS office software • 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. • Prepare a power point presentation on any three known topics with various design features • Invoke excel sheet from MS WORD and vice versa • Identify the cables and network components. • Making UTP cross cables and testing, Making straight cables and testing, Making cable layout drawing	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.
11-12	**<u>Electronic circuit simulation software</u>** • Prepare simple digital and electronic circuits using the software • Simulate and test the prepared digital and analog circuits • Convert the prepared circuit into a layout diagram. • 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 (03 days)**	

Block –II

Basic Training

Week No.	Professional Skills	Professional Knowledge
1-2	**Basic Gates and combination circuits** • 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. • Verify the truth tables of all Logic Gate ICs by connecting switches and LEDs. • Construct and verify the truth table of all the gates using NAND and NOR gates • Use digital IC tester to test the various digital ICs (TTL and CMOS) • Construct Half Adder/Full adder circuit and verify the truth table. • 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** • Identify different Flip-Flop (ICs) by the number printed on them • Verify the truth tables of Flip-Flop ICs (RS, D, T, JK, MSJK) by connecting switches and LEDs • Construct and test a four bit asynchronous binary counter using 7493. • Construct and test synchronous Decade counter. • Identify and test common anode and common cathode seven segment LED display using multi meter • Display the two digit count value on seven segment display using decoder/driver ICs. • Construct a shift register using RS/D/JK flip flop and verify the result • Construct and test four bit SIPO register • Construct and test four bit PIPO register • Construct and test bidirectional shift registers	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,
5-6	**Op – Amp & Timer 555 Applications:** • Use analog IC tester to test the various analog ICs • Construction and testing of various Op-Amp circuits Inverting, Non-inverting and Summing Amplifiers	Block diagram and Working of Op-Amp, importance, Ideal characteristics, advantages and applications.

	• Construct and test Differentiator and Integrator • Construct and test a zero crossing detector • Construct and test Instrumentation amplifier • Construct and test a Binary weighted and R-2R Ladder type Digital-to-Analog Converters. • Construct and test Astable timer circuit using IC 555. • Construct and test mono stable timer circuit using IC 555. • Construct and test VCO (V to F Converter) using IC 555. • Construct and test 555 timers as pulse width modulator.	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)** • Identify various ICs & their functions on the given Microcontroller Kit • Identify the address range of RAM & ROM. • Write data into RAM & observe its volatility • Measure the crystal frequency, connect it to the controller. • Identify the port pins of the controller & configure the ports for Input & Output operation • Connect an input switch & control a lamp using necessary program • Demonstrate the initialization, load & turn on a LED with delay using Timer. • Demonstrate the use of a Timer as an Event counter to count external events. • Demonstrate entering of simple programs, execute & monitor the results	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. Introduction to PIC Architecture.
10-12	**Sensors ,Transducers and Applications** • 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 • Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart. • Measure temperature of a lit fire using RTD and record the readings referring to data	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.

	chart. • Measure the strain of a given material using strain gauge • Measure the DC voltage of a LVDT • Detect different objectives using capacitive, inductive and photoelectric proximity sensors	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 (03 days)**	

9.2 Practical Training (On-Job Training)
(Block – I&II)
Duration: 18 Months

GENERAL INFORMATION

1) **Name of the Trade** :**ELECTRONICS MECHANIC**
2) **Duration of On-Job Training** : As per Apprenticeship Act amended time to time.
3) **Batch size** : 20
4) **Examination** : i) The assessment/examination will be held on completion of each block
   ii) NCVT exam will be conducted at the end of 2nd year.
5) **Instructor Qualification** :

a) B.E./B. Tech in Electronics/Electornics & Telecommunication/Electronics & Communication with one year expreience in the relevent field.
OR
b) Diplome in Elctronics/Electronics & telecomunication/Electronics & Communication from recognized board of technical education with two years experience in the relevent field.
OR
c) NTC/NAC in the trade with three years' experience respective in the relevent field.

6) **Tools, Equipments & Machinery required** : - As per Annexure – II

9.2.1 DETAIL SYLLABUS OF PROFESSIONAL SKILL& PROFESSIONAL KNOWLEDGE

Block – I
On-Job Training

Week No.	Professional Skills	Professional Knowledge
1	**Rectifiers** • Identify diodes, diode bridges • Record the specifications of different diodes using data book/ web site • Test the given diode using multi meter • Construct and test Diode as a half wave, full wave and Bridge rectifier. • Construct a rectifier with capacitor filter circuit and measure the output voltage • Use CRO to observe the ripple from rectifiers for different load and filter capacitors • Identify and Test Zener diode. • Construct and test Zener based voltage regulator circuit.	Semiconductor component number coding for different electronic components such as Diodes, Zeners. PN Junction, Forward and Reverse biasing of diodes. Working principles of Zener diode / specifications / applications, Varactor diode /Tunnel diode/ specifications with applications.
2-3	**IC Regulators** • Identify the different types of fixed +ve and –ve regulator ICs and the different current ratings (78/79 series) • Construct a fixed voltage regulator as a variable one by floating the reference • Observe the output voltage of different IC regulators by varying the input voltage • Construct a dual power supply by using the fixed IC regulators with current limiting and short circuit protection features	Regulated Power supply using 78XX series, 79XX series, , voltage regulation, error correction and amplification etc.
4-6	**Amplifier** • Construct and test voltage divider bias • Construct and Test a common emitter amplifier with and without bypass capacitors • Construct and Test common base amplifier • Construct and Test common collector/emitter follower amplifier • Construct and Test Darlington amplifier • Construct and test a two stage RC Coupled amplifier • Construct and test a Class B complementary push pull amplifier • Construct and test class C Tuned amplifier	Transistor (CB, CE & CC) configurations and their characteristics and applications Transistor biasing circuits and stabilization Techniques. Classification of amplifiers according to frequency, mode of operation, methods of coupling, Voltage amplifiers- voltage gain, loading effect. Configuration of common emitter, common base, common collector transistor, their definition characteristics and applications. Single stage CE amplifier, (CC

		amplifier) emitter follower circuit and its advantages RC coupled amplifier, Distinguish between voltage and power amplifier, Push pull amplifier and class C tuned amplifier Alpha, beta, voltage gain, Concept of dB dBm. Feedback and its types.
7-8	**Oscillator :** • Demonstrate Colpitts oscillator, Hartley oscillator circuits • Construct and test a RC phase shift oscillator circuits • Construct and test a crystal oscillator circuits • Demonstrate Astable, monsotable, bistable circuits using transistors.	Introduction to positive feedback and requisites of an oscillator, Study of Colpitts, Hartley, Crystal and RC oscillators. Types of multi vibrators and study of circuit diagrams
9-12	**Power Electronic Components** • Identify FET transistors and record main parameters from the Data book • Test the given FET using multi meter • Construct and test a FET Amplifier • Identify SCRs of different ratings and the packages • Test different SCRs using a Multi meter and component tester • Construct a test circuit to test SCRs • Construct a test circuit of SCR using UJT triggering • Identify different heat sinks used with SCRs. • Construct a snubber circuit for protecting SCR use freewheeling diode to reduce back e.m.f. • Construct and test solid state relay. • Construct a jig circuit to test DIAC • Identify and test a TRIAC using multi meter • Construct a simple dimmer circuit using TRIAC • Identify and Test a UJT using multi meter • Construct UJT based free running oscillator and change its frequency.	Construction of FET, differentiate it with BJT. Purpose of Gate, Drain and source terminals and voltage / current relations between them, Impedances between various terminals. Interpret the main parameters of the FET. Suitability of FET amplifiers in measuring device applications. Working of power electronic components such as SCR, TRIAC, DIAC and UJT.
13-14	MOSFET & IGBT: • Identify MOSFET by its number • Identify different heat sinks used with various power MOSFET devices. • Construct MOSFET test circuit with a small load • Identify IGBT by its number	Working of MOSFET, Power MOSFET and IGBT - their types, characteristics, switching speed, power ratings and protection. Differentiate FET with MOSFET, differentiate a Transistor with IGBT.

	• Construct IGBT test circuit with a small load	
15	**Basic SMD (2,3,4 terminal components):** • Identification of 2,3,4 terminal SMD components • De-solder the SMD components from the given PCB • Solder the SMD components in the same PCB • Check for cold continuity of PCB • Identification of loose /dry solder, broken tracks on printed wired assemblies	Introduction to SMD technology Identification of 2,3,4 terminal SMD components, advantages of SMD components over conventional lead components Introduction to solder paste and machine. Soldering of SM assemblies - Reflow soldering Tips for selection of hardware, Inspection of SM.
16-19	**SMD Soldering and De-soldering:** • Identify various connections and the setup required for SMD Soldering station • Identification of crimping tools for various IC packages. • Make the necessary settings on SMD soldering station to de-solder various ICs of different packages (at least four) by choosing proper crimping tools. • Make the necessary settings on SMD soldering station to solder various ICs of different packages (at least four) by choosing proper crimping tools.	Soldering / de-soldering of above components Identification of Programmable Gate Array (PGA) packages Soldering / De-soldering of above PGA components

20-23	**PCB Rework:** • Prevention of Static charges, Handling of static sensitive devices • Construction of Printed Circuit Boards (single, Double, multi-layer), Important tests for PCBs • Identify different types of soldering guns and practice soldering of different electronic active and passive components and IC bases on lug boards and PCBs • Join the broken PCB track and test • Demonstrate soldering and de soldering using soldering and de-soldering stations • Familiarizations of soldering technology, use of materials like solder, flux and cleaning solvents, Usage of correct tools, Component mounting, Solderability testing, • Practical on Rework of through hole and surface mount soldered joints	ESD Control in Electronics Introduction to Static charges, Prevention of Static charges, Handling of static sensitive devices, Various standards for ESD Introduction to non soldering interconnections Introduction to crimping, wire wrapping, Conductive adhesives, Chip on Board, Tape Automated bonding. Introduction to components, Printed Circuit Boards Introduction to components, Construction of Printed Circuit Boards(single, Double, multi-layer), Important tests for PCBs Soldering guns Different types of soldering guns, related to Temperature and wattages, types of tips. Solder materials and their grading. Selection of a soldering gun for specific requirement. Reliable Soldering Practices (Manual) Fundamentals of soldering technology, Materials selection like solder, flux and cleaning solvents, Usage of correct tools, Component mounting, Solderability testing, Process for soldering Inspection of solder joints, Defects of soldered joints Introduction to Surface Mount Technology (SMT) Introduction to surface mount technology – advantages Surface Mount components and packages, Introduction to solder paste (flux), Soldering of SM assemblies - Reflow soldering Tips for selection of hardware, Inspection of SM. Rework and Repair of Printed Circuit board assemblies Introduction to rework and repair concepts Types of conformal coating and its removal methods Rework of through hole and surface mount soldered joints

24-38	**Electronic Cables & Connectors** • Identify various types of cables used for various applications viz. insulation, gauge, current capacity, flexibility etc. used in various electronics products. • Identify suitable connectors, solder/crimp /terminate & test the cable sets. • Read & follow markings on the connectors for testing the continuity of the prepared cable sets The set of cables prepared should cover applications like computer, audio, video products, RF,DATA Transmission, IDE etc	Cable signal diagram conventions Classification of electronic cables as per the application w.r.t. insulation, gauge, current capacity, flexibility etc. different types of connector & their terminations to the cables. Male / Female type DB connectors, Ethernet 10 Base cross over cables and pin out assignments, UTP and STP, SCTP Cables Cable trays. Different types of connectors Servo 0.1" connectors, FTP, RCA,BNC,HDMI Audio/video connectors like XLR,RCA(phono),6.3mm PHONO,3.5/2.5mm PHONO, BANTAM,SPEAKON, DIN, mini DIN, RF connectors, USB, Firewire, SATA Connectors, VGA,DVI connectors, MIDI etc
29-34	**Communication electronics:** • Modulate and Demodulate various signals using AM and FM on the trainer kit and observe waveforms • Construct and test IC based AM Receiver • Construct and test IC based FM transmitter • Construct and test IC based FM Receiver • Dismantle the given FM receiver set and identify different stages (AM section, audio amplifier section etc) • Modulate and Demodulate a signal using PAM,PPM,PWM Techniques	Radio Wave Propagation – Principle, Fading, Need for Modulation, types of modulation. Demodulation techniques. Fundamentals of Antenna, various parameters, types of Antennas & application. Introduction to AM, FM & PM, SSB-SC & DSB-SC, block diagram of AM and FM transmitter. FM Generation & Detection Radio Receivers: Types, Super heterodyne receiver Blocks, Principle, characteristics, advantages and disadvantages, Block diagram of FM Receives, RF, IF & AF Amplifier Sections, AM/FM RF Alignment. Digital modulation and demodulation techniques, sampling, quantization& encoding. Concept of multiplexing and de multiplexing of AM/FM/PAM/ PPM /PWM signals. A simple block diagram approach to be adopted for explaining the above mod/demo. techniques.

35-38	**Cell phones** • Dismantle, identify the parts and assemble different types of smart phones • Dismantle the cell phone/smart phone replace the display • Dismantle the cell phone/smart phone remove the key pad and clean it, test for the continuity of the matrix/tracks • Interface the cell phone/smart phone to the PC and transfer the data • Enhance the memory capacity of the cell phone/smart phone • Connect internet on cell phone and browse popular web sites • Flash the various brands of cell phone/smart phone (at least 3) • Upgrade the OS • Format the cell phone/smart phone for virus(approach the mobile repair shop/service centre) • Unlock the handsets through codes and software • Identify the defective parts and rectify • Clean the water damage sets using CTC with vibrator tubs • Replace various faulty parts like mic, speaker, data/charging/audio jack etc.	Introduction to mobile communication, concept cell site, hand off, frequency reuse, block diagram and working of cell phones, cell phone features, GSM and CDMA technology. Use IEMI number to trace lost/misplaced mobile phone.
39	**Assessment/Examination**	

Block – II
On-Job Training

Week No.	Professional Skills	Professional Knowledge
1-4	**Analog IC Applications** 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)	Discussion on the identified projects with respect to data of the concerned ICs, components used in the project
5-8	**Digital IC Applications** 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)	Discussion on the identified projects with respect to data of the concerned ICs, components used in the project
9-11	**SMPS:**	Concept and block diagram of manual, automatic and servo voltage stabilizer, o/p

	• Dismantle the given stabilizer and find major sections/ ICs components. • Measure voltages at vital test points. • Identify various input and output sockets / connectors of the given SMPS. • Apply input and measure outputs using a multi meter. • Test capacity of the given SMPS. • Identify major sections/ ICs/components of SMPS. • Measure / Monitor major test points of computer SMPS. • Identify and replace the faulty components. • ***Use SMPS used in TVs and PCs for Practice*** • Construct and test IC Based DC-DC converter for different voltages • Construct and test a switching step down regulator using LM2576 • Construct and test a switching step up regulator using MC 34063	voltage adjustment, voltage cutoff systems, study of different types of relays used in stabilizer. Block Diagram of Switch mode power supplies and their working principles Various types of chopper circuits step-up, step down, inverting types. Introduction to DC-DC Converters ICs used for converting DC- DC, block diagrams and their pin outs. Applications of DC-DC converters
12-15	**<u>UPS</u>** • Make individual connections between batteries of battery stack and test for healthiness of batteries on stack. • Connect battery stack to the UPS. • Identify front panel control & indicators of UPS • Identify & practice on the use of back panel sockets & connections. • Connect Battery & load to UPS & test on battery mode • Measure battery current UPS is working on Battery Mode & measure load current • Open Top cover of UPS & identify isolator transformer & UPS transformer & additional circuit other than inverter • Identify various circuit boards in UPS and monitor voltages at various test points • Perform load test to measure backup time. • Test UPS under Fault condition & rectify fault • Perform all above experiment for three phase UPS	Concept of UPS, Difference between Inverters and UPS. Basic block diagram of UPS & operating principle,- explanation of rectifier, battery, inverter, static transfer switch. Types of UPS : Off line UPS, On line UPS, Line interactive UPS & their comparison UPS specifications. Load power factor & types of indications & protections UPS circuit description and working - controlling circuits, Micro controller circuits, power circuits, charging circuits, alarm circuits, Indicator circuits. Three phase UPS Circuits. Installation of single phase & three phase UPS Electrical wiring for Single phase and Three phase systems, Earthing and earth resistance measurement, calculation of load power and

		power factor of a power source. Protection circuits used in inverters– battery level, over load, over charging etc. Various faults and its rectification
16-20	**Solar Power (Renewable Energy System)** • Install a solar panel to a roof. • Wire a solar panel to a solar controller. • Wire a solar controller to a battery storage station. • Connect storage batteries to a power inverter • Wire a power inverter to an electrical service panel. • Connect and test solar panel to the Inverter and run the load. • Test circuits for voltages. • Installation of Solar Inverter. • Take the trainees to the nearest solar power installation and demonstrate various aspects to cover skills as specified above.	Need for renewable energy sources, Solar energy as a renewable resource. Materials used for solar cells. Principles of conversion of solar light into electricity. Basics of photovoltaic's cell. Types of solar cells. Mono crystalline and poly crystalline PV cells. Define Components like Solar cell, Module, panel and Arrays. Factors that influence the output of a PV module. SPV systems and the key benefits. Difference between SPV and conventional power. Define solar charge controller or regulator and its role. Safety precautions while working with solar systems.
21-26	**LCD and LED TV** • Identification and operate different Controls on LCD, LED TV • Identify various connectors provided on a LCD TV and test the healthiness. • Identification of components and different sector of LCD and LED TV. • Dismantle, Identify the parts of the remote control • Trace and rectify the faults of a various remote controls • Identify various connectors and connect the cable operator's external decoder (set top box) to the TV.	Difference between a conventional CTV with LCD & LED TVs, Principle of LCD and LED TV and function of its different section. Basic principle and working of 3D TV. IPS panels and their features Different types of interfaces like HDMI, USB, RGB etc with latest TVs. TV Remote Control –Types, parts and functions, IR Code transmitter and IR Code Receiver, Working principle, operation of remote control. Different adjustments, general faults in Remote Control.

27-28	**Protection devices and Electrical control circuits:** • Identify different types of fuses along with fuse holders. • Wire an MCB to a motor and run it • Test and rectify defects associated with MCBs. • Connect an ELCB and test the leakage of an electrical motor control circuit. • Measure the coil winding resistance of the given motor • Prepare the setup and Control an induction motor using a DOL Starter • Construct a direction control circuit to change direction of an induction motor • Connect an overload relay and test for its proper functioning.	Fuse ratings, types of Fuses, Fuse bases, single/three phase MCBs, single phase ELCBs. Types of Contactors, contactor coils and working voltages, contactor contact currents, protection to contactors and high current applications. Fundamentals of single phase Induction motors, synchronous speed, slip, rotor frequency, torque – speed characteristics, Starters used for Induction motors.
29-32	**AC Drives** • Study the AC Drive set up and its connections • Identify different cables and connectors used in the AC DRIVE setup • Identify various input and output terminals of the DRIVE unit, Operator panel and display unit. • Familiarization with PMU & different terminals of Micro – Master AC Drive • Demonstration – Access parameter number & values • Familiarization with parameters • Parameter values for various operation • Commissioning parameter numbers and values • Installation of AC Drive(similar to SIEMENS MM-420/440) • Familiarization with:- Commissioning & Quick Commissioning(similar to SIEMENS MM-420/440) • Reset to default value / Factory setting values • MM Drive Programming /Parameterization for different control operations- • ON/OFF, Forward/Reverse, Jog (R)/Jog (L), braking and speed control	Block diagram of AC Drive – (Sources of supply – Converter /Rectifier – DC Link – Inverter –Motor Load) 1 phase & 3 phase rectifier circuits. Inverter – 1 phase Inverter 3 phase Inverter Switching circuit (Sequence and Switching timing control – PWM Technique & Switching Devices. Microprocessor / Microcontroller) – VFD (Variable Frequency Drive) VV VF Control – (3 phase induction motor) Speed control. Introduction of PID controller. Installation of AC Drive / Siemens Micro master Drive – MM-420/440 Commissioning / Quick commissioning of MM –420/440 Micro – Master Drive – Programming (Parameterization)
33-36	**Servo Motor** • Construct a simple circuit to control servo motor using IC 555. • Connect servo motor with drive & control its	Servo mechanism, Servo motor principal, Difference between motors & servo motor. Types of servo motor AC & DC - brushless

	parameters. • Connect servo motor to computer for monitoring & controlling of various parameters. • Parameter programming of servo motor • Various control method for controlling velocity & torque.	servo motor & permanent magnet servo motor construction & application. Control method for servo motor. Study of servo drive.
37-38	• Identify an area within the Industry where IoT concepts can be applied . • Identify the components of Raspberry Pi micro computer and learn the differences with regular desktops. • Wire a Raspberry Pi components, set up ,log-in, and load the graphical user interface. • Open and Close some applications • Design, Estimate cost and construct a simple IoT project (eg. Weather station)	a. Explain the history, future and significance of IoT. b. Draw and explain IoT with a block diagram c. Explain basics of Machine to Machine (m2m) typical topology. d. Project related theory.
39	**Assessment / Examination**	

10. ASSESSMENT STANDARD

10.1 Assessment Guideline:

Appropriate arrangements should be made to ensure that there will be no artificial barriers to assessment. The nature of special needs should be taken into account while undertaking assessment. Due consideration to be given while assessing for team work, avoidance/reduction of scrap/wastage and disposal of scarp/wastage as per procedure, behavioral attitude and regularity in training.

The following marking pattern to be adopted while assessing:

a)Weightage in the range of 60-75% to be allotted during assessment under following performance level:

For 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.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- many tolerances while undertaking different work are in line 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 above75%- 90% to be allotted during assessment under following performance level:

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.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- the majority of tolerances while undertaking different work are in line with those demanded by the component/job.
- a good level of neatness and consistency in the finish
- little support in completing the project/job

c)Weightage in the range of above 90% to be allotted during assessment under following performance level:

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.

In this work there is evidence of:

- high skill levels in the use of hand tools, machine tools and workshop equipment
- tolerances while undertaking different work being substantially in line 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

10.2 INTERNAL ASSESSMENTS (FORMATIVE ASSESSMENT)

ASSES. NO.	ASSESSABLE OUTCOME	INTERNAL MARKS
	GENERIC OUTCOME (Applicable to each Block)	
1	Recognize & comply safe working practices, environment regulation and housekeeping.	
2	Work in a team, understand and practice soft skills, technical English to communicate with required clarity.	
3	Explain the concepts and principles of basic arithmetic, algebraic, trigonometric and apply knowledge of specific areas to perform practical operations which requires well developed skills	
4	Understand and explain basic electrical and material sciences and apply the knowledge.	
5	Read and apply engineering drawing for different application in the field of work.	
6	Understand and explain the concept in productivity, quality tools, labour & welfare legislation and apply such in day to day work to improve productivity and quality.	
7	Explain the general concept and process of energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources..	
8	Explain personnel finance management, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	
9	Apply the general concept of basic computer, basic operating system and uses of internet services to take benefit of IT developments in the industry.	
	SPECIFIC OUTCOME	
10	Perform basic mechanical workshop operation using suitable tools for fitting riveting, drilling etc., with suitable care & safety.	
11	Carry out routine testing of various electrical/electronic components using proper measuring instruments where choices are clear	
12	Configure, install, troubleshoot, upgrade, interconnect given computer system(s) and demonstrate &utilize application packages for different application	
13	Plan and organise the work to Simulate, monitor and analyze analog and digital circuits using Electronic simulator software and check the result	
14	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	
15	Assemble various electronic circuits using SMD components and test them using suitable test equipment and perform the repair work on the PCB track	
16.	Prepare, crimp, terminate and test various cables used in different electronics industries	
17.	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.	
18	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	
	SUB TOTAL FOR BLOCK I	**250**
19.	Understand, explain, Assemble, test and troubleshoot the various digital circuits and apply this knowledge to troubleshoot display systems, digital clock, digital timer and Event counter	
20	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	
21.	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	
22.	Plan, organize and construct various projects using analog and digital ICs and check for the effectiveness of the project	
23.	Explain and apply working principles of SMPS, UPS and inverters and perform day to day to repair and maintenance	
24	Plan and organize Installation solar panel using appropriate tools and instruments and perform day to day repair and maintenance and check for quality standard .	
25	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	
26	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	
	SUB TOTAL FOR BLOCK II	**250**
	TOTAL INTERNAL MARKS	**500**

10.3 FINAL ASSESSMENT- ALL INDIA TRADE TEST(SUMMATIVE ASSESSMENT)

	SUBJECTS	Marks	Internal assessment based on competency	Full Marks	Pass Marks	Duration of Exam.
Block – I & II	**Block - I**		**250**	**250**	**150**	
	Professional Skill	250		250	150	**08 hrs.**
	Professional Knowledge	100		100	40	3 hrs.
	Workshop Cal. & Sc.	50		50	20	3 hrs.
	Engineering Drawing	50		50	20	4 hrs.
	Employability Skill	50		50	20	3 hrs.
	Block - II		**250**	**250**	**150**	
	TOTAL for Block – I & II	**500**	**500**	**1000**	**550**	
	Grand Total		**500**			

Marks Distribution TOTAL: 1000 marks for I & II Blocks Pass marks: 550

Note: - The candidate pass in each subject conducted under all India trade test.

11. FURTHER LEARNING PATHWAYS

On successful completion of the course,

- The trainees will be employed in reputed Industries / Organizations.
- The trainee may be given lateral entry to Diploma course
- They can also undergo CITS course in the relevant trade to become instructor in the ITI's

Employment opportunities:

On successful completion of this course, the candidates expected to gain employment in the following industries:

1. Various Electronics Equipment Manufacturing Industries.
2. Automobile electronics and allied industries
3. Industries manufacturing Solar power based inverters.
4. Industries manufacturing LED Lights
5. Service industries like BOSCH, BSNL, MTNL, Home appliances manufacturing company, Railways, ISRO, Naval dockyard, RCF, BPCL etc, depending on their requirements.
6. Various Mobile industries like LG, Samsung, Nokia, Sony etc.
7. In public sector industries like BHEL, BEL,BEML, NTPC, etc and private industries in India & abroad. Petrochemical industries like ONGC, IOCL, HPCL etc. as per the requirements.
8. Self employment

12. LIST OF EXPERT MEMBERS

Sl. No.	Name & Designation	Organization	Expert Group Designation
1.	Sh.Jayant Krishna, Principal Consultant	Tata Consultancy Services	Chairman
2.	Sh. TC Saravanabava, DDG(AT)	MSDE	Member
3.	Smt. Sandhya Salwan Director (AT)	MSDE	Member
4.	Sh. Sathya Shankar B.P. Director	CSTARI, Kolkata	Member
5.	C S Murthy, DDT	ATI-EPI, Hyderabad	Member
6.	L K Mukherjee, DDT	CSTARI, Kolkatta	Member
7.	Mr. Jinesh Kadaval Purayil Asst. Manager Training & Development	M/s. BOSCH, Bangalore	Member
8.	R Malathi, T O	RVTI(W), Bengaluru	Member
9.	Ashwini Koli, VI	RVTI(W), Bengaluru	Member
10.	Rupa Chakraborthy, Instructor	DIT, West Bengal	Member
11.	Keya Basu(Chanda),Instructor	DIT, West Bengal	Member

ANNEXURE – I

TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE: ELECTRONICS MECHANIC

LIST OF TOOLS & EQUIPMENTS FOR -20 APPRENTICES

A. TRAINEES TOOL KIT: -

Sl. No.	Names of the Items	Quantity (Indicative)
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

Sl. No	Name of the items	Quantity (Indicative)
1.	Steel rule 300mm	4 Nos
2.	Steel measuring tape-3 m	4 Nos
3.	Tools makers vice 100mm (clamp)	1 Nos
4.	Tools maker vice 50mm (clamp)	1 Nos
5.	Crimping tool (pliers)	2 Nos
6.	Magneto spanner set	2 Nos
7.	File flat 200mm bastard	2 Nos
8.	File flat 200mm second cut	2 Nos
9.	File flat 200mm smooth	2Nos
10.	100mm flat pliers	4 Nos
11.	100mm round Nose pliers	4 Nos
12.	Scriber straight 150mm	2 Nos
13.	Hammer ball pen 0.5Kg	1 No
14.	Allen key set (set of 9)	1 No
15.	Tubular box spanner (set of 6Nos)	1 set
16.	Magnifying lenses 75mm	2 Nos
17.	Continuity tester	6 Nos
18.	Hacksaw frame adjustable	2 Nos
19.	Cold chisel 20mm	1 No
20.	Scissors 200mm	1 No
21.	Handsaw 450mm	1 No
22.	Hand Drill Machine	2 Nos
23.	First aid kit	1 No

24.	Fire Extinguisher	2 Nos
25.	Bench Vice	1 No
26.	Dual DC regulated power supply 30-0-30 V, 2 Amps	4 Nos
27.	DC regulated variable power supply 0-24 V, 1Amp	2 Nos
28.	LCR meter (Digital)	1 No
29.	CRO Dual Trace 20 MHz (component testing facilities)	2 Nos
30.	Signal Generator, 0-100 KHz	2 Nos
31.	Analog multimeter	4 Nos
32.	Function generator (Triangular, square and sine wave)	2 Nos
	Or ELECTRONIC WORK BENCH Instead of sl no's (26,27,29,31,34)	2 Nos
33.	Dimmer start 3 Amps	2 Nos
34.	Analog Component Trainer	4 Nos
35.	Op Amp trainer	3 Nos
36.	Digital IC Trainer	4 Nos
37.	Digital IC Tester	1 No
38.	Digital and Analog Bread Board Trainer	6 Nos
39.	Rheostats various values and ratings	2 Nos
40	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
41	Laptops latest configuration	1 No
42	Laser jet Printer	1 No
43	INTERNET BROADBAND CONNECTION	1 No
44	Electronic circuit simulation software with 6 user licenses	1 No
45	Different types of Analog electronic components, general purpose PCBs, bread board	As required

46	Digital ICs, analog ICs, general purpose PCBs, bread board	As required
47	8051 micro controller kit with any 6 application module	4 nos
48	Sensors trainer kit	2 nos

C.WORKSHOP FURNITURE:

Sl.No.	Name of the items	Quantity (Indicative)
1	Instructor's table	1 No
2	Instructor's chair	2 Nos
3	Metal Rack, 100cm x 150cm x 45cm	4 Nos
4	Lockers with 16 drawers standard size	2 Nos
5	Steel Almirah, 2.5 m x 1.20 m x 0.5 m	2 Nos
6	Black board/white board	1 No

ANNEXURE – II

TOOLS & EQUIPMENT FOR ON-JOB TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

TRADE: ELECTRONICS MECHANIC

For Batch of 20APPRENTICES

Instrument & General Shop outfit

Sl.No	Name of the items	Quantity (Indicative)
1.	Steel rule 300mm	4 Nos
2.	Steel measuring tape-3 m	4 Nos
3.	Tools makers vice 100mm (clamp)	1 No
4.	Tools maker vice 50mm (clamp)	1 No
5.	Crimping tool (pliers)	2 Nos
6.	Magneto spanner set	2 Nos
7.	File flat 200mm bastard	2 Nos
8.	File flat 200mm second cut	2 Nos
9.	File flat 200mm smooth	2Nos
10.	100mm flat pliers	4 Nos
11.	100mm round Nose pliers	4 Nos
12.	Scriber straight 150mm	2 Nos
13.	Hammer ball pen 0.5Kg	1 No
14.	Allen key set (set of 9)	1 No
15.	Tubular box spanner (set of 6Nos)	1 set
16.	Magnifying lenses 75mm	2 Nos
17.	Continuity tester	6 Nos
18.	Hacksaw frame adjustable	2 Nos

19.	Cold chisel 20mm	1 No
20.	Scissors 200mm	1 No
21.	Handsaw 450mm	1 No
22.	Hand Drill Machine	2 Nos
23.	First aid kit	1 No
24.	Fire Extinguisher	2 Nos
25.	Bench Vice	1 No
26.	Dual DC regulated power supply 30-0-30 V, 2 Amps	4 Nos
27.	DC regulated variable power supply 0-24 V, 1Amp	2 Nos
28.	LCR meter (Digital)	1 No
29.	CRO Dual Trace 20 MHz (component testing facilities)	2 Nos
30.	Signal Generator, 0-100 KHz	2 Nos
31.	Analog multimeter	4 Nos
32.	Function generator (Triangular, square and sine wave)	2 Nos
	Or ELECTRONIC WORK BENCH Instead of sl no's (26,27,29,31,34)	2 Nos
33.	Dimmer start 3 Amps	2 Nos
34.	Analog Component Trainer	4 Nos
35.	Op Amp trainer	3 Nos
36.	Digital IC Trainer	4 Nos
37.	Digital IC Tester	1 No
38.	Digital and Analog Bread Board Trainer	6 Nos
39.	Rheostats various values and ratings	2 Nos
40.	POWER ELECTRONICS TRAINER with at least 6 no's of onboard applications	4 Nos
41	Laptops latest configuration	1 No
42	Laser jet Printer	1 No

43	INTERNET BROADBAND CONNECTION	1 No
44	Different types of electronic and electrical cables, connectors, sockets, terminations.	As required
45	Different types of Analog electronic components, digital ICs, power electronic components, general purpose PCBs, bread board, MCB, ELCB	As required
46	Tacho meter	4Nos
47	Soldering station for SMD soldering with different bits	2 Nos
48	Induction motor with DOL starter 0.5 hp	2 Nos
49	UPS trainer kit	2 Nos
50	Solar panel with solar inverter and battery (1 KVA)	1 set
51	AC drive	2Nos
52	Servo drive with motor	2Nos
53	Raspberry Pi B+ complete kit	1 No
54	Fibre optic trainer kit	1 No
55	Meggar	1 No
56	Various crimping tools for cable harness	1 No each
57	LCD/LEDTV 32”	1 No each
58	LCD/LED TV trainer	1 no

ANNEXURE-III

GUIDELINES FOR INSTRUCTORS AND PAPER SETTERS

1. All the questions of theory paper for the trade will be in objective type format.

2. Due care to be taken for proper & inclusive delivery among the batch. Some of the following some method of delivery may be adopted:

A) LECTURE
B) LESSON
C) DEMONSTRATION
D) PRACTICE
E) GROUP DISCUSSION
F) DISCUSSION WITH PEER GROUP
G) PROJECT WORK
H) INDUSTRIAL VISIT

3. Maximum utilization of latest form of training viz., audio visual aids, integration of IT, etc. may be adopted.

4. The total hours to be devoted against each topic may be decided with due diligence to safety & with prioritizing transfer of required skills.

5. Questions may be set based on following instructions:-

Sl. No.	Question on different aspect	Weightage in %age	Key Words may be like
1	Information received	25	What, Who, When
2	Knowledge	50	Define, Identify, Recall, State, Write, List & Name
3	Understanding	15	Describe, Distinguish, Explain, Interpret & Summarize
4	Application	10	Apply, Compare, Demonstrate, Examine, Solve & Use

6. Due weightage to be given to all the topics under the syllabus while setting the question paper.