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

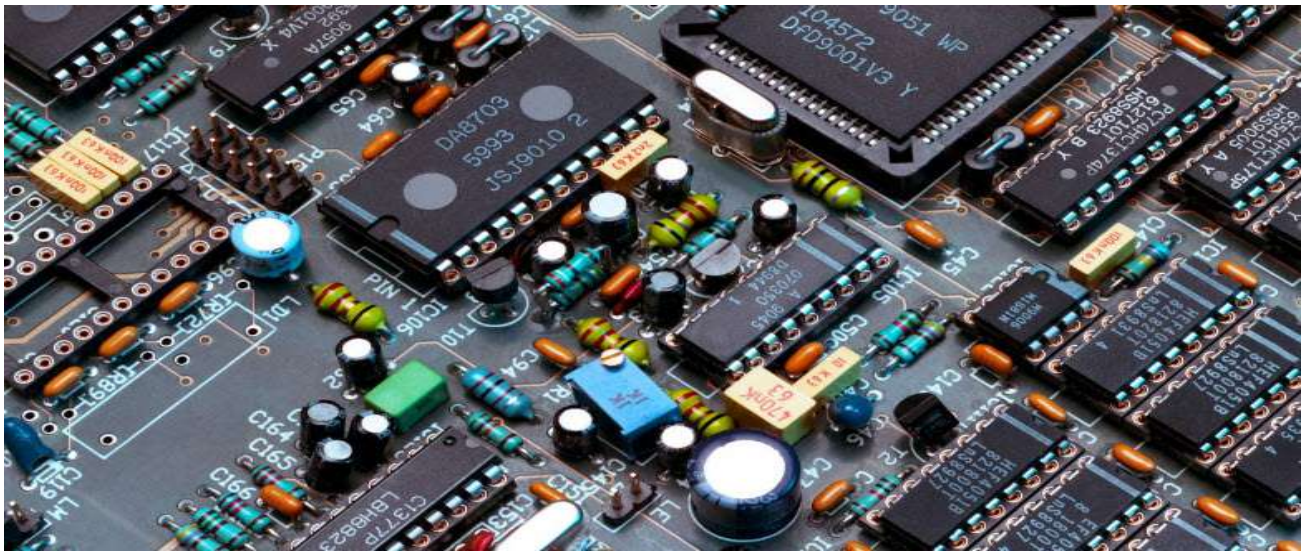
COMPETENCY BASED CURRICULUM

ELECTRONICS MECHANIC

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 5



SECTOR –Electronics & Hardware

Directorate General of Training

ELECTRONICS MECHANIC

(Engineering Trade)

(Revised in 2019)

Version: 1.2

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 5

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE

EN-81, Sector-V, Salt Lake City,

Kolkata – 700 091

www.cstaricalcutta.gov.in

CONTENTS

1. COURSE INFORMATION

During the two-year duration of Electronics Mechanic trade a candidate is trained on professional skill, professional knowledge, Engineering Drawing, Workshop Calculation & Science and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The Broad components covered professional skill, subjects are as below:-

FIRST YEAR: In this year the trainee learns about safety and environment, use of fire extinguishers, artificial respiratory resuscitation to begin with. He gets the idea of trade tools & its standardization, Familiarize with basics of electricity, test the cable and measure the electrical parameter. Skilling practice on different types & combination of cells for operation and maintenance of batteries being done. Identify and test passive and active electronic components. Construct and test unregulated and regulated power supplies. Practice soldering and de-soldering of various types of electrical and electronic components on through hole PCBs. Assemble a computer system, install OS, Practice with MS office. Use the internet, browse, create mail IDs, download desired data from internet using search engines. The candidate will be able to construct and test amplifier, oscillator and wave shaping circuits. Testing of power electronic components. Construct and test power control circuits. Identify and test opto electronic devices. Able to achieve the skill on SMD Soldering and De-soldering of discrete SMD components. Verifying the truth tables of various digital ICs by referring Data book. Practice circuit simulation software to simulate and test various circuits. Identify various types of LEDs, LED displays and interface them to a digital counter and test. Construct and test various circuits using linear ICs 741 & 555.

SECOND YEAR: In this year the trainee will be able to operate DSO and perform various functions. Gaining the skill by practicing SMD Soldering and De-soldering of various types of IC Packages. Able to identify the defects and do rework of PCB. Construct and test simple electrical control circuits and various electrical protective devices. Identify, prepare, terminate and test various types of electronic cables used in various electronic systems. Identify various functional blocks and I/O Ports of a 8051 microcontroller system, Familiarize with the instruction set of 8051 micro controller. Interface a model application with the Microcontroller kit and run the application. Construct and test various modulation/demodulation circuits. The trainee will identify and test various types of sensors used in electronic industries and construct and test circuits using various sensors system. They can construct and test analog and digital IC based application circuits as a part of project work. The trainee will work with DPM Modules to measure various electrical parameter, also interface the LCD modules to display a word. They will also skilled with various modulation techniques to acquaint with fibre optic communication techniques by using trainer kit. Identify various functional blocks/major components/ICs in the given stabilizer, rectify the faults. Identify various Input and output sockets/connectors of the given SMPS and UPS. Install and troubleshoot the given solar panel system. Dismantle and assemble various types of cell / smart phones and trouble shoot the cell/smart phone. Dismantle and assemble the given LED light stack. Design a LED light for the given ratings. Assemble decorative lighting system (serial lights) using LED strips. Dismantle, assemble, trouble shoot and rectify LED and LCD TV sets.

2. TRAINING SYSTEM

2.1 GENERAL

Directorate General of Training (DGT) under Ministry of Skill Development & Entrepreneurship offers range of vocational training courses catering to the need of different sectors of economy/ Labour market. The vocational training programmes are delivered under aegis of Directorate General of Training (DGT). Craftsman Training Scheme (CTS) with variants and Apprenticeship Training Scheme (ATS) are two pioneer programmes of DGT for propagating vocational training.

Electronics Mechanic trade under CTS is one of the most popular courses delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) impart professional skills and knowledge, while Core area (Workshop Calculation and science, Engineering Drawing and Employability Skills) impart requisite core skill & knowledge and life skills. After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognized worldwide.

Candidates need broadly to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional knowledge, core skills & employability skills while performing the job and repair & maintenance work.
- Check the job with circuit diagrams/components as per drawing for functioning, diagnose and rectify faults in the electronics components/module.
- Document the technical parameters in tabulation sheet related to the task undertaken.

2.2 PROGRESSION PATHWAYS:

- Can join industry as Technician and will progress further as Senior Technician, Supervisor and can rise up to the level of Manager.
- Can become Entrepreneur in the related field.
- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education.
- Can take admission in diploma course in notified branches of Engineering by lateral entry.
- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE:

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

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	1000	1000
2	Professional Knowledge (Trade Theory)	280	360
3	Workshop Calculation & Science	80	80
4	Engineering Drawing	80	80
5	Employability Skills	160	80
	Total	**1600**	**1600**

2.4 ASSESSMENT & CERTIFICATION:

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGT from time to time.

a) The **Continuous Assessment** (Internal) during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in.

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

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%. There will be no Grace marks.

2.4.2 ASSESSMENT GUIDELINE:

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

Assessment will be evidence based comprising the following:

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

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

Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • 60-70% accuracy achieved while undertaking different work with those demanded by the component/job. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.

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

3. JOB ROLE

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, transmitters, and telemetering control systems following blueprints and manufacturer's specifications and using hand tools and test instruments. Tests faulty equipment and applies knowledge of functional operation of electronic units and systems to diagnose cause of malfunction. Tests electronic components and circuits to locate defects, using instruments, such as oscilloscopes, signal generators, ammeters and voltmeters. Replaces defective components and wiring and adjusts mechanical parts, using hand tools and soldering iron. Aligns, adjusts and calibrates testing instruments. Maintains records of repairs, calibrations and test.

Radio Technician (Radio Manufacturing); tests assembled radio sets with testing equipment to ensure that assembly soldering, frequency, performance, etc. are in accordance with prescribed standards. Places assembled radio set in position and visually examines it to ensure that position of components, connections, soldering, wiring, etc. are in order. Switches on and operates different knobs to check calibration, audibility and general performance of set by varying its tone and listening to various stations and frequencies. Tightens loose nuts and screws, locates faults, replaces defective components and conducts necessary changes. Approves correctly assembled sets for further processing and rejects defective ones for rectification. May tests sets at different stages of assembly. May service, repair and overhaul radio sets.

Solar Panel Installation Technician; is also known as 'Panel Installer', the Solar Panel Installation Technician is responsible for installing solar panels at the customers' premises. The individual at work checks the installation site, understands the layout requirement as per design, assesses precautionary measures to be taken, installs the solar panel as per customer's requirement and ensures effective functioning of the system post installation.

Optical fibre technician; is responsible for maintaining uptime and quality of the network segment (both optical media and equipment) assigned to him by undertaking periodic preventive maintenance activities and ensuring effective fault management in case of fault occurrence. He is also required to

coordinate activities for installation and commissioning of Optical Fibre Cable (OF) as per the route plan.

Field Technician: UPS and Inverter; is also called, 'UPS repair Technician', this is an after sales service job for installing and providing support to customers of different types of UPS and inverters. The individual at work installs the newly purchased UPS or inverter. The individual also and interacts with customers to diagnose problems in them, assesses possible causes, rectifies faults or replaces faulty modules or recommends factory repairs for bigger faults as per the route plan. Installation, service, repair and overhaul radio sets service centre. May install television sets.

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

Cable Television Installer; installs cable television cables and equipment on customer's premises, using electrician' stools 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 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.

Television Repair Technician; job role is applicable to both Television manufacturing facilities as well as electronics service centers. This role pertains to rectify faults identified during testing of TV on in manufacturing process and providing after sales assistance and ensuring appropriate functioning of

television sets. A TV repair technician identifies the section in the TV that is not functioning. If the problem identified is in the Printed Circuit Board (PCB), the technician identifies the specific fault in the PCB and corrects it. Replaces the dysfunctional PCB with a new one, if the damage identified requires fixing at the service centre.

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-2015:

a) 7421.0100 - Electronics Fitter, General
b) 7421.0300 - Electronics Mechanic
c) 7422.1100 - Television Installation Man
d) 7422.1200 - Cable Television Installer
e) 7422.1300 - Television Service and Repairman
f) 7422.1302 - Television Repair Technician
g) 7422.1400 - Radio Technician (Radio Manufacturing)
h) 7421.1401 - Solar Panel Installation Technician
i) 7422.0801 - Optical fibre technician
j) 7421.0801 - Field Technician: UPS and Inverter

4. GENERAL INFORMATION

Name of the Trade	**ELECTRONICS MECHANIC**
Trade Code	DGT/1005
NCO - 2015	7421.0100, 7421.0300, 7422.1100, 7422.1200. 7422.1300, 7422.1302, 7422.1400, 7421.1401, 7422.0801, 7421.0801
NSQF Level	Level-5
Duration of Craftsmen Training	Two Years (3200 Hours)
Entry Qualification	Passed 10th class examination with Science and Mathematics or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF, AUTISM, SLD
Unit Strength (No. Of Student)	24 (There is no separate provision of supernumerary seats)
Space Norms	56 Sq. m
Power Norms	3.04 KW
Instructors Qualification for	
1. Electronics Mechanic Trade	B.Voc/Degree in Electrical/ Electrical and Electronics Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Electrical/ Electrical and Electronics Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field **OR** NTC/NAC passed in the Trade of "Electronics Mechanic" With three years' experience in the relevant field. **<u>Essential Qualification</u>:** Relevant National Craft Instructor Certificate (NCIC) in any of the variants under DGT. **NOTE: Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications.**

	However both of them must possess NCIC in any of its variants.
2. Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/ UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years experience. **<u>Essential Qualification:</u>** National Craft Instructor Certificate (NCIC) in relevant trade **OR** NCIC in RoDA or any of its variants under DGT
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/ UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE/recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Electrical groups (Gr-II) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **<u>Essential Qualification:</u>** National Craft Instructor Certificate (NCIC) in relevant trade. OR NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills from DGT institutes. (Must have studied English/ Communication Skills and Basic Computer at 12^{th} / Diploma level and above) **OR** Existing Social Studies Instructors in it is with short term ToT Course in Employability Skills from DGT institutes.

5. Minimum age for Instructor	21 years
List of Tools and Equipment	As per Annexure – I

Distribution of training on Hourly basis: (Indicative only)

Year	Total Hrs. /week	Trade Practical	Trade Theory	Workshop Cal. & Sc.	Engg. Drawing	Employability Skills
1st	40 Hours	25 Hours	7 Hours	2 Hours	2 Hours	4 Hours
2nd	40 Hours	25 Hours	9 Hours	2 Hours	2 Hours	2 Hours

5. LEARNING OUTCOME

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

5.1 LEARNING OUTCOMES (TRADE SPECIFIC)

FIRST YEAR:

1. Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care & safety following safety precautions.
2. Select and perform electrical/electronic measurement of single range meters and calibrate the instrument.
3. Test & service different batteries used in electronic applications and record the data to estimate repair cost.
4. Plan and execute soldering & de-soldering of various electrical components like Switches, PCB& Transformers for electronic circuits.
5. Test various electronic components using proper measuring instruments and compare the data using standard parameter.
6. Assemble simple electronic power supply circuit and test for functioning.
7. Install, Configure, interconnect given computer system(s) and demonstrate & utilize application packages for different application.
8. Construct, test and verify the input/output characteristic of various analog circuits.
9. Plan and construct different power electronic circuits and analyse the circuit functioning.
10. Select the appropriate opto electronics components and verify the characteristics in different circuit.
11. Assemble, test and troubleshoot various digital circuits.
12. Simulate and analyze the analog and digital circuits using Electronic simulator software
13. Identify , place, solder and desolder and test different SMD discrete components and IC's package with due care and following safety norms using proper tools/setup
14. Construct and test different circuits using ICs 741 Operational amplifiers & ICs 555 linear integrated circuits and execute the result.

SECOND YEAR:

15. Measure the various parameters by DSO and execute the result with standard one.
16. Rework on PCB after identifying defects from SMD soldering and de-soldering.
17. Construct different electrical control circuits and test for their proper functioning with due care and safety.
18. Prepare, crimp, terminate and test various cables used in different electronics industries.
19. Assemble and test a commercial AM /FM receiver and evaluate performance.

20. Test, service and troubleshoot the various components of different domestic/ industrial programmable systems.
21. Execute the operation of different process sensors, identify, wire & test various sensors of different industrial processes by selecting appropriate test instruments
22. Plan and carry out the selection of a project, assemble the project and evaluate performance for a domestic/commercial applications.
23. Prepare fibre optic setup and execute transmission and reception.
24. Plan and Interface the LCD, LED DPM panels to various circuits and evaluate performance.
25. Detect the faults and troubleshoot SMPS, UPS and inverter.
26. Install a solar panel, execute testing and evaluate performance by connecting the panel to the inverter.
27. Dismantle, identify the various parts and interface of a cell phone to a PC. Estimate and troubleshoot.
28. Check the various parts of a LED lights and stacks and troubleshoot
29. Identify, operate various controls, troubleshoot and replace modules of the LCD/LED TV & its remote.

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care &safety following safety precautions.	Identify basic hand tools for fitting, riveting, drilling etc. with due care and safety.
	Fix surface mounting type of accessories in a panel board.
	Connect electrical accessories.
	Make and Wire up of a test board and test it.
2. Select and perform electrical/ electronic measurement of single range meters and calibrate the instrument.	Plan work in compliance with standard safety norms.
	Identify the type of electronic instruments.
	Determine the measurement errors while measuring resistance by voltage drop method.
	Extend the range of MC voltmeter and ammeter.
	Measure the value of resistance, voltage and current using digital multimeter.
	Calibrate analog multimeter.
3. Test & service different batteries used in electronic applications and record the data to estimate repair cost.	Identify Tools and instruments for testing of batteries.
	Observe safety procedure during testing of batteries and work as per standard norms and company guidelines
	Identify the primary and secondary cells.
	Measure and test the voltages of the given cells/battery using analog / digital multimeter.
	Charging and discharging the battery.
	Maintain and estimate the repair cost of secondary battery.
	Use a hydro meter to measure the specific gravity of the secondary battery.
4. Plan and execute soldering & de-soldering of various electrical components like Switches, PCB & Transformers for electronic circuits.	Plan work in compliance with standard safety norms.
	Identify different types of mains transformers and test.
	Identify the primary and secondary transformer windings and test the polarity.
	Measure the primary and secondary voltage of different transformers.

	Solder the given components
	Identify and test the variac.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
5. Test various electronic components using proper measuring instruments and compare the data using standard parameter.	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Plan work in compliance with standard safety norms.
	Identify the different types of resistors.
	Measure the resistor values using colour code and verify the reading by measuring in multi meter.
	Identify the power rating using size.
	Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter.
	Identify different inductors and measure the values using LCR meter.
	Identify the different capacitors and measure capacitance of various capacitors using LCR meter.
	Ascertain and select tools and materials for the job and make this available for use in.
6. Assemble simple electronic power supply circuit and test for functioning.	Practice soldering on components, lug and board with safety.
	Identify the passive /active components by visual appearance, Code number and test for their condition.
	Identify the control and functional switches in CRO and measure the D.C. & A.C. voltage, frequency and time period.
	Construct and test a half & full wave rectifiers with and without filter circuits.
	Construct and test a bridge rectifier with and without filter circuits.
	Construct and test a Zener based voltage regulator circuit.
7. Install, configure, interconnect given computer system(s) and demonstrate & utilize application packages for different application.	Plan, work in compliance with standard safety norms.
	Select hardware and software component.
	Install and configure operating systems and applications.
	Integrate IT systems into networks.
	Deploy tools and test programmes.
	Avoid e-waste and dispose the waste as per the procedure.

8. Construct, test and verify the input/ output characteristics of various analog circuits.	Ascertain and select tools and instruments for carrying out the jobs.
	Plan and work in compliance with standard safety norms.
	Practice on soldering components on lug board with safety.
	Identify the passive /active components by visual appearance, Code number and test for their condition.
	Construct and test the transistor based switching circuit
	Construct and test CB,CE & CC amplifier circuit
	Ascertain the performance of different oscillator circuits.
	Construct and test Clipper, Clamper and Schmitt trigger circuit.
9. Plan and construct different power electronic circuits and analyse the circuit functioning.	Construct and test of Transistor and JFET amplifiers, oscillators and multi vibrators.
	Construct and test a UJT as relaxation oscillator.
	Construct and test lamp dimmer using TRIAC/DIAC with safety.
	Construct and test MOSFET, IGBT test circuit and apply for suitable operation with proper safety.
	Construct and test the universal motor speed controller using SCR with safety.
	Construct and test a switching circuits using optical devices.
10. Select the appropriate opto electronics components and verify the characteristics in different circuit.	Plan work in compliance with standard safety norms.
	Identify the different types of LEDs and IR LEDs.
	Measure the resistance, voltage, current through electronic circuit using multimeter.
	Construct and test a circuit using photo transistor and verify its characteristics.
	Identify photo coupler/ optical sensor input/output terminals and measure the quantum of isolation between the terminals.
11. Assemble, test and troubleshoot various digital circuits.	Illustrate to practice the digital trainer kit with safety.
	Identify various digital ICs, test IC using digital IC tester and verify the truth table.
	Construct and verify the truth table of all gates using NOR and NAND gates.
	Construct an adder cum substractor circuits and verify the truth table.
	Construct a decoder and encoder, multiplexer and de-

	multiplexer circuits and verify the truth table.
	Construct a multiplexer and de-multiplexer and verify the truth table.
	Construct and verify the truth table of various flip flop, counter and shift register circuits.
12. Simulate and analyze the analog and digital circuits using Electronic simulator software.	Plan the work incompliance with standard procedure.
	Prepare simple analog and digital electronic circuits using the simulator software.
	Simulate and test the prepared analog and digital circuits.
	Convert the prepared circuit into layout diagram.
	Explore various trouble shooting and fault finding the resources provided in the simulation software
13. Identify, place, solder and desolder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup.	Identify the various crimping tools for various IC packages.
	Identify different types of soldering guns and choose the suitable tip for the application.
	Practice the soldering and de-soldering the different active and passive components, IC base on GPCBs using solder, flux, pump and wick.
	Make the necessary setting on SMD soldering station to solder and de-solder various IC's of different packages by following the safety norms.
	Identify SMD components, de-solder and solder the SMD components on the PCB.
	Check the cold continuity, identify loose/dry solder and broken track on printed wired assemblies and rectify the defects.
	Avoid waste, ascertain unused materials and components for safe disposal.
14. Construct and test different circuits using ICs 741operational amplifiers & ICs 555 linear integrated circuits and execute the result.	Demonstrate analog trainer kit with safety precautions.
	Identify various ICs, differentiate by code No. and test for their condition.
	Construct and test various OPAMP circuits.
	Construct and test R-2R ladder type digital to analog converter circuit.
	Construct and test different configurations of 555 IC e.g. astable, monostable, bi-astable and VCO circuits.

SECOND YEAR	
15. Measure the various parameters by DSO and execute the result with standard one.	Identify and demonstrate various control elements on front panel of a DSO.
	Measure different parameters of electronic signals using DSO.
	Store the waveform of a signal in DSO.
	Connect DSO with a printer and take printout of signal waveforms.
16. Rework on PCB after identifying defects from SMD soldering and de-soldering.	Plan the work in compliance with standard safety procedures.
	Demonstrate various tools and accessories used in PCB rework.
	Construct a PCB to demonstrate defects on soldered joints.
	Repair defective soldered joints.
17. Construct different electrical control circuits and test for their proper functioning with due care and safety.	Measure the coil winding of the given motor.
	Prepare the setup and control an induction motor using a DOL starter by following the safety norms.
	Construct a direction control circuit to change direction of an induction motor.
	Connect an overload relay and test for its proper functioning.
18. Prepare, crimp, terminate and test various cables used in different electronics industries.	Plan and work incompliance with standard safety norms.
	Prepare, terminate and test various electronics cable using proper crimping tools.
19. Assemble and test a commercial AM/ FM receiver and evaluate performance.	Plan and select tools to assemble the receiver.
	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 and receiver.
	Modulate and Demodulate a signal using PAM, PPM, PWM Techniques.
	Troubleshoot and replace the faulty components.
	Check the functionality of AM/FM receiver.
20. Test, service and troubleshoot the various components of different domestic/ industrial	Understand and interpret the procedure as per manual of Micro controller.
	Identity various ICs & their functions on the given Microcontroller Kit.

programmable systems.	Identify the address range of RAM & ROM.
	Write data into RAM & observe its volatility.
	Identify the port pins of the controller & configure the ports for Input & Output operation.
	Demonstrate entering of simple programs, execute & monitor the results.
21. Execute the operation of different process sensors, identify, wire & test various sensors of different industrial processes by selecting appropriate test instruments.	Ascertain and select tools, material for the job and make this available for use in the timely manner.
	Plan work in compliance with safety norms.
	Demonstrate possible solution and agree task within the team.
	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 chart.
	Measure the DC voltage of a LVDT.
	Detect different objectives using capacitive, inductive and photoelectric proximity sensors.
22. Plan and carry out the Selection of a project, assemble the project and evaluate performance for a domestic/commercial applications.	Plan, analyze and estimate the cost of the particular project.
	Identify the various tools required for the job.
	Prepare the simple digital/ analog electronic circuit.
	Simulate and test the prepared circuit.
	Assemble and test the circuit.
23. Prepare fibre optic setup and execute transmission and reception.	Plan and select appropriate tools to complete the job safely.
	Identify the resources and their need on the given fiber optic trainer kit.
	Make optical fibre setup to transmit and receive analog and digital data.
	Demonstrate and apply FM modulation and demodulation using OFC trainer kit using audio signal and voice link.
	Demonstrate PWM modulation and demodulation using OFC trainer kit using audio signal and voice link.

	Demonstrate PPM modulation and demodulation using OFC trainer kit using audio signal and voice link.
24. Plan and Interface the LCD, LED, DPM panels to various circuits and evaluate performance.	Identify LCD/LED Display module and its decoder/driver ICs and display a word on a two line LCD/LED.
	Measure/current flowing through a resistor and display it. Measure/current flowing through a sensor and display it on a LCD/LED module (DPM).
	Avoid waste and dispose the waste as per the procedures.
25. Detect the faults and troubleshoot SMPS, UPS and inverter.	Identify the tools and equipments to perform the job with due care and safety.
	Dismantle the given stabilizer and find major sections/ ICs components.
	Identify various input and output sockets / connectors of the given SMPS.
	Identify major sections/ ICs/components of SMPS.
	Identify and replace the faulty components and construct and test IC Based DC-DC converter for different voltages.
	Identify front panel control & indicators of UPS.
	Connect Battery & load to UPS & test on battery mode.
	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.
	Test UPS under Fault condition & rectify fault.
26. Install a solar panel, execute testing and evaluate performance by connecting the panel to the inverter.	Select appropriate tools and equipment.
	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.
	Installation of Solar Inverter.
	Demonstrate the installation with team.
27. Dismantle, identify the various parts and interface	Understand and interpret repair procedure as per manual of cell phone and select appropriate tools & equipment for

of a cell phone to a PC. Estimate and troubleshoot.	undertaking job.
	Plan to repair and assemble the components used as per circuit diagram.
	Dismantle, identify the parts and assemble different types of smart phones.
	Interface the cell phone/smart phone to the PC and transfer the data and browse internet.
	Flash the various brands of cell phone/smart phone (at least 3) and upgrade the OS.
	Format the cell phone/smart phone for virus (approach the mobile repair shop/service centre).
	Identify the defective parts and rectify.
28. Check the various parts of a LED lights & stacks and troubleshoot.	Understand and interpret measuring procedure as per manual.
	Conduct systematic trouble shooting.
	Dismantle the LED light, identify the connections of LEDs stacks, protection circuits, regulator.
	Measure the voltage across LED stacks.
	Identify the rectifier, controller part of LED lights.
	Test various subassemblies of the given LED light system.
	Comply with safety rules when performing the above operations.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
29. Identify, operate various controls, troubleshoot and replace modules of the LCD/LED TV & its remote.	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Plan to Dismantle and assemble modules as per circuit diagram.
	Identification and operate different Controls on LCD, 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.
	Comply with safety rules when performing the above operations.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.

SYLLABUS FOR ELECTRONICS MECHANIC TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care & safety following safety precautions.	**Trade and Orientation** 1. Visit to various sections of the institute and identify location of various installations. (5 hrs) 2. Identify safety signs for danger, warning, caution & personal safety message. (3hrs) 3. Use of personal protective equipment (PPE). (5 hrs) 4. Practice elementary first aid. (5hrs) 5. Preventive measures for electrical accidents & steps to be taken in such accidents. (2 hrs) 6. Use of Fire extinguishers. (5hrs)	Familiarization with the working of Industrial Training Institute system. Importance of safety and precautions to be taken in the industry/shop floor. Introduction to PPEs. Introduction to First Aid. Response to emergencies e.g. power failure, fire, and system failure. Importance of housekeeping & good shop floor practices. Occupational Safety & Health: Health, Safety and Environment guidelines, legislations & regulations as applicable.(07 hrs.)
		Hand tools and their uses 7. Identify the different hand tools. (5 hrs) 8. Selection of proper tools for operation and precautions in operation. (7hrs) 9. Care & maintenance of trade tools. (8hrs) 10. Practice safety precautions while working in fitting jobs. (10hrs) 11. Workshop practice on filing and hacks awing. (5hrs)	Identification, specifications, uses and maintenance of commonly used hand tools. State the correct shape of files for filing different profiles. Riveting of tags and lugs, cutting and bending of sheet metals, chassis and cabinets. (14 hrs.)

		12. Practice simple sheet metal works, fitting and drilling.(5hrs) 13. Make an open box from metal sheet. (10 hrs)	
Professional Skill 50Hrs; Professional Knowledge 14 Hrs	Select and perform electrical/ electronic measurement of single range meters and calibrate the instrument.	**Basics of AC and Electrical Cables** 14. Identify the Phase, Neutral and Earth on power socket, use a testers to monitor AC power. (03hrs) 15. Construct a test lamp and use it to check mains healthiness. (03hrs) 16. Measure the voltage between phase and ground and rectify earthing. (03 hrs) 17. Identify and test different AC mains cables. (03hrs) 18. Prepare terminations, skin the electrical wires /cables using wire stripper and cutter. (03hrs) 19. Measure the gauge of the wire using SWG and outside micrometer. (03 hrs) 20. Refer table and find current carrying capacity of wires. (01hrs) 21. Crimp the lugs to wire end. (03 hrs) 22. Measure AC and DC voltages using multi meter. (03 hrs)	Basic terms such as electric charges, Potential difference, Voltage, Current, Resistance. Basics of AC & DC. Various terms such as +ve cycle, -ve cycle, Frequency, Time period, RMS, Peak, 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. (07 hrs.)
		23. Identify the type of meters by dial and scale marking/ symbols. (3 Hrs) 24. Demonstrate various analog measuring Instruments. (3	**Single range meters** Introduction to electrical and electronic measuring instruments. Basic principle and parts of

		Hrs) 25. Find the minimum and maximum measurable range of the meter. (3 Hrs) 26. Carryout mechanical zero setting of a meter. (4Hrs) 27. Check the continuity of wires, meter probes and fuse etc. (5 Hrs) 28. Measure voltage and current using clamp meter. (5Hrs)	simple meters. Specifications, symbols used in dial and their meaning.(07 hrs.)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Test & service different batteries used in electronic applications and record the data to estimate repair cost.	**Cells & Batteries** 29. Identify the +ve and -ve terminals of the battery. (2 hrs) 30. Identify the rated output voltage and Ah capacity of given battery. (1 hrs) 31. Measure the voltages of the given cells/battery using analog/ digital multimeter. (3 hrs) 32. Charge and discharge the battery through load resistor. (5 hrs) 33. Maintain the secondary cells. (5 hrs) 34. Measure the specific gravity of the electrolyte using hydrometer. 3 hrs) 35. Test a battery and verify whether the battery is ready for use of needs recharging. (6 hrs)	**Cells & Batteries** Construction, types of primary and secondary cells. Materials used, Specification of cells and batteries. Charging process, efficiency, life of cell/battery. Selection of cells / Batteries etc. Use of Hydrometer. Types of electrolytes used in cells and batteries. Series/ parallel connection of batteries and purpose of such connections. (07 hrs.)
Professional Skill 50 Hrs; Professional Knowledge	Test various electronic components using proper measuring instruments and	**AC & DC measurements** 36. Use the multi meter to measure the various functions (AC V, DC V, DC I, AC I, R) (8 hrs.)	Introduction to electrical measuring instruments. Importance and classification of meters.

14 Hrs	compare the data using standard parameter.	37. Identify the different types of meter for measuring AC & DC parameters (8hrs.) 38. Identify the different controls on the CRO front panel and observe the function of each control (12hrs.) 39. Measure DC voltage, AC voltage, time period using CRO sine wave parameters (10hrs.) 40. Identify the different controls on the function generator front panel and observe the function of each controls (12 hrs.)	Forces necessary to work a meter. MC and MI meters. 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 (14 hrs.)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Plan and execute soldering & de-soldering of various electrical components like Switches, PCB & Transformers for electronic circuits.	**Soldering/ De-soldering and Various Switches** 41. Practice soldering on different electronic components, small transformer and lugs. (5 hrs) 42. Practice soldering on IC bases and PCBs. (5 hrs) 43. Practice de-soldering using pump and wick (2 hrs) 44. Join the broken PCB track and test (3 hrs) 45. Identify and use SPST, SPDT, DPST, DPDT, tumbler, push button, toggle, piano switches used in electronic industries (5 hrs) 46. Make a panel board using different types of switches for a given application (5 hrs)	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 soldering gun for specific requirement. Soldering and De-soldering stations and their specifications. Different switches, their specification and usage. (07 hrs.)

Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	Test various electronic components using proper measuring instruments and compare the data using standard parameter.	**Active and Passive Components** 47. Identify the different types of active electronic components. (3hrs). 48. Measure the resistor value by colour code and verify the same by measuring with multimeter (3hrs) 49. Identify resistors by their appearance and check physical defects. (2 hrs) 50. Identify the power rating of carbon resistors by their size. (3 hrs) 51. Practice on measurement of parameters in combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources. (9hrs) 52. Measurement of current and voltage in electrical circuits to verify Kirchhoff's Law (5Hrs) 53. Verify laws of series and parallel circuits with voltage source in different combinations. (5 hrs) 54. Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter (8hrs) 55. Identify different inductors and measure the values using LCR meter (5 hrs) 56. Identify the different capacitors and measure	Ohm's law and Kirchhoff's Law. Resistors; 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. Principles of induction, inductive reactance. Types of inductors, construction, specifications, applications and energy storage concept. Self and Mutual induction. Behaviour of inductor at low and high frequencies. Series and parallel combination, Q factor. Capacitance and Capacitive Reactance, Impedance. Types of capacitors, construction, specifications and applications. Dielectric constant. Significance of Series parallel connection of capacitors. Capacitor behaviour with AC and DC. Concept of Time constant of a RC circuit. Concept of Resonance and its application in RC, RL & RLC series and parallel circuit. Properties of magnets and their materials, preparation of artificial magnets, significance of electromagnetism, types of cores.

		capacitance of various capacitors using LCR meter (5 hrs) 57. Identify and test the circuit breaker and other protecting devices. (5 hrs) 58. Dismantle and identify the different parts of a relay. (5 hrs) 59. Connect a timer relay in a circuit and test for its working. (3 hrs) 60. Connect a contactor in a circuit and test for its working (2 hrs) 61. Construct and test RC time constant circuit (4 hrs) 62. Construct a RC differentiator circuit and convert triangular wave into square wave (5 hrs.) 63. Construct and test series and parallel resonance circuit (3 hrs)	Relays, types, construction and specifications etc.(21 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Assemble simple electronic power supply circuit and test for functioning.	**Power Supply Circuits** 64. Identify different types of diodes, diode modules and their specifications. (5 hrs) 65. Test the given diode using multi meter and determine forward to reverse resistance ratio. (5 hrs) 66. Measure the voltage and current through a diode in a circuit and verify its forward characteristic. (8 hrs) 67. Identify different types of transformers and test. (3 hrs) 68. Identify the primary and	Semiconductor materials, components, number coding for different electronic components such as Diodes and Zeners etc. PN Junction, Forward and Reverse biasing of diodes. Interpretation of diode specifications. Forward current and Reverse voltage. Packing styles of diodes. Different diodes, Rectifier configurations, their efficiencies, Filter components

		secondary transformer windings and test the polarity (2 hrs) 69. Construct and test a half wave, full wave and Bridge rectifier circuit. (10hrs) 70. Measure ripple voltage, ripple frequency and ripple factor of rectifiers for different load and filter capacitors. (5 hrs) 71. Identify and test Zener diode. (2 hrs) 72. Construct and test Zener based voltage regulator circuit. (5 hrs) 73. Calculate the percentage regulation of regulated power supply. (5 hrs)	and their role in reducing ripple. Working principles of Zener diode, varactor diode, their specifications and applications. Working principle of a Transformer, construction, Specifications and types of cores used. Step-up, Step down and isolation transformers with applications. Losses in Transformers. Phase angle, phase relations, active and reactive power, power factor and its importance. (14 hrs.)
Professional Skill 125 Hrs; Professional Knowledge 35 Hrs	Install, configure, interconnect given computer system(s) and demonstrate & utilize application packages for different application.	**Computer Hardware, OS, MS office and Networking** 74. Identify various indicators, cables, connectors and ports on the computer cabinet. (5 hrs) 75. Demonstrate various parts of the system unit and motherboard components. (5 hrs) 76. Identify various computer peripherals and connect it to the system. (5 hrs) 77. Disable certain functionality by disconnecting the concerned cables SATA/ PATA. (5 hrs) 78. Replace the CMOS battery and extend a memory module. (5 hrs) 79. Test and Replace the SMPS	Basic blocks of a computer, Components of desktop and motherboard. Hardware and software, I/O devices, and their working. Different types of printers, HDD, DVD. Various ports in the computer. Windows OS MS widows: Starting windows and its operation, file management using explorer, Display & sound properties, screen savers, font management, installation of program, setting and using of control panel, application of accessories, various IT tools and applications. Concept of word processing,:

		(5 hrs) 80. Replace the given DVD and HDD on the system (5 hrs) 81. Dismantle and assemble the desktop computer system. (10 hrs) 82. Boot the system from Different options (5 hrs) 83. Install OS in a desktop computer. (5 hrs) 84. Install a Printer driver software and test for print outs (5 hrs) 85. Install antivirus software, scan the system and explore the options in the antivirus software. (5 hrs) 86. Install MS office software (5 hrs) 87. Create folder and files, draw pictures using paint. (5 hrs) 88. Explore different menu/ tool/ format/ status bars of MS word and practice the options. (8 hrs) 89. Explore different menu/ tool/ format/ status bars of MS excel and practice the options. (7 hrs) 90. Prepare power point presentation on any three known topics with various design, animation and visual effects. (5 hrs) 91. Convert the given PDF File into Word file using suitable software. (5 hrs) 92. Browse search engines, create email accounts,	MS word – Menu bar, standard tool bar, editing, formatting, printing of document etc. Excel – Worksheet basics, data entry and formulae. Moving data in worksheet using tool bars and menu bars, Formatting and calculations, printing worksheet, creating multiple work sheets, creating charts. Introduction to power point Basics of preparing slides, different design aspects of slides, animation with slides etc. Concept of Internet, Browsers, Websites, search engines, email, chatting and messenger service. Downloading the Data and program files etc. **Computer Networking:-** Network features - Network medias Network topologies, protocols- TCP/IP, UDP, FTP, models and types. Specification and standards, types of cables, UTP, STP, Coaxial cables. Network components like hub, Ethernet switch, router, NIC Cards, connectors, media and firewall. Difference between PC & Server. (35 hrs.)

		practice sending and receiving of mails and configuration of email clients. (5 hrs) 93. Identify different types of cables and network components e.g. Hub, switch, router, modem etc. (5 hrs) 94. Prepare terminations, make UTP and STP cable connectors and test. (5 hrs) 95. Connect network connectivity hardware and check for its functioning. (5 hrs) 96. Configure a wireless Wi-Fi network (5 hrs)	
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Assemble simple electronic power supply circuit and test for functioning.	**IC Regulators** 97. Construct and test a +12V fixed voltage regulator. (5 hrs) 98. Identify the different types of fixed +ve and –ve regulator ICs and the different current ratings (78/79 series) (5 hrs) 99. Identify different heat sinks for IC based regulators. (2 hrs) 100. Observe the output voltage of different IC 723 metal/ plastic type and IC 78540 regulators by varying the input voltage with fixed load (8 hrs) 101. Construct and test a 1.2V – 30V variable output regulated power supply using IC LM317T. (5 hrs)	Regulated Power supply using 78XX series, 79XX series. Op-amp regulator, 723 regulator, (Transistorized & IC based). Voltage regulation, error correction and amplification etc. (14 hrs.)

Professional Skill 100 Hrs; Professional Knowledge 28 Hrs	Construct, test and verify the input/ output characteristics of various analog circuits.	**Transistor** 102. Identify different transistors with respect to different package type, B-E-C pins, power, switching transistor, heat sinks etc. (03hrs) 103. Test the condition of a given transistor using ohm-meter. (03hrs) 104. Measure and plot input and output characteristics of a CE amplifier. (05hrs) 105. Construct and test a transistor based switching circuit to control a relay (use Relays of different coil voltages and Transistors of different β) (05hrs)	Construction, working of a PNP and NPN Transistors, purpose of E, B & C Terminals. Significance of α, β and relationship of a Transistor. Need for Biasing of Transistor. VBE, VCB, VCE, IC, IB, Junction Temperature, junction capacitance, frequency of operation. Transistor applications as switch and amplifier. Transistor input and output characteristics. Transistor power ratings & packaging styles and use of different heat sinks. (07 hrs.)
		Amplifier 106. Construct and test fixed-bias, emitter-bias and voltage devider-bias transistor amplifier. (08hrs) 107. Construct and Test a common emitter amplifier with and without bypass capacitors (03hrs) 108. Construct and Test common base amplifier. (03hrs) 109. Construct and Test common collector/emitter follower amplifier. (03hrs) 110. Construct and Test Darlington amplifier. (5 hrs) 111. Construct and test a two	Different types of biasing, various configurations of transistor (C-B, C-E & C-C), their characteristics and applications. Transistor biasing circuits and stabilization Techniques. Classification of amplifiers according to frequency, mode of operation and methods of coupling. Voltage amplifiers - voltage gain, loading effect. Single stage CE amplifier and CC amplifier. Emitter follower circuit and its advantages. RC coupled amplifier, Distinguish between voltage and power amplifier, Push pull

		stage RC Coupled amplifier. (04hrs) 112. Construct and test a Class B complementary push pull amplifier. (8 hrs) 113. Construct and test class C Tuned amplifier. (5 hrs)	amplifier and class C tuned amplifier. Alpha, beta, voltage gain, Concept of dB dBm. Feedback and its types. (14 hrs.)
		Oscillators 114. Demonstrate Colpitts oscillator, Hartley oscillator circuits and compare the output frequency of the oscillator by CRO. (05hrs) 115. Construct and test a RC phase shift oscillator circuits. (5 hrs) 116. Construct and test a crystal oscillator circuits. (5 hrs) 117. Demonstrate Astable, monostable, bistable circuits using transistors. (05hrs)	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. (07 hrs.)
		Wave shaping circuits 118. Construct and test shunt clipper. (6 hrs) 119. Construct and test series and dual clipper circuit using diodes. (7 hrs) 120. Construct and test clamper circuit using diodes. (5 hrs) 121. Construct and test Zener diode as a peak clipper. (7 hrs)	Diode shunt clipper circuits, Clamping / limiting circuits and Zener diode as peak clipper, uses their applications. (07 hrs.)
Professional Skill 75 Hrs; Professional	Plan and construct different power electronic circuits and analyse the	**Power Electronic Components** 122. Identify different power electronic components, their specification and	Construction of FET & JFET, difference with BJT. Purpose of Gate, Drain and source terminals and voltage /

Knowledge 21 Hrs	circuit functioning.	terminals. (6 hrs) 123. Construct and test a FET Amplifier. (6 hrs) 124. Construct a test circuit of SCR using UJT triggering. (7 hrs) 125. Identify different heat sinks used in SCRs. (3 hrs) 126. Construct a snubber circuit for protecting SCR use freewheeling diode to reduce back emf. (7 hrs) 127. Construct a jig circuit to test DIAC. (7 hrs) 128. Construct a simple dimmer circuit using TRIAC. (7 hrs) 129. Construct UJT based free running oscillator and change its frequency. (7 hrs)	current relations between them and Impedances between various terminals. Heat Sink- Uses & purpose. Suitability of FET amplifiers in measuring device applications. Working of different power electronic components such as SCR, TRIAC, DIAC and UJT. (14 hrs.)
		MOSFET & IGBT 130. Identify various Power MOSFET by its number and test by using multimeter. (5 hrs) 131. Identify different heat sinks used with various power MOSFET devices. (5 hrs) 132. Construct MOSFET test circuit with a small load. (5 hrs) 133. Identify IGBTs by their numbers and test by using multimeter. (5 hrs) 134. Construct IGBT test circuit with a small load. (5 hrs)	MOSFET, Power MOSFET and IGBT, their types, characteristics, switching speed, power ratings and protection. Differentiate FET with MOSFET. Differentiate Transistor with IGBT. (07 hrs.)
Professional Skill 50 Hrs;	Select the appropriate opto	**Opto Electronics** 135. Test LEDs with DC supply	Working and application of LED, IR LEDs, Photo diode,

Professional Knowledge 14 Hrs	electronics components and verify the characteristics in different circuit.	and measure voltage drop and current using multimeter. (5 hrs) 136. Construct a circuit to test photo voltaic cell. (5 hrs) 137. Construct a circuit to switch a lamp load using photo diode. (5 hrs) 138. Construct a circuit to switch a lamp load using photo transistor. (5 hrs) 139. Identify opto coupler input and output terminals and measure the quantum of isolation between input/output terminals and operate a relay by connecting a switch. (5 hrs)	photo transistor, their characteristics and applications. Optical sensor, opto-couplers, circuits with opto isolators. Characteristics of LASER diodes. (14 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Assemble, test and troubleshoot various digital circuits.	**Basic Gates** 140. Identify different Logic Gates (AND, OR, NAND, NOR, EX-OR, EX-NOR, NOT ICs) by the number printed on them. (05hrs) 141. Verify the truth tables of all Logic Gate ICs by connecting switches and LEDs. (05hrs) 142. Construct and verify the truth table of all the gates using NAND and NOR gates. (04hrs) 143. Use digital IC tester to test the various digital ICs (TTL and CMOS). (03hrs)	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. Various Logic Gates and their truth tables.(05 hrs.)
		Combinational Circuits 144. Construct Half Adder circuit using ICs and verify the truth table. (3 hrs)	Combinational logic circuits such as Half Adder, Full adder, Parallel Binary adders, 2-bit

		145. Construct Full adder with two Half adder circuit using ICs and verify the truth table. (03hrs) 146. Construct the adder cum subtractor circuit and verify the result. (03hrs) 147. Construct and Test a 2 to 4 Decoder. (3 hrs) 148. Construct and Test a 4 to 2 Encoder. (3 hrs) 149. Construct and Test a 4 to 1 Multiplexer. (3 hrs) 150. Construct and Test a 1 to 4 De Multiplexer. (3 hrs)	and four bit full adders. Magnitude comparators. Half adder, full adder ICs and their applications for implementing arithmetic operations. Concept of encoder and decoder. Basic Binary Decoder and four bit binary decoders. Need for multiplexing of data. 1:4 line Multiplexer / De-multiplexer. (04 hrs.)
		Flip Flops 151. Identify different Flip-Flop (ICs) by the number printed on them. (03hrs) 152. Construct and test four bit latch using 7475. (03hrs) 153. Construct and test R-S flip-flop using IC7400 with clock and without clock pulse. (03hrs) 154. Verify the truth tables of Flip-Flop ICs (RS, D, T, JK, MSJK) by connecting switches and LEDs. (03hrs)	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. (05 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Simulate and analyze the analog and digital circuits using Electronic simulator software.	**Electronic circuit simulator** 155. Prepare simple digital and electronic circuits using the software (10 hrs) 156. Simulate and test the prepared digital and analog circuits (16 hrs) 157. Convert the prepared circuit into a layout diagram. (10 hrs) 158. Prepare simple, power	Study the library components available in the circuit simulation software. Various resources of the software. (14 hrs.)

		electronic and domestic electronic circuit using simulation software. (14 hrs)	
Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	Assemble, test and troubleshoot various digital circuits.	**Counter & shift Registers** 159. Construct and test a four bit asynchronous binary counter using 7493 (6hrs) 160. Construct and test 7493 as a modulus-12 counter. (6hrs) 161. Construct and test a four bit Synchronous binary counter using 74163. (8hrs) 162. Construct and test synchronous Decade counter. (6hrs) 163. Construct and test an up/down synchronous decade counter using 74190 and monitor the output on LEDs. (8hrs) 164. Identify and test common anode and common cathode seven segment LED display using multi meter. (5hrs) 165. Display the two digit count value on seven segment display using decoder/driver ICs. (6hrs) 166. Construct a shift register using RS/D/JK flip flop and verify the result. (6hrs) 167. Construct and test four bit SIPO register. (8hrs) 168. Construct and test four bit PIPO register. (8hrs) 169. Construct and test bidirectional shift registers. (8hrs)	Basics of Counters, types, two bit and three bit Asynchronous binary counters and decade counters with the timing diagrams. 3-bit Synchronous counters and synchronous decade counters. Types of seven segment display. BCD display and BCD to decimal decoder. BCD to 7 segment display circuits. Basics of Register, types and application of Registers. (21 hrs.)
Professional Skill 75 Hrs;	Construct and test different circuits using ICs	**Op – Amp & Timer 555 Applications** 170. Use analog IC tester to	Block diagram and Working of Op-Amp, importance, Ideal

Professional Knowledge 21 Hrs	741operational amplifiers & ICs 555 linear integrated circuits and execute the result.	test the various analog ICs. (5 hrs) 171. Construct and test various Op-Amp circuits Inverting, Non-inverting and Summing Amplifiers. (10hrs) 172. Construct and test Differentiator and Integrator (10 hrs) 173. Construct and test a zero crossing detector. (5 hrs) 174. Construct and test Instrumentation amplifier (10 hrs) 175. Construct and test a Binary weighted and R-2R Ladder type Digital-to-Analog Converters (10hrs.) 176. Construct and test Astable timer circuit using IC 555 (05hrs) 177. Construct and test mono stable timer circuit using IC 555. (05hrs) 178. Construct and test VCO (V to F Converter) using IC 555. (05hrs) 179. Construct and test 555 timers as pulse width modulator. (10 hrs)	characteristics, advantages and applications. Schematic diagram of 741, symbol. Non-inverting voltage amplifier, inverting voltage amplifier, summing amplifier, Comparator, zero cross detector, differentiator, integrator and instrumentation amplifier, other popular Op-Amps. Block diagram of 555, functional description w.r.t. different configurations of 555 such as monostable, astable and VCO operations for various application. (28 hrs.)
Project work / Industrial visit **Broad Areas:** a) Delayed automatic power on circuit. b) Neon flasher circuit using IC 741 c) UJT act as a relaxation oscillator d) Up/down synchronous decade counter e) Portable continuity cum capacitor tester			

SYLLABUS FOR ELECTRONICS MECHANIC TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Measure the various parameters by DSO and execute the result with standard one.	**Digital Storage Oscilloscope** 180. Identify the different front panel control of a DSO. (5 hrs) 181. Measure the Amplitude, Frequency and time period of typical electronic signals using DSO. (7 hrs) 182. Take a print of a signal from DSO by connecting it to a printer and tally with applied signal. (6 hrs) 183. Construct and test function generator using IC 8038. (7 hrs)	Advantages and features of DSO. Block diagram of Digital storage oscilloscope (DSO)/ CRO and applications. Applications of digital CRO. Block diagram of function generator. Differentiate a CRO with DSO. (09 hrs.)
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	Identify, place, solder and desolder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup.	**Basic SMD (2, 3, 4 terminal components)** 184. Identification of 2, 3, 4 terminal SMD components. (5 hrs) 185. De-solder the SMD components from the given PCB. (5 hrs) 186. Solder the SMD components in the same PCB. (5 hrs) 187. Check for cold continuity of PCB. (3 hrs) 188. Identification of loose /dry solder, broken tracks on printed wired assemblies. (7 hrs)	Introduction to SMD technology Identification of 2, 3, 4 terminal SMD components. Advantages of SMD components over conventional lead components. Soldering of SM assemblies - Reflow soldering. Tips for selection of hardware, Inspection of SM. (09 hrs.)

		SMD Soldering and De-soldering 189. Identify various connections and setup required for SMD Soldering station. (5 hrs) 190. Identify crimping tools for various IC packages. (3 hrs) 191. Make the necessary settings on SMD soldering station to de-solder various ICs of different packages (at least four) by choosing proper crimping tools. (14 hrs) 192. Make the necessary settings on SMD soldering station to solder various ICs of different packages (at least four) by choosing proper crimping tools. (14 hrs) 193. Make the necessary setting rework of defective surface mount component used soldering / de-soldering method. (14 hrs)	Introduction to Surface Mount Technology (SMT). 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. Identification of Programmable Gate array (PGA) packages. Specification of various tracks, calculation of track width for different current ratings. Cold/ Continuity check of PCBs. Identification of lose / dry solders, broken tracks on printed wiring assemblies. Introduction to Pick place Machine, Reflow Oven, Preparing stencil,& stencil printer (18 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Rework on PCB after identifying defects from SMD soldering and de-soldering.	**PCB Rework** 194. Checked and Repair Printed Circuit Boards single, Double layer, and important tests for PCBs. (12 hrs) 195. Inspect soldered joints, detect the defects and test the PCB for rework. (8 hrs) 196. Remove the conformal	Introduction to Static charges, prevention, handling of static sensitive devices, various standards for ESD. Introduction to non-soldering interconnections. Construction of Printed Circuit Boards (single, Double, multi-layer), Important tests for PCBs.

		coatings by different methods. (8 hrs) 197. Perform replacement of coating. (8 hrs) 198. Perform baking and preheating. (8 hrs) 199. Repair solder mask and damage pad. (6 hrs)	Introduction to rework and repair concepts. Repair of damaged track. Repair of damaged pad and plated through hole. Repair of solder mask. (18 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Construct different electrical control circuits and test for their proper functioning with due care and safety.	**Protection devices** 200. Identify different types of fuses along with fuse holders, overload (no volt coil), current adjust (Biometric strips to set the current). (9 hrs) 201. Test the given MCBs. (8 hrs) 202. Connect an ELCB and test the leakage of an electrical motor control circuit. (8 hrs)	Necessity of fuse, fuse ratings, types of fuses, fuse bases. Single/ three phase MCBs, single phase ELCBs. Types of contactors, relays and working voltages. Contact currents, protection to contactors and high current applications. (09 hrs.)
		Electrical control circuits 203. Measure the coil winding resistance of the given motor. (6 hrs.) 204. Prepare the setup of DOL starter and Control an induction motor. (7 hrs) 205. Construct a direction control circuit to change direction of an induction motor. (6 hrs.) 206. Connect an overload relay and test for its proper functioning. (6 hrs)	Fundamentals of single phase Induction motors, synchronous speed, slip, rotor frequency. Torque-speed characteristics, Starters used for Induction motors. (09 hrs.)
Professional Skill 50 Hrs; Professional Knowledge	Prepare, crimp, terminate and test various cables used in different electronics	**Electronic Cables & Connectors** 207. Identify various types of cables viz. RF coaxial feeder, screened cable, ribbon cable, RCA	Cable signal diagram conventions Classification of electronic cables as per the application

18 Hrs	industries.	connector cable, digital optical audio, video cable, RJ45, RJ11, Ethernet cable, fibre optic cable splicing, fibre optic cable mechanical splices, insulation, gauge, current capacity, flexibility etc. used in various electronics products, different input output sockets. (15 hrs) 208. Identify suitable connectors, solder/crimp /terminate & test the cable sets. (10 hrs) 209. Check the continuity as per the marking on the connector for preparing the cable set. (10 hrs) 210. Identify and select various connectors and cables inside the CPU cabinet of PC. (10 hrs) 211. Identify the suitable connector and cable to connect a computer with a network switch and prepare a cross over cable to connect two network computers. (5 hrs)	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, TPC, coaxial, types of fibre optical Cables and Cable trays. Different types of connectors Servo 0.1" connectors, FTP, RCA, BNC, HDMI Audio/video connectors like XLR, RCA (phono), 6.3 mm PHONO, 3.5 / 2.5 mm PHONO, BANTAM, SPEAKON, DIN, mini DIN, RF connectors, USB, Fire wire, SATA Connectors, VGA, DVI connectors, MIDI and RJ45,RJ11 etc. (18 hrs.)
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	Assemble and test a commercial AM/ FM receiver and evaluate performance.	**Communication electronics** 212. Modulate and Demodulate various signals using AM and FM on the trainer kit and observe waveforms (10hrs) 213. Construct and test IC based AM Receiver (10hrs)	Radio Wave Propagation – principle, fading. Need for Modulation, types of modulation and demodulation. Fundamentals of Antenna, various parameters, types of Antennas & application. Introduction to AM, FM & PM,

		214. Construct and test IC based FM transmitter (10hrs) 215. Construct and test IC based AM transmitter and test the transmitter power. Calculate the modulation index. (10hrs) 216. Dismantle the given FM receiver set and identify different stages (AM section, audio amplifier section etc) (10hrs) 217. Modulate two signals using AM kit draw the way from and calculate percent (%) of modulation. (10hrs) 218. Modulate and Demodulate a signal using PAM, PPM, PWM Techniques (15hrs)	SSB-SC & DSB-SC. Block diagram of AM and FM transmitter. FM Generation & Detection. 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/demod techniques.*** (27 hrs.)
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	Test, service and troubleshoot the various components of different domestic/ industrial programmable systems.	**Microcontroller (8051)** 219. Identify various ICs & their functions on the given Microcontroller Kit. (5hrs) 220. Identify the address range of RAM & ROM. (5hrs) 221. Measure the crystal frequency, connect it to the controller. (5hrs) 222. Identify the port pins of the controller & configure the ports for Input & Output operation. (7hrs) 223. Use 8051 microcontroller, connect 8 LED to the port, blink the LED with a switch. (10hrs) 224. Perform the initialization,	Introduction Microprocessor & 8051Microcontroller, 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

		load & turn on a LED with delay using Timer. (8hrs) 225. Perform the use of a Timer as an Event counter to count external events. (10 hrs) 226. Demonstrate entering of simple programs, execute & monitor the results. (10 hrs) 227. Perform with 8051 microcontroller assembling language program, check the reading of an input port and sending the received bytes to the output port of the microcontroller, used switches and LCD for the input and output. (15hrs)	configuration for different applications. Comparative study of 8051 with 8052. Introduction to PIC Architecture. (27 hrs.)
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	Execute the operation of different process sensors, identify, wire & test various sensors of different industrial processes by selecting appropriate test instruments.	**Sensors, Transducers and Applications** 228. Identify sensors used in process industries such as RTDs, Temperature ICs, Thermocouples, proximity switches (inductive, capacitive and photo electric), load cells, strain gauge. LVDT PT 100 (platinum resistance sensor), water level sensor, thermostat float switch, float valve by their appearance (15hrs) 229. Measure temperature of a lit fire using a Thermocouple and record the readings referring to	Basics of passive and active transducers. Role, selection and characteristics. Sensor voltage and current formats. Thermistors/ Thermocouples - Basic principle, salient features, operating range, composition, advantages and disadvantages. Strain gauges/ Load cell – principle, gauge factor, types of strain gauges. Inductive/ capacitive

		data chart. (15hrs) 230. Measure temperature of a lit fire using RTD and record the readings referring to data chart (15 hrs.) 231. Measure the DC voltage of a LVDT (15hrs) 232. Detect different objectives using capacitive, inductive and photoelectric proximity sensors (15hrs)	transducers - Principle of operation, advantages and disadvantages. Principle of operation of LVDT, advantages and disadvantages. Proximity sensors – applications, working principles of eddy current, capacitive and inductive proximity sensors (27 hrs.)
Professional Skill 100 Hrs; Professional Knowledge 36 Hrs	Plan and carry out the selection of a project, assemble the project and evaluate performance for a domestic/commercial applications.	**Analog IC Applications** 233-237 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)** (50Hrs)	Discussion on the identified projects with respect to data of the concerned ICs. Components used in the project. (18 hrs.)
		Digital IC Applications 238-242 Make simple projects/Applications	Discussion on the identified projects with respect to data of the concerned ICs.

		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)** (50 Hrs)	Components used in the project. (18 hrs.)
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Prepare fibre optic setup and execute transmission and reception.	**Fiber optic communication** 243. Identify the resources and their need on the given fiber optic trainer kit (3 hrs) 244. Make optical fiber setup to transmit and receive analog and digital data (4 hrs) 245. Set up the OFC trainer kit to study AM, FM, PWM modulation and demodulation. (6 hrs) 246. Perform FM modulation and demodulation using OFC trainer kit using audio signal and voice link (4 hrs)	Introduction to optical fiber, optical connection and various types optical amplifier, its advantages, properties of optic fiber, testing, losses, types of fiber optic cables and specifications. Encoding of light. Fiber optic joints, splicing, testing and the related equipment/ measuring tools. Precautions and safety aspects while handling optical cables. (09 hrs.)

		247. Perform PWM modulation and demodulation using OFC trainer kit using audio signal and voice link (4 hrs) 248. Perform PPM modulation and demodulation using OFC trainer kit using audio signal and voice link (4 hrs)	
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Plan and Interface the LCD, LED DPM panels to various circuits and evaluate performance.	**Digital panel Meter** 249. Identify LED Display module and its decoder/driver ICs (6 hrs) 250. Display a word on a two line LED (8 hrs) 251. Measure/current flowing through a resistor and display it on LED Module (10 hrs) 252. Measure/current flowing through a sensor and display it on a LED module(DPM) (10 hrs) 253. Identify LCD Display module and its decoder/driver ICs (8 hrs) 254. Measure/current flowing through a resistor and display it. (8 hrs)	Different types of seven segment displays, decoders and driver ICs. Concept of multiplexing and its advantages. Block diagrams of 7106 and 7107 and their configuration for different measurements. Use of DPM with seven segment display. Principles of working of LCD. Different sizes of LCDs. Decoder/ driver ICs used with LCDs and their pin diagrams. Use of DPM with LCD to display different voltage & current signals. (18 hrs.)
Professional Skill 150Hrs; Professional Knowledge 54 Hrs	Detect the faults and troubleshoot SMPS, UPS and inverter.	**SMPS and Inverter** 255. Identify the components/devices and draw their corresponding symbols (4 hrs) 256. Dismantle the given stabilizer and find major sections/ ICs components. (6 hrs) 257. List the defect and	Concept and block diagram of manual, automatic and servo voltage stabilizer, o/p voltage adjustment. Voltage cut-off systems, relays used in stabilizer. Block Diagram of different types of Switch mode power supplies and their working

		symptom in the faulty SMPS. (5 hrs) 258. Measure / Monitor major test points of computer SMPS. (8 hrs) 259. Troubleshoot the fault in the given SMPS unit. Rectify the defect and verify the output with load. Record your procedure followed for trouble shooting the defects (10 hrs) 260. Use SMPS used in TVs and PCs for Practice. (6 hrs) 261. Install and test the SMPS in PC (6 hrs) 262. Install and test an inverter. (6 hrs) 263. Troubleshoot the fault in the given inverter unit. Rectify the defects and verify the output with load. (6 hrs) 264. Construct and test IC Based DC-DC converter for different voltages (6 hrs) 265. Construct and test a switching step down regulator using LM2576 (6 hrs) 266. Construct and test a switching step up regulator using MC 34063 (6 hrs)	principles. Various types of chopper circuits. Inverter; principle of operation, block diagram, power rating, change over period. Installation of inverters, protection circuits used in inverters. Battery level, overload, over charging etc. Various faults and its rectification in inverter. Block diagram of DC-DC converters and their working principals. (27 hrs.)
		UPS 267. Connect battery stack to the UPS. (4 hrs) 268. Identify front panel	Concept of Uninterrupted power supply. Difference between Inverters

		control & indicators of UPS. (4 hrs) 269. Connect Battery & load to UPS & test on battery mode. (6 hrs) 270. Open top cover of a UPS; identify its isolator transformers, the UPS transformer and various circuit boards in UPS. (10 hrs) 271. Identify the various test point and verify the voltages on these (7 hrs.) 272. Identify various circuit boards in UPS and monitor voltages at various test points (7 hrs) 273. Perform load test to measure backup time. (7 hrs) 274. Perform all above experiment for three phase UPS. (30 hrs)	and UPS. Basic block diagram of UPS & operating principle. 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. Installation of single phase & three phase UPS. (27 hrs.)
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	Install a solar panel, execute testing and evaluate performance by connecting the panel to the inverter.	**Solar Power (Renewable Energy System)** 275. Install a solar panel to a roof. (25 hrs) 276. Wire a solar controller to a battery storage station. (5 hrs) 277. Install solar power 500 panel to directly 12 V DC appliances (15 hrs) 278. Connect storage batteries to a power inverter (5 hrs) 279. Connect and test solar panel to the Inverter and run the load. (5 hrs) 280. Install a solar power to	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. 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. Solar charge controller or regulator and its role.

		charge a rechargeable 12 V DC battery and find out the charging time (15 hrs) 281. Install a Solar Inverter. (5 hrs)	Safety precautions while working with solar systems. (27 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Dismantle, identify the various parts and interface of a cell phone to a PC. Estimate and troubleshoot.	**Cell phones** 282. Dismantle, identify the parts and assemble different types of smart phones (6 hrs) 283. Dismantle the cell phone/smart phone remove the key pad and clean it, test for the continuity of the matrix/tracks (10 hrs) 284. Interface the cell phone/smart phone to the PC and transfer the data card (6 hrs) 285. Flash the various brands of cell phone/smart phone (at least 3) (5 hrs) 286. Format the cell phone/smart phone for virus (approach the mobile repair shop/service centre) (5 hrs) 287. Unlock the handsets through codes and software (3 hrs) 288. Perform the interfacing of cell phone/smart phone to the PC and dismantle the cell phone and identify the power section and test its healthiness (6 hrs) 289. Find out the fault of basic	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. (18 hrs.)

		cell phone system. Rectify the fault in ringer section and check the performance (6 hrs) 290. Replace various faulty parts like mic, speaker, data/ charging/ audio jack etc. (5 hrs)	
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Check the various parts of a LED lights & stacks and troubleshoot.	**LED Lights** 291. Dismantle the LED light, identify the connections of LEDs stacks, protection circuits, regulator (12 hrs) 292. Identify the rectifier, controller part of LED lights (8 hrs) 293. Make series string connection of six LED's and connect four Series strings in parallel. (8 hrs) 294. Connect to such parallel sets in Series to create a matrix of LED's. (14 hrs.) 295. Apply suitable voltage and check Voltage across series strings. (8 hrs)	Types of LED panels used in various lighting applications. Stacking of LEDs. Driving of LED stacks. (09 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Identify, operate various controls, troubleshoot and replace modules of the LCD/LED TV & its remote.	**LCD and LED TV** 296. Identify and operate different Controls on LCD, LED TV (05hrs) 297. Identify components and different sectors of LCD and LED TV. (10hrs) 298. Dismantle; Identify the parts of the remote control (05hrs) 299. Dismantle the given LCD/LED TV to find faults with input stages through connectors. (10hrs)	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. TV Remote Control –Types, parts and functions, IR Code

		300. Detect the defect in a LED/LCD TV receiver given to you. Rectify the fault. (15hrs) 301. Troubleshoot the faults in the given LED/LCD TV receiver. Locate and rectify the faults. (15hrs) 302. Test LED/LCD TV after troubleshooting the defects (10 hrs) 303. Identify various connectors and connect the cable operators external decoder (set top box) to the TV. (5 hrs.)	transmitter and IR Code Receiver. Working principle, operation of remote control. Different adjustments, general faults in Remote Control. (36 hrs.)
Project work / Industrial visit **Broad areas:** a) Remote control for home appliances b) Solar power inverter c) Musical light chaser d) 7 segment LED display decoder drive circuit			

SYLLABUS FOR CORE SKILLS
1. Workshop Calculation & Science(Common for two years course) (80Hrs + 80 Hrs)
2. Engineering Drawing (Common for Group-II (Electrical, Electronics & IT Trade Group)) (80Hrs + 80 Hrs)
3. Employability Skills (Common for all CTS trades) (160Hrs + 80 Hrs)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately inwww.bharatskills.gov.in

ANNEXURE-I

List of Tools & Equipment			
ELECTRONICS MECHANIC(for batch of 24 candidates)			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-12 is required additionally)			
1.	Connecting screwdriver	10 X 100 mm	12 Nos.
2.	Neon tester 500 V.	500 V	8 Nos.
3.	Screw driver set	Set of 7	12 Nos.
4.	Insulated combination pliers	150 mm	8 Nos.
5.	Insulated side cutting pliers	150mm	10 Nos.
6.	Long nose pliers	150mm	8 Nos.
7.	Soldering iron	25 Watt, 240 Volt	12 Nos.
8.	Electrician knife	100 mm	8 Nos.
9.	Tweezers	150 mm	12 Nos.
10.	Digital Multimeter	(3 3/4 digit) ,4000 Counts	12 Nos.
11.	Soldering Iron Changeable bits	15 Watt, 240 Volt	8 Nos.
12.	De- soldering pump electrical heated, manual operators	230 V, 40 W	12 Nos.
B. SHOP TOOLS, INSTRUMENTS – For 2 (1+1) units no additional items are required			
Lists of Tools:			
13.	Steel rule graduated both in Metric and English Unit	300 mm,	4 Nos.
14.	Precision set of screw drivers	T5, T6, T7	2 Nos.
15.	Tweezers – Bend tip		2 Nos.
16.	Steel measuring tape	3 meter	4 Nos.
17.	Tools makers vice	100mm (clamp)	1 Nos.
18.	Tools maker vice	50mm (clamp)	1 Nos.
19.	Crimping tool (pliers)	7 in 1	2 Nos.
20.	Magneto spanner set	8 Spanners	2 Nos.
21.	File flat bastard	200 mm	2 Nos.
22.	File flat second cut	200 mm	2 Nos.
23.	File flat smooth	200 mm	2Nos.

24.	Plier - Flat Nose	150 mm	4 Nos.
25.	Round Nose pliers	100 mm	4 Nos.
26.	Scriber straight	150 mm	2 Nos.
27.	Hammer ball pen	500 grams	1 No.
28.	Allen key set (Hexagonal -set of 9)	1 - 12 mm, set of 24 Keys	1 No.
29.	Tubular box spanner	Set - 6 - 32 mm	1 set.
30.	Magnifying lenses	75 mm	2 Nos.
31.	Continuity tester		6 Nos.
32.	Hacksaw frame adjustable	300 mm	2 Nos.
33.	Chisel - Cold - Flat	10 mm X 150 mm	1 No.
34.	Scissors	200mm	1 No.
35.	Handsaw 450mm	Hand Saw - 450 mm	1 No.
36.	Hand Drill Machine Electric with Hammer Action	13 mm	2 Nos.
37.	First aid kit		1 No.
38.	Bench Vice	Bench Vice - 125 mm	1 No. each
		Bench Vice - 100 mm	
		Bench Vice - 50 mm	
List of Equipments			
39.	Dual DC regulated power supply	30-0-30 V, 2 Amps	4 Nos.
40.	DC Regulated Variable Programmable DC Power Supply	0-30V/3A	2 Nos.
41.	LCR meter (Digital) Handheld		1 No.
42.	CRO Dual Trace	20 MHz (component testing facilities)	2 Nos.
43.	Signal Generator with Digital Display for Frequency Amplitude	10 Hz to 100 Khz, 50/600 Ohms (output impedance)	2 Nos.
44.	Battery Charger	0 - 6 - 9 - 12 - 24 - 48 V, 30 Amp	1 No.
45.	Analog multimeter		4 Nos.
46.	Clamp meter	0 - 10 A	2 Nos.
47.	Function generator (DDS Technology (Sine, Square, Triangle, Ramp, Pulse, Serial Data, TTL and Modulation.)	1 mHz -10 MHz Function-Pulse – Modulation Generator with Built in 40MHz Frequency Counter	2 Nos.
48.	Dimmer starter	3 Amps	2 Nos.

49.	Autotransformer	15 Amps	2 Nos.
50.	Analog Component Trainer	Breadboard for Circuit design with necessary DC /AC power supply: Sine, Square, Triangle Modulating Signal Generator and Simulation Software	4 Nos.
51.	Milli Ammeter (AC)	0 – 200 mA	2 Nos.
52.	Milli Ammeter (DC)	0 – 500 mA	2 Nos.
53.	Op Amp trainer		2 Nos.
54.	Digital IC Trainer	Breadboard for Circuit design with necessary DC Power Supply, Graphical LCD, Clock Frequency 4 different steps, Data Switches: 8 Nos, LED Display: 8 Nos. (TTL), Seven Segment Display, Teaching Simulation Software	4 Nos.
55.	Digital IC Tester		1 No.
56.	Digital and Analog Bread Board Trainer	DC/AC Power Supply, Sine/ Square/ TTL Generator Data Switches, LED indication, LED Display: 8 in Nos Simulation/Teaching Content through software	6 Nos.
57.	Rheostats various values and ratings		2 Nos. each
58.	POWER ELECTRONICS TRAINER with at least 6 no's of application board MOSFET Characteristics SCR Characteristics SCR Lamp Flasher SCR Alarm Circuit Series Inverter Single Phase PWM Inverter		4 No.
59.	Computers in the assembled		4 Nos.

	form (including cabinet, motherboards, HDD, DVD, SMPS, Monitor, KB, Mouse, LAN card, Blu-Ray drive and player), MS Office education version.		
60.	Laptops latest configuration		1 No.
61.	Laser jet Printer		1 No.
62.	INTERNET BROADBAND CONNECTION		1 No.
63.	Electronic circuit simulation software with 6 user licenses	Circuit Design and Simulation Software with PCB Design with Gerber and G Code Generation, 3D View of PCB, Breadboard View, Fault Creation and Simulation.	1 No.
64.	Different types of electronic and electrical cables, connectors, sockets, terminations.		As required
65.	Different types of Analog electronic components, digital ICs, power electronic components, general purpose PCBs, bread board, MCB, ELCB		As required
66.	DSO (colour)	4 Channel , 50MHz Real Time Sampling 1G Samples/Sec, 12 Mpts Memory with PC Interface USB, LAN and math function includes +, -, FFT, differential, integral, abs, log etc.	1 No.
67.	Soldering & De soldering Station		1 No.
68.	SMD Soldering & De soldering Station with necessary accessories		2 Nos.
69.	DOL starter		1 No.
70.	AC Motor Trainer Kit ¼ HP motor		1 No.

	Single Phase Contactors Relays MCB DOL Starter		
71.	Frequency modulator and Demodulator trainer kit	FM Modulator Type : Reactance Modulator, Varactor Modulator, VCO Based Modulator FM Demodulator type All 5 demodulation techniques Detailed teaching and learning contents through software.	2 Nos.
72.	PAM, PPM,PWM trainer kit		2 Nos.
73.	AM/FM Commercial radio receivers		2 Nos.
74.	Microcontroller kits (8051) along with programming software (Assembly level Programming)	Core 8051, ready to run programmer for AT89C51/52 & 55, programming modes Key Pad and PC circuits. Detailed learning content through simulation Software.	4 Nos.
75.	Application kits for Microcontrollers 6 different applications	1. Input Interface : 4x4 Matrix Keypad, ASCII Key PAD, Four Input Switch 2. Display Module 16X2 LCD, Seven Segment, LED Bar Graph 3. ADC/DAC Module with most popular DC/DAC0808 4. PC Interface: RS232 & USB 5. Motor Drive: DC, Servo, Stepper 6. DAQ: Data Acquisition to sense different sensors signals	1 set
76.	Sensor Trainer Kit Containing following Sensors 1. Thermocouple 2. RTD 3. Load Cell/ Strain Gauge 4. LVDT	Graphical touch LCD with inbuilt processor for viewing the output waveforms, In built DAQ, and standard processing circuits like Inverting , Non – Inverting , Power, Current ,	2 Nos.

	5. Smoke Detector Sensors 6. Speed Sensor 7. Limit Switch 8. Photo sensors 9. Optocouplor 10. Proximity Sensor	Instrumentation Differential Amplifier, F/V,V/F,V/I,I/V Converter, **Sensors :**RTD,NTC Thermistor,LM35 Thermocouple, Gas(Smoke) Sensor, Load cell, LVDT Sensor, Speed Sensor	
77.	Various analog and digital ICs useful for doing project works mentioned in the digital and analog IC applications modules		As required
78.	Different types of electronic and electrical cables, connectors, sockets, terminations.		As required
79.	Fiber optic communication trainer	Full Duplex Analog & Digital Trans-receiver with 660nm & 950nm, Noise Generator with variable gain, Four Seven Segment Display BER Counter, Eye Pattern.	2 Nos.
80.	Seven segment DPM trainer		6 Nos.
81.	LCD based DPM		6 Nos.
82.	SMPS of different make		4 Nos.
83.	UPS trainer	PWM switching technology, Test points to measures the voltages of different sections Overall functioning of UPS Trainer, AVR transformer, UPS with load condition	1No.
84.	UPS		As required
85.	Mobile phone Trainer	2G /3G/4G Dual SIM GSM Handset. Frequency measurement and band verification. Real time Mobile Operation	1 No.
86.	Smart phones of different make (android/Windows)		4 Nos.

87.	Cell phone power source with charger chords for different cell phones		As required
88.	LCD TV (Trainer kit)	21-inch full HD LCD Color Television should support PAL/ NTSC video formats Complete block diagram of a LCD TV system, Study board indicating various sections of LCD TV along with the test points and switch faults	1 No.
89.	LCD TV (21”)		2 Nos.
90.	LED TV (Trainer kit)	20-inch full HD LED Color Television, PAL/ NTSC video formats, complete block diagram of a LED TV system, Study board indicating various sections of LED TV along with the test points and switch faults Trouble shooting in different sections.	1 No.
91.	LED TV (21”)		2 Nos.
92.	Home theatre system		1No.
93.	Solar Training Kit/ Simulator	With built in meters for DCV, DCA, AC multifunction Meter (for ACI, ACV, Power, Frequency), Protection Circuits, BS-10 terminals for making the connection, Single/ Dual axis tracking system Charge Controller : PWM based MPPT, Charging Stage : Bulk, Absorptions and Float	1 No.
94.	LED lighting system	Measurement of Power, Voltage, Current, Power Factor and Light output performance of different lighting products like LED, CFL at variable input	2 sets

		voltages 0 to 245V variable AC	
C. Shop Floor Furniture and Materials - For 2 (1+1) units no additional items are required.			
95.	Instructor's table		1 No.
96.	Instructor's chair		2 Nos.
97.	Metal Rack	100cm x 150cm x 45cm	4 Nos.
98.	Lockers with 16 drawers standard size		2 Nos.
99.	Steel Almirah	2.5 m x 1.20 m x 0.5 m	2 Nos.
100.	Black board/white board		1 No.
101.	Fire Extinguisher		2 Nos.
102.	Fire Buckets		2 Nos.

ANNEXURE - II

The DGT sincerely acknowledges contributions of the Industries, State Directorates, Trade Experts, Domain Experts, trainers of ITIs, NSTIs, faculties from universities and all others who contributed in revising the curriculum.

Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

List of Expert Members participated for finalizing the course curriculum of Electronics Mechanic trade on 13.01.2017 at CSTARI, Kolkata			
S No.	**Name & Designation Shri/Mr./Ms.**	**Organization**	**Remarks**
1.	DEEPANKAR MALLICK, DDG (Trg.)	DGT, MSDE, New Delhi	Chairman
2.	H. V. SAMVATSAR, Director	CSTARI, Kolkata	Member
3.	SANJAY KUMAR Joint Director of Trg.	CSTARI, Kolkata	Member
4.	L. K. MUKHERJEE Dy. Director of Trg.	CSTARI, Kolkata	Member
5.	R. N. BADYOPADHYAYA Chairman	Board of Studies & Skill, WBSCT&VE&SD	Member
6.	P. K. BISWAS Sr. DGM	BHEL – PSER, Salt Lake, Sec – II	Member
7.	P. C. BHANDARI Technical Advisor	J K Cement Ltd. Kanpur	Member
8.	AMALENDU JANA Manager	TATA Communication Pvt. Ltd. Ultadanga, Kolkata	Member
9.	VIVEK KR. SINGH SC-D & DDO	SAMEER Kolkata Centre Plot – L2, Block –GP, Sec-V, Kolkata-91	Member
10.	K. RAVIKUMAR DGM	AAI, NetajiSubhash Chandra Bose International Airport	Member
11.	K. C. DUTTA Sr. Superintendent	AAI, NetajiSubhash Chandra Bose International Airport	Member
12.	SUMANTA MODAK, General Manager (Works)	EVEREADY Industries Pvt. Ltd. (Representative of ***CII)***	Member
13.	D. W. PATNE, Secretary/Principal	Association of Non Govt. ITI, Maharastra	Member
14.	UPENDRA KUMAR MALLICK Dy. Director	DTE&T, Odisha	Member
15.	R. K. JHA Dy. Director of Trg.	FTI, Jamshedpur	Member

16.	N. R. PATTANAIK Principal	Govt. ITI Balasore, Odisha	Member
17.	VIVEK CHAUDHARI Principal	Ujjwal ITI Nashirabad, Dist-Jalgoan, Maharastra	Member
18.	Fr. JOSE PADAMATTAM Principal	Don Bosco Technical Institute, Park Circus	Member
19.	NIRMALYA NATH Asst. Director of Trg.	CSTARI, Kolkata	Member
20.	Brindaban Das Asst. Director of Trg.	CSTARI, Kolkata	Member
21.	RANADIP MITRA Manager (HRD)	GRSE Ltd., Kolkata	Member
22.	JOYDEEP PAL MAJUMDER Asst. Work Manager	Rifle Factory, Ishapore, Ministry of Defence, Govt. India, WB	Member
23.	PRABHAT SAMIR PAL Jr. Manager	GRSE Ltd., Kolkata	Member
24.	SATYABADI SATAPATHY Training Officer	HAL – Koraput Division, Koraput, Odisha	Member
25.	P. K. BAIRAGI Training Officer	CSTARI, Kolkata	Member
26.	B. K. NIGAM Training Officer	CSTARI, Kolkata	Member
27.	RUPA MALLIK Instructor	Govt. ITI Gariahat, Kolkata – 19	Member
28.	DEBLINA ROY Instructor	Don Bosco Technical Institute, Park Circus	Member
29.	H. B. KOSHTI, Craft Instructor	Govt. ITI Byculla, Mumbai - 400011	Member

MEMBERS OF SECTOR MENTOR COUNCIL			
S No.	**Name & Designation Sh/Mr./Ms.**	**Organization**	**Mentor Council Designation**
1	M.R.K Naidu, Head (CR&D)	ECIL, Hyderabad	Chairman
2	PradeepDoshi , SVP	ESSCI, NewDelhi	Member
3	T. Venkataswamy, Assit. Engg.	BHEL, Hyderabad	Member
4	A Prasanna Lakshmi, Faculty	BHEL, Hyderabad	Member
5	T. Venkateswara Sharma, Sr. Officer HR	BEL, Hyderabad	Member
6	P. Chandrashekhar, MD	Techno Design Group,	Member

		Hyderabad	
7	S.CH. Apparao, Managers(operations)	BEL, Hyderabad	Member
8	T. Ram Mohan Rao, Sr.Manager	BDL, Hyderabad	Member
9	B UdayaBhaskarRao, DGM Electronics	BDL, Hyderabad	Member
10	M Manoharan, MD	Automation Solutions, Hyderabad	Member
11	S K Sastry, MD	EPROSYS, Hyderabad	Member
12	KBR Siva Prasad	HAL, Hyderabad	Member
Mentor			
1.	R.L Singh, DDG(T)	DGET, MOLE, NewDelhi	Mentor
Members of Core Group			
2.	C.S Murthy, DDT	ATI-EPI, Hyderabad	TEAM LEADER
3.	C.H Ravi , DDT	ATI-EPI, Mumbai	Member
4.	L K Mukherjee, DDT	CSTARI, Kolkata	Member
5.	N.R Aravindan JDT	NIMI, Chennai	Member
6.	C. Ramasubramanian, DDT	AHI, Bangalore	Member
7.	H.C Goyal, DDT	ATI-EPI, Dehradun	Member
8.	Avinash Kishore, ADT	DGET, MOLE, NewDelhi	Member
9.	R. Malathi, TO	RVTI(W), Bangalore	Member
10.	D K Ojha, DDT	ATI-EPI, Dehradun	Member
11.	DM Basha, TO	ATI, Mumbai	Member
12.	AshwiniKoli, JTA	RVTI (W), Bangalore	Member
13.	H N Bargal, TO	ITI, Mumbai	Member
14.	R S Nemade, TO	ITI, Mumbai	Member
15.	Z A Gadyal, JTO	ITI, Belgaum	Member
16.	M V Pillai, GI	ITI, Thane	Member

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprenticeship Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्