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

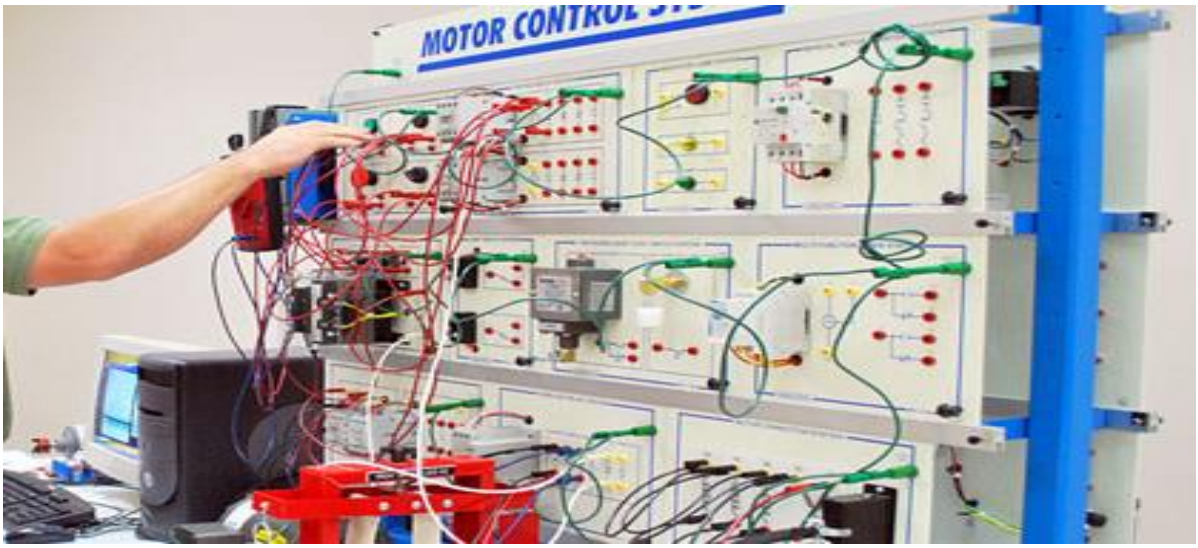
COMPETENCY BASED CURRICULUM

TECHNICIAN POWER ELECTRONIC SYSTEMS

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 5



SECTOR –ELECTRONICS & HARDWARE

Directorate General of Training

TECHNICIAN POWER ELECTRONIC SYSTEMS

(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

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1. COURSE INFORMATION

During the two-year duration of Technician Power Electronic Systems 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 under Professional Skill subject 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. Introduction with protection devices. Familiarize with the instruction set of 8051 microcontroller. Interface a model application with the Microcontroller kit and run the application. Working with three phase rectifier, chopper, SMPS, inverters and UPS. Interpret electrical control circuits used in industries. Installation and setup of fibre-optic communication system. Identify construction of various electro-pneumatic circuits. Make simple project applications using ICs, transformer and other discrete components.The trainee will work on installing a solar panel, execute testing and evaluate performance by connecting the panel to the inverter. Operation of different process sensor, identify, wire & test various sensors of different industrial processes by selecting appropriate test instruments. Assemble, test & troubleshoot various digital controlled field devices and execute the result. Perform speed control of DC machine and single phase and 3-phase AC machines. Install, configure and check the performance of AC and DC drive to control

the speed. Perform speed control of servo motor and test different industrial process circuit by selecting the suitable function. Install, test & control the Electro-Pneumatic actuators using various pneumatic valves. Execute the operation of different indication on PLC modules and wire different field devices of PLC and configure the system and perform the suitable function.

2. TRAINING SYSTEM

2.1 GENERAL

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

Technician Power Electronic Systemstrade under CTS is one of the popular newly designed courses. The earlier course was Industrial Electronics. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) imparts professional skills and knowledge, while Core area (Workshop Calculation and science, Engineering Drawing and Employability Skills) imparts 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.

Trainee broadly needs 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, repair and maintenance work.
- Check the job with circuit diagrams/components as per drawing for functioning, diagnose and rectify faults in the electronics Components/modules.
- 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 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-year is as follows: -

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 has to maintain an 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 the basis for setting question papers for final**

assessment. The examiner during final examination will also check the individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

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 the assessment. Due consideration should be given while assessing for teamwork, avoidance/reduction of scrap/wastage and disposal of scrap/waste as per procedure, behavioral attitude, sensitivity to the environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-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 examining body. The following marking pattern to be adopted while assessing:

Performance Level	Evidence
(a) Weightage in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment.

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

3. JOB ROLE

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 Fitters, 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.

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 Fiber 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 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.

PLC Assembly Operator; is responsible for completing the printed circuit board (PCB) and box assembly of the PLC components. The individual at work assembles the power supply and micro-controller PCBs, sends them for programming and completes the box assembly thereafter.

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:

(i) 7421.0100 – Electronics Fitter, General
(ii) 7421.0200 – Electronics Fitters, Other
(i) 7421.0300 – Electronics Mechanic
(ii) 7421.1401 – Solar Panel Installation Technician
(i) 7422.0801 – Optical Fiber Technician
(ii) 7421.0801 – Field Technician: UPS and Inverter
(iii) 8212.2002 – PLC Assembly Operator

4. GENERAL INFORMATION

Name of the Trade	**TECHNICIAN POWER ELECTRONIC SYSTEMS**
Trade Code	DGT/1067
NCO – 2015	7421.0100, 7421.0101, 7421.0300, 7421.1401, 7422.0801, 7421.0801, 8212.2002
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 Students)	24(There is no separate provision of supernumerary seats)
Space Norms	56 Sq. m
Power Norms	3.04 KW
Instructors Qualification for	
(i) Technician Power Electronic Systems Trade	B.Voc/Degree in Electronics/ Electronics and Telecommunication/ Electronics and Communication Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Electronics/ Electronics and telecommunication/ Electronics and communication 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 "Technician Power Electronics System" With three years' experience in the relevant field. **Essential Qualification:** 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.
(ii)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. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in relevant trade. OR NCIC in RoDA or any of its variants under DGT.
(iii) 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, Electronics & IT Trade group (Gr-II) trades categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years experience. **Essential Qualification:** National Craft Instructor Certificate (NCIC) in relevant trade. OR NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
(iv) 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 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs with short term ToT Course in Employability Skills from DGT institutes.
(v) 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. 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. Test various electronic components using proper measuring instruments and compare the data using standard parameter.
5. Plan and execute soldering & de-soldering of various electrical components like Switches, PCB & Transformers for electronic circuits.
6. Assemble simple electronic power supply circuit and test for functioning.
7. Install, configure, interconnect given computer system(s) and demonstrate and 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. Construct and test different circuits using IC 741 Operational amplifiers & IC 555 linear integrated circuits and execute the result.

SECOND YEAR:

14. Measure the various parameters by DSO and execute the result with standard one.
15. Identify, place, solder and de-solder and test different SMD discrete components and IC's package with due care and following safety norms using proper tools/setup.

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. Test, service and troubleshoot the various components of different domestic/ industrial programmable systems.
19. Plan and interface the LCD, LED, DPM panels to various circuits and evaluate performance.
20. Assemble, test and troubleshoot single phase & 3-phase controlled and uncontrolled rectifier using SCR.
21. Construct, test & repair different chopper using MOSFET and IC based DC-DC converter and execute the result.
22. Detect the faults and troubleshoot Power supplies, SMPS, UPS and inverter.
23. Prepare fiber optic setup and execute transmission and reception.
24. Install a solar panel, execute testing and evaluate performance by connecting the panel to the inverter.
25. Execute the operation of different process sensor, identify, wire & test various sensors of different industrial processes by selecting appropriate test instruments.
26. Assemble, test & troubleshoot various digital controlled field devices and execute the result.
27. Perform speed control of DC machine and single phase and 3-phase AC machines.
28. Install, configure and check the performance of AC and DC drive to control the speed.
29. Perform speed control of servo motor and test different industrial process circuit by selecting the suitable function.
30. Install, test & control the Electro-Pneumatic actuators using various pneumatic valves.
31. Execute the operation of different indication on PLC modules and wire different field devices of PLC and configure the system and perform the suitable function.

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. 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. 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 multimeter.

	Identify the power rating using size.
	Measure the resistance, Voltage, Current through series and parallel connected networks using multimeter.
	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.
5. 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 testthe 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.
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	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.

application packages for different application.	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 analyze 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 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 photocoupler/ 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 subtractor 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 troubleshooting and fault finding by the resources provided in the simulation software.
13. 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 OP-AMP circuits.
	Construct and test R-2R ladder type digital to analog converter circuit.
	Construct and test different configurations of 555 ICe.g. astable, monostable, bi-astable and VCO circuits.
SECOND YEAR	
14. 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.
15. Identify place, solder/ de-solder and test different SMD discrete components	Identify the various crimping tools for various IC packages.
	Identify different types of soldering guns and choose the suitable tip for the application.

and IC's package with due care and following safety norms using proper tools/setup.	Practice 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 ICs 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.
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 aDOL 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. Test, service and troubleshoot the various components of different domestic/ industrial programmable systems.	Understand and interpret the procedure as per manual of Micro controller.
	Identity various ICs & their functions on the given Microcontroller Kit.
	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.
19. Plan and interface the LCD, LED, DPM panels to various	Identify LCD/LED Display module and its decoder/driver ICs and display a word on a two line LCD/LED.

circuits and evaluate performance.	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.
20. Assemble & repair power supply using SCR.	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.
	Construct & Test 3-phase uncontrolled half wave rectifier.
	Construct & Test 3-phase uncontrolled Bridge rectifier.
	Construct & Test single phase half control rectifier using SCR.
	Construct & Test single phase full control rectifier using SCR.
	Construct & Test 3 phase controlled rectifiers (half wave & bridge) using SCR.
21. Construct, test & repair different chopper using MOSFET and IC based DC-DC converter and execute the result.	Ascertain and select tools and instruments for carrying out the jobs.
	Plan and work in compliance with standard safety norm.
	Practice on soldering components on lug board with safety.
	Construct & test chopper circuit using MOSFET.
	Construct & test step up/step down type chopper circuit.
	Construct & test IC based DC –DC converter for different voltages.
22. Detect the faults and troubleshoot Power supplies, 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.
23. Prepare fiber 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. 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.
25. Execute the operation of the different process sensor, 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 solutions and tasks within the team.
	Identify sensors used in process industries such as RTDs, Temperature ICs, Thermocouples, proximity switches (inductive, capacitive and photoelectric), 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.
26. Assemble, test & troubleshoot various digital controlled of field devices and execute the result.	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 subtractor circuit and verify the truth table.
	Construct a decoder and encoder, multiplexer and a 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.
27. Perform speed control of DC machine and single phase and three phase AC machines.	Identify different parts for different types of motor.
	Measure the coil resistance (armature and field) of AC andDC motor.
	Connect & run DC shunt motor using 3 point starter.
	Control the speed of DC motor by armature control method and field control method.
	Construct PWM circuit and SCR chopper circuit for the speed control of DC shunt motors.
	Construct a self-hold contactor circuit and run a 3-Phase Induction Motor.
	Connect and run the motor (below 5hp) in star and delta connection, record the phase voltage, line voltage and line current.
	Connect and operate an induction motor using DOL starter.
	Connect and run a 3-phase motor using manual and automatic star-delta starters.
	Reverse the direction of rotation of Induction motor.

	Connect & run three phase induction motors in a sequence using contactor & relay.
28. Install, configure and demonstrate the AC and DC drive to control the speed.	Identify different cables and connectors used in the AC DRIVE setup.
	Identify various input and output terminals of the DRIVE unit, operator panel and display unit.
	Install of AC Drive(similar to SIEMENS MM-420/440)
	Adjust the pressure as per the requirements MM Drive Programming/Parameterization for different control operations.
	Perform ON/OFF, Forward/Reverse, Jog (R)/Jog (L), braking and speed control Familiarization with different parts and terminals of DC Drive.
	Perform Parameterization for variation of motor speed through POT with Armature voltage feedback (with internal setting), through POT with encoder feedback and external speed raise/ lower buttons.
29. Perform speed control of servo motor and test different industrial process circuit by selecting the suitable function.	Understand and interpret the procedure as per manual of servo motor.
	Select test methods and test use of different parts servo motor, test control circuits.
	Identify various IC and their functions on the given servo motor drive trainer kits.
	Construct a direction control of various parameters to change direction of a servo motor.
	Write data into a RAM and observe its volatility.
	Identify the port pins of the controller and configure the input and output operator.
	Demonstrate entering of simple programs, execute and monitor the result.
30. Install, test &control, the Electro-Pneumatic actuators using various pneumatic valves.	Identify different pneumatic and electro-pneumatic components.
	Construct and control a single acting cylinder and double acting cylinder.

	Construct and control single/double acting cylinder using series/ parallel circuits.
	Construct and perform bidirectional control of a cylinder.
	Construct and control, automatic return of a double acting cylinder.
	Construct and control the oscillating motion of a double acting cylinder.
	Construct and control a latching circuit using single or double acting cylinder.
	Construct and control, automatic return initiated by a limit switch.
31. Execute the operation of different indication on PLC modules and wire different field devices of PLC and configure the system and perform the suitable function.	Identify various indicators on PLC Modules and interpret.
	Connect PLC hardware and configure the software.
	Wire in various digital and analog input and output devices to the respective modules.
	Develop and run simple programs to read sensor status and to control various outputs.
	Perform online editing of a rung/network and prepare data tables and monitor.

SYLLABUS FOR TECHNICIAN POWER ELECTRONIC SYSTEMS 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. following safety precautions.	**Trade and Orientation** 1. Visit to various sections of the institute and identify location of various installations. (05 hrs) 2. Identify safety signs for danger, warning, caution & personal safety message. (03 hrs) 3. Use of personal protective equipment (PPE). (05 hrs) 4. Practice elementary first aid.(05 hrs) 5. Preventive measures for electrical accidents & steps to be taken in such accidents.(02 hrs) 6. Use of Fire extinguishers.(05 hrs)	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. (07hrs.)
		Hand tools and their uses 7. Identify the different hand tools. (05 hrs) 8. Selection of proper tools for operation and precautions in operation. (07 hrs) 9. Care & maintenance of trade tools. (08 hrs) 10. Practice safety precautions while working in fitting jobs. (10 hrs)	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.)

		11. Workshop practice on filing and hacksawing. (05 hrs) 12. Practice simple sheet metal works, fitting and drilling.(05 hrs) 13. Make an open box from metal sheet. (10 hrs)	
Professional Skill 75 Hrs; Professional Knowledge 21 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. (06 hrs) 15. Construct a test lamp and use it to check mains healthiness. (07 hrs) 16. Measure the voltage between phase and ground and rectify earthing. (05 hrs) 17. Identify and test different AC mains cables. (07 hrs) 18. Prepare terminations, skin the electrical wires/cables using wire stripper and cutter.(07 hrs) 19. Measure the gauge of the wire using SWG and outside micrometer. (05 hrs) 20. Refer table and find current carrying capacity of wires. (03 hrs) 21. Crimp the lugs to wire end. (05 hrs) 22. Measure AC and DC voltages using multimeter. (05 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. (14 hrs.)

		Single range meters 23. Identify the type of meters by dial and scale marking/ symbols. (03 hrs) 24. Demonstrate various analog measuring Instruments. (03 hrs) 25. Find the minimum and maximum measurable range of the meter. (03 hrs) 26. Carryout mechanical zero setting of a meter. (05 hrs) 27. Check the continuity of wires, meter probes and fuse etc. (05 hrs) 28. Measure voltage and current using clamp meter. (06 hrs)	Introduction to electrical and electronic measuring instruments. Basic principle and parts of 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. (02 hrs) 30. Identify the rated output voltage and Ah capacity of given battery. (01 hr) 31. Measure the voltages of the given cells/battery using analog/ digital multimeter. (03 hrs) 32. Charge and discharge the battery through load resistor. (05 hrs) 33. Maintain the secondary cells. (05 hrs) 34. Measure the specific gravity of the electrolyte using hydrometer. (03 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.)

		35. Test a battery and verify whether the battery is ready for use or needs recharging. (06 hrs)	
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Test various electronic components using proper measuring instruments and compare the data using standard parameter.	**AC & DC measurements** 36. Use the multimeter to measure the various functions (AC V, DC V, DC I, AC I, R) (08 hrs) 37. Identify the different types of meter for measuring AC & DC parameters (08 hrs) 38. Identify the different controls on the CRO front panel and observe the function of each control (12 hrs) 39. Measure DC voltage, AC voltage, time period using CRO sine wave parameters (10 hrs) 40. Identify the different controls on the function generator front panel and observe the function of each control. (12 hrs.)	Introduction to electrical measuring instruments. Importance and classification of meters. Forces necessary to work a meter. MC and MI meters. Range extension, need of calibration. Characteristics of meters and errors in meters. Multimeter, 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. (05 hrs) 42. Practice soldering on IC bases and PCBs. (05 hrs) 43. Practice de-soldering using pump and wick (02 hrs) 44. Join the broken PCB track	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

		and test (03 hrs) 45. Identify and use SPST, SPDT, DPST, DPDT, tumbler, push button, toggle, piano switches used in electronic industries (05 hrs) 46. Make a panel board using different types of switches for a given application (05 hrs)	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. (03 hrs) 48. Measure the resistor value by colour code and verify the same by measuring with multimeter. (03 hrs) 49. Identify resistors by their appearance and check physical defects. (02 hrs) 50. Identify the power rating of carbon resistors by their size. (03 hrs) 51. Practice on measurement of parameters in combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources. (09 hrs) 52. Measurement of current and voltage in electrical circuits to verify Kirchhoff's Law. (05 Hrs) 53. Verify laws of series and parallel circuits with voltage	Ohm's law and Kirchhoff's Law. Resistors; types of resistors, their construction & specific use, colour 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 andenergy 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.

		source in different combinations. (05 hrs) 54. Measure the resistance, Voltage, Current through series and parallel connected networks using multimeter. (08 hrs) 55. Identify different inductors and measure the values using LCR meter. (05 hrs) 56. Identify the different capacitors and measure capacitance of various capacitors using LCR meter. (05 hrs) 57. Identify and test the circuit breaker and other protecting devices. (05 hrs) 58. Dismantle and identify the different parts of a relay. (05 hrs) 59. Connect a timer relay in a circuit and test for its working. (03 hrs) 60. Connect a contactor in a circuit and test for its working. (02 hrs) 61. Construct and test RC time constant circuit. (04 hrs) 62. Construct a RC differentiator circuit and convert triangular wave into square wave. (05 hrs) 63. Construct and test series and parallel resonance circuit. (03 hrs)	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 electro magnetism, types of cores. Relays, types, construction and specifications etc. (21 hrs.)
Professional	Assemble simple electronic power	**Power Supply Circuits** 64. Identify different types of	Semiconductor materials, components, number coding

Skill 50 Hrs; Professional Knowledge 14 Hrs	supply circuit and test for functioning.	diodes, diode modules and their specifications. (05 hrs) 65. Test the given diode using multimeter and determine forward to reverse resistance ratio. (05 hrs) 66. Measure the voltage and current through a diode in a circuit and verify its forward characteristic. (08 hrs) 67. Identify different types of transformers and test. (03 hrs) 68. Identify the primary and secondary transformer windings and test the polarity (02 hrs) 69. Construct and test a half wave, full wave and Bridge rectifier circuit. (10 hrs) 70. Measure ripple voltage, ripple frequency and ripple factor of rectifiers for different load and filter capacitors. (05 hrs) 71. Identify and test Zener diode. (02 hrs) 72. Construct and test Zener based voltage regulator circuit. (05 hrs) 73. Calculate the percentage regulation of regulated power supply. (05 hrs)	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 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 100 Hrs; Professional Knowledge	Install, configure, interconnect given computer system(s) and demonstrate & utilize application	**Computer Hardware, OS, MS office and Networking** 74. Identify various indicators, cables, connectors and ports on the computer	Basic blocks of a computer, Components of desktop and motherboard. Hardware and software, I/O devices, and their working.

28 Hrs	packages for different application.	cabinet. (03 hrs) 75. Demonstrate various parts of the system unit and motherboard components. (02 hrs) 76. Identify various computer peripherals and connect it to the system. (05 hrs) 77. Disable certain functionality by disconnecting the concerned cables SATA/ PATA. (05 hrs) 78. Replace the CMOS battery and extend a memory module. (03 hrs) 79. Test and Replace the SMPS (02 hrs) 80. Replace the given DVD and HDD on the system (05 hrs) 81. Dismantle and assemble the desktop computer system. (15 hrs) 82. Boot the system from different options (03 hrs) 83. Install OS in a desktop computer. (02 hrs) 84. Install a Printer driver software and test for print outs. (05 hrs) 85. Install antivirus software, scan the system and explore the options in the antivirus software. (03 hrs) 86. Install MS office software. (02 hrs) 87. Create folder and files, draw pictures using paint. (05 hrs)	Different types of printers, HDD, DVD. Various ports in the computer. Windows OS MS windows: 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: 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 worksheets, 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

		88. Explore different menu/ tool/ format/ status bars of MS word and practice the options. (05 hrs) 89. Explore different menu/ tool/ format/ status bars of MS excel and practice the options. (05 hrs) 90. Prepare power point presentation on any three known topics with various design, animation and visual effects. (05 hrs) 91. Convert the given PDF File into Word file using suitable software. (03 hrs) 92. Browse search engines, create email accounts, practice sending and receiving of mails and configuration of email clients. (05 hrs) 93. Identify different types of cables and network components e.g. Hub, switch, router, modem etc. (02 hrs) 94. Prepare terminations, make UTP and STP cable connectors and test. (05 hrs) 95. Connect network connectivity hardware and check for its functioning. (05 hrs) 96. Configure a wireless Wi-Fi network. (05 hrs)	engines, email, chatting and messenger service. Downloading the Data and program files etc. **Computer Networking:** Network features- Network media, 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. (28 hrs.)
Professional	Assemble simple	**IC Regulators**	Regulated Power supply using

Skill 25 Hrs; Professional Knowledge 07 Hrs	electronic power supply circuit and test for functioning.	97. Construct and test a +12V fixed voltage regulator. (05 hrs) 98. Identify the different types of fixed +ve and –ve regulator ICs and the different current ratings (78/79 series). (05 hrs) 99. Identify different heat sinks for IC based regulators. (02 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. (08 hrs) 101. Construct and test a 1.2 V – 30V variable output regulated power supply using IC LM317T. (05 hrs)	78XX series, 79XX series. Op-amp regulator, 723 regulator (Transistorized & IC based). Voltage regulation, error correction and amplification etc. (07 hrs.)
Professional Skill 75 Hrs; Professional Knowledge 21 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. (05 hrs) 103. Test the condition of a given transistor using ohmmeter. (05 hrs) 104. Measure and plot input and output characteristics of a CE amplifier. (07 hrs) 105. Construct and test a transistor based switching circuit to control a relay (use Relays of different	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.)

		coil voltages and Transistors of different β). (08hrs)	
		Amplifier 106. Construct and test fixed-bias, emitter-bias and voltage divider-bias transistor amplifier. (12 hrs) 107. Construct and test a common emitter amplifier with and without bypass capacitors. (05hrs) 108. Construct and test common base amplifier. (05hrs) 109. Construct and Test common collector/emitter follower amplifier. (05hrs) 110. Construct and test Darlington amplifier. (05hrs) 111. Construct and test a two stage RC Coupled amplifier. (05 hrs) 112. Construct and test a Class B complementary push pull amplifier. (08hrs) 113. Construct and test class C Tuned amplifier. (05hrs)	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 amplifier and class C tuned amplifier. Alpha, beta, voltage gain, Concept of dB dBm. Feedback and its types. (14 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Construct, test and verify the input/ output characteristics of various analog circuits.	**Oscillators** 114. Demonstrate Colpitts oscillator, Hartley oscillator circuits and compare the output frequency of the oscillator by CRO. (07 hrs) 115. Construct and test a RC	Introduction to positive feedback and requisites of an oscillator. Study of Colpitts, Hartley, Crystal and RC oscillators. Types of multivibrators and study of circuit diagrams.(07 hrs.)

		phase shift oscillator circuits. (05 hrs) 116. Construct and test a crystal oscillator circuits. (05 hrs) 117. Demonstrate Astable, monostable, bistable circuits using transistors. (08 hrs)	
		Wave shaping circuits 118. Construct and test shunt clipper. (06 hrs) 119. Construct and test series and dual clipper circuit using diodes. (07 hrs) 120. Construct and test clamper circuit using diodes. (05 hrs) 121. Construct and test Zener diode as a peak clipper. (07 hrs)	Diode shunt clipper circuits, Clamping/limiting circuits and Zener diode as peak clipper,uses their applications. (07 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Plan and construct different power electronic circuits and analyze the circuit functioning.	**Power Electronic Components** 122. Identify different power electronic components, their specification and terminals. (06 hrs) 123. Construct and test a FET Amplifier. (06hrs) 124. Construct a test circuit of SCR using UJT triggering. (07hrs) 125. Identify different heat sinks used in SCRs. (03hrs) 126. Construct a snubber circuit for protecting SCR use freewheeling diode to reduce back emf. (07hrs) 127. Construct a jig circuit to	Construction of FET & JFET, difference with BJT. Purpose of Gate, Drain and source terminals and voltage/ 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.)

		test DIAC. (07 hrs) 128. Construct a simple dimmer circuit using TRIAC. (07hrs) 129. Construct UJT based free running oscillator and change its frequency. (07hrs)	
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Plan and construct different power electronic circuits and analyze the circuit functioning.	**MOSFET & IGBT** 130. Identify various Power MOSFET by its number and test by using a multimeter. (05 hrs) 131. Identify different heat sinks used with various power MOSFET devices. (05hrs) 132. Construct MOSFET test circuit with a small load.(05hrs) 133. Identify IGBTs by their numbers and test by using a multimeter. (05 hrs) 134. Construct an IGBT test circuit with a small load. (05hrs)	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 25 Hrs; Professional Knowledge 07 Hrs	Select the appropriate opto-electronics components and verify the characteristics in different circuit.	**Opto-Electronics** 135. Test LEDs with DC supply and measure voltage drop and current using multimeter. (05hrs) 136. Construct a circuit to test photovoltaic cell. (05hrs) 137. Construct a circuit to switch a lamp load using photo diode. (05hrs) 138. Construct a circuit to switch a lamp load using	Working and application of LED, IR LEDs, Photodiode, photo transistor, their characteristics and applications. Optical sensor, Opto-couplers, circuits with Opto-Isolators. Characteristics of LASER diodes. (07 hrs.)

		photo transistor. (05hrs) 139. Identify optocoupler input and output terminals and measure the quantum of isolation between input/output terminals and operate a relay by connecting a switch. (05hrs)	
Professional Skill 25 Hrs; Professional Knowledge 07 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) with the number printed on them. (06 hrs) 141. Verify the truth tables of all Logic Gate ICs by connecting switches and LEDs. (08 hrs) 142. Construct and verify the truth table of all the gates using NAND and NOR gates. (06 hrs) 143. Use a digital IC tester to test the various digital ICs (TTL and CMOS). (05 hrs)	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. (07 hrs.)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Assemble, test and troubleshoot various digital circuits.	**Combinational Circuits** 144. Construct Half Adder circuit using ICs and verify the truth table. (03hrs) 145. Construct Full adder with two Half adder circuit using ICs and verify the truth table. (05hrs) 146. Construct the adder cum subtractor circuit and verify the result. (05 hrs) 147. Construct and test a 2 to 4	Combinational logic circuits such as Half Adder, Full adder, Parallel Binary adders, 2-bit and four bit full adders. Magnitude comparators. Half adder, full adder ICs and their applications for implementing arithmetic operations. Concept of encoder and decoder. Basic Binary Decoder and four bit binary decoders.

		Decoder. (03hrs) 148. Construct and test a 4 to 2 Encoder. (03hrs) 149. Construct and test a 4 to 1 Multiplexer. (03hrs) 150. Construct and test a 1 to 4 De Multiplexer. (03hrs)	Need for multiplexing of data. 1:4 line Multiplexer/De-multiplexer. (07 hrs.)
Professional Skill 25 Hrs; Professional Knowledge 07 Hrs	Assemble, test and troubleshoot various digital circuits.	**Flip Flops** 151. Identify different Flip-Flop (ICs) by the number printed on them. (05hrs) 152. Construct and test four bit latch using 7475. (05 hrs) 153. Construct and test R-S flip-flop using IC7400 with clock and without clock pulse. (05 hrs) 154. Verify the truth tables of Flip-Flop ICs (RS, D, T, JK, MSJK) by connecting switches and LEDs. (10 hrs)	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. (07 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 14 Hrs	Simulate and analyze the analog and digital circuits using the 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 electronic and domestic electronic circuit using simulation software. (14 hrs)	Study the library components available in the circuit simulation software. Various resources of the software. (14 hrs.)
Professional	Assemble, test and	**Counter & shift registers**	Basics of Counters, types, two

Skill 75 Hrs; Professional Knowledge 21 Hrs	troubleshoot various digital circuits.	159. Construct and test a four bitasynchronous binary counter using 7493. (10 hrs) 160. Construct and test 7493 as a modulus-12 counter. (10hrs) 161. Construct and test a four bit Synchronous binary counter using 74163. (10 hrs) 162. Construct and test synchronous Decade counter. (05 hrs) 163. Construct and test an up/down synchronous decade counter using 74190 and monitor the output on LEDs. (10 hrs) 164. Identify and test common anode and common cathode seven segment LED display using a multimeter. (05 hrs) 165. Display the two digit count value on seven segment display using decoder/driver ICs. (05 hrs) 166. Construct a shift register using RS/D/JK flip flop and verify the result. (05 hrs) 167. Construct and test four bit SIPO register. (05 hrs) 168. Construct and test four bit PIPO register. (05 hrs) 169. Construct and test bidirectional shift	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.)

		registers. (05 hrs)	
Professional Skill 75 Hrs; Professional Knowledge 21 Hrs	Construct and test different circuits using ICs 741operational amplifiers & ICs 555 linear integrated circuits and execute the result.	**Op – Amp & Timer 555 Applications** 170. Use analog IC tester to test the various analog ICs. (04 hrs) 171. Construct and test various Op-Amp circuits Inverting, Non-inverting and Summing Amplifiers. (10hrs) 172. Construct and test Differentiator and Integrator (7hrs) 173. Construct and test a zero crossing detector. (04hrs) 174. Construct and test Instrumentation amplifier (7 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. (7 hrs) 177. Construct and test mono stable timer circuit using IC 555. (7hrs) 178. Construct and test VCO (V to F Converter) using IC 555. (9 hrs) 179. Construct and test 555 timers as pulse width modulator (10 hrs)	Block diagram and Working of Op-Amp, importance, Ideal characteristics, advantages and applications. Schematic diagram of 741, symbol. Non-inverting voltage amplifier, inverting voltage amplifier, summing amplifier, Comparator, zero cross detector, differentiator, Integrator and instrumentation amplifiers, 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. (21 hrs.)

Industrial Visit/ Project Work

Broad Areas:

a) Pencil charger indicator.
b) Delayed automatic power on the circuit.
c) Neon flasher circuit using IC741.
d) UJT act as a relaxation oscillator.
e) Up/down synchronous decade counter.
f) Test a 4 to 1 multiplexer circuit.
g) Dimmer circuit of Light & Fan using DIAC & TRIAC.
h) Timer Circuit using IC-555.

SYLLABUS FOR TECHNICIAN POWER ELECTRONIC SYSTEMS TRADE			
SECOND YEAR			
Duration	**Learning Outcome Reference**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 25Hrs; Professional Knowledge 09Hrs	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.(05 hrs) 181. Measure the Amplitude, Frequency and time period of typical electronic signals using DSO &Store a portion of signal waveform using DSO. (07 hrs) 182. Take a print of a signal from the DSO by connecting it to a printer & tally with applied signal. (06 hrs) 183. Construct and test function generator using IC 8038. (07 hrs)	Block diagram of CRO and applications of CRO, application of digital CRO, block diagram of function generator. Differentiate a CRO with DSO. Advantages of DSO. (09 hrs.)
Professional Skill 25Hrs; Professional Knowledge 09Hrs	Identify, place, solder, de-solder and test different SMD discrete components and IC's 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 terminals SMD components. (05 hrs) 185. De-solder the SMD components from the given PCB. (05 hrs) 186. Solder the SMD components on the same PCB. (05 hrs) 187. Check for cold continuity of PCB. (03 hrs)	Introduction to SMD technology Identification of 2, 3, 4 terminals 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.)

		188. Identification of loose/dry solder, broken tracks on printed wired assemblies. (07 hrs)	
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Identify, place, solder and de-solder and test different SMD discrete components and IC's Package with due care and following safety norms using proper tools/setup.	**SMD Soldering and De-soldering:** 189. Identify various connections and the setup required for the SMD soldering station. (05 hrs) 190. Identification of crimping tools for various IC packages.(03 hrs) 191. Make the necessary settings on SMD soldering station to de-solder various ICs of different packages (at least four) by choosing proper clamping 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 clamping tools.(14 hrs) 193. Make the necessary setting rework of a defective surface mount component used soldering/de-soldering method. (14 hrs)	Soldering/ de-soldering of the above components. Identification of PGA packages. Soldering/ de-soldering of above PGA components. Cold/Continuity check of PCBs. Identification of lose/dry solders, broken tracks on printed wiring assemblies. (18 hrs.)
Professional Skill 25 Hrs;	Rework on PCB after identifying defects from SMD soldering	**PCB Rework:** 194. Check and repair Printed Circuit Boards single,	ESD Control in Electronics Introduction to Static charges, Prevention of Static

Professional Knowledge 09 Hrs	and de-soldering.	Double layer, and important tests for PCBs. (6 hrs) 195. Inspect soldered joints, detect the defects and test the PCB for rework. (04 hrs) 196. Remove the conformal coatings by different methods. (04 hrs) 197. Perform replacement of coating. (04 hrs) 198. Perform baking and preheating. (04 hrs) 199. Repair solder mask and damage pad. (03 hrs)	charges, Handling of static sensitive devices, Various standards for ESD Introduction to non-soldering interconnections Introduction to crimping, wire wrapping, Conductive adhesives, Chip on Board, Tape Automated bonding. Introduction to components, Printed Circuit Boards Introduction to components, Construction of Printed Circuit Boards (single, Double, multi-layer), Important tests for PCBs 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. Introduction to rework and repair concepts. Repair of damaged track. Repair of damaged pad and plated through hole. Repair of solder mask. (09 hrs.)

Professional Skill 50Hrs; Professional Knowledge 18Hrs	Construct different electrical control circuits and test for their proper functioning with due care and safety.	**<u>Protection devices</u>:** 200. Identify different types of fuses along with fuse holders. (06 hrs) 201. Wire an MCB to a motor and run it. (04 hrs) 202. Test and rectify defects associated with MCBs.(07 hrs) 203. Connect an ELCB and test the leakage of an electrical motor control circuit. (08 hrs)	Fuse ratings, types of Fuses, Fuse bases, single/three phase MCBs, single phase ELCBs. Types of Contactors, contactor coils and working voltages, contactor contact currents, protection to contactors and high current applications. (09 hrs.)
		<u>Electrical control circuits</u>: 204. Measure the coil winding resistance of the given motor. (06 hrs) 205. Prepare the setup and Control an induction motor using a DOL Starter. (07 hrs) 206. Construct a direction control circuit to change the direction of an induction motor. (06 hrs) 207. Connect a overload relay and test for its proper function.(06 hrs)	Fundamentals of single phase Induction motors, synchronous speed, slip, rotor frequency, torque– speed characteristics, Starters used for Induction motors. (09 hrs.)
Professional Skill 75Hrs; Professional Knowledge 27Hrs	Test, service and troubleshoot the various components of different domestic/ industrial programmable systems.	**<u>Microcontroller</u>** 208. Identify various ICs & their functions on the given Microcontroller 8051 Kit. (05 hrs) 209. Identify the address range of RAM & ROM. (05 hrs) 210. Write data into RAM & observe its volatility. (05	Introduction to 8051 Microcontroller, architecture, pin details & the bus system. The function of different ICs used in the Microcontroller Kit. Differentiate microcontroller with microprocessor. Interfacing of memory to the

		hrs) 211. Measure the crystal frequency, connect it to the controller. (05 hrs) 212. Identify the port pins of the controller & configure the ports for Input & Output operation. (10 hrs) 213. Connect an input switch & control a lamp using necessary program. (10 hrs) 214. Demonstrate the initialization, load & turn on an LED with delay using Timer. (10 hrs) 215. Demonstrate the use of a Timer as an even counter to count external events. (10 hrs) 216. Demonstrate entering of simple programs, execute & monitor the results. (15 hrs)	microcontroller. Internal hardware resources of microcontroller. I/O port pin configuration. Different variants of 8051 & their resources. Register banks & their functioning. SFRs & their configuration for different applications. Utilization of on chip resources such as ADC. Availability of assembly software & compiler for 8051. Application of microcontroller in domestic, consumer & industries. (27 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**: 217. Identify LED Display module and its decoder/driver ICs. (06 hrs) 218. Display a word on a two line LED. (08 hrs) 219. Measure/current flowing through a resistor and display it on LED Module. (08 hrs) 220. Measure/current flowing through a sensor and display it on an LED	Different types of seven segment displays, decoders and driver ICs for them. Concept of multiplexing and its advantages. Block diagrams of 7106 and 7107 and their configuration for different measurements. Use of DPM (Digital Panel Meter) with seven segment displays to display different voltage & current signals. Principles of working of LCD. Different sizes of LCDs.

		module (DPM). (10 hrs) 221. Identify LCD Display module and its decoder/driver ICs. (08 hrs) 222. Display a word on a two line LCD. (04 hrs) 223. Measure/current flowing through a sensor and display it on an LCD module (DPM). (06 hrs)	Decoder/Driver ICs used with LCDs and their pin-out diagrams. Scrolling displays and its design. Use of DPM (Digital Panel Meter) to display different voltage & current signals. (18 hrs.)
Professional Skill 25Hrs; Professional Knowledge 09Hrs	Assemble, test and troubleshoot single phase & 3-phase controlled and uncontrolled rectifier using SCR.	**3-Phase Rectifier (controlled &uncontrolled)** 224. Construct & test three phase uncontrolled rectifiers (half wave & bridge). (04 hrs) 225. Construct & test single phase Half controlled rectifier using SCR. (04 hrs) 226. Construct & test single phase full controlled rectifier using SCR. (04 hrs) 227. Identify and replace the faulty components. (04 hrs). 228. Test, 3-phase controlled rectifiers under fault condition & rectify faults. (04 hrs) 229. Construct & test three phase controlled rectifiers (half wave & bridge) using SCR. (05 hrs)	High current rectifiers. Differentiate uncontrolled and controlled rectifiers. Discuss on 3-phase uncontrolled rectifier, control and power circuits and their applications. Discussion on 3-phase controlled rectifiers, control and power circuits and their applications. (09 hrs.)
Professional Skill 25Hrs; Professional	Construct, test & repair different chopper using MOSFET and IC based	**Chopper** 230. Construct & test chopper circuit using MOSFET. (05 hrs)	Various types of chopper circuits step up, step down, inverting types. Introduction

Knowledge 09Hrs	DC-DC converter and execute the result.	231. Construct and test step up type chopper circuit. (05 hrs) 232. Construct and test step down type chopper circuit. (05 hrs) 233. Construct and test IC Based DC-DC converter for different voltages. (05 hrs) 234. Test chopper circuit under fault condition and rectify fault. (05 hrs)	to DC-DC Converters. Applications of DC-DC converters. ICs used for converting DC-DC. Applications of DC-DC converters. (09 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Detect the faults and troubleshoot Power supplies, SMPS, UPS and inverter.	**Power Supplies & SMPS** 235. Identify different front panel controls and connectors of the given power supply. (04 hrs) 236. Test the given power supply and limit the output to a specific voltage and current. (04 hrs) 237. Open the power supply and identify major sections and power components with heat sinks. (04 hrs) 238. Test the semiconductor power switches of a power supply. (04 hrs) 239. Operate a programmable power supply and test its features. (04 hrs) 240. Identify various input and output sockets/ connectors of the given SMPS. (04 hrs) 241. Apply input and measure outputs using a multimeter. (04 hrs)	Specifications & block diagram of Linear power supplies. Front panel controls and features of various power supplies. Different types of power switches and heat sinks used in power supplies. Block Diagram of Switch mode power supplies and their working principles. Various ICs used in different types of SMPS. Principles of Inversion and Inverter circuits using different techniques. Pulse width modulation and their applications. (18 hrs.)

		242. Test capacity of the given SMPS. (04 hrs) 243. Identify major sections/ ICs/ components of SMPS. (08 hrs) 244. Measure/ monitor major test points of SMPS. (05 hrs) 245. Identify and replace the faulty components. (05 hrs) (Use SMPS used in TVs and PCs for practice)	
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Detect the faults and troubleshoot Power supplies, SMPS, UPS and inverter.	**Inverters** 246. Construct & test simple inverter circuit using transistors/ MOSFET. (04 hrs) 247. Prepare a load bank using resistive & Inductive load up to 2KW for testing of Inverter & UPS. (04 hrs) 248. Identify front panel control & indicators of Inverter. (04 hrs) 249. Identify & understand the use of back panel sockets &connections.(04 hrs) 250. Connect battery & load to Inverter & test on battery mode. (04 hrs) 251. Open Top cover of Inverter & identify isolator transformer &inverter transformer. (04 hrs) 252. Identify various circuit boards in Inverter and monitor voltages at	Inverter – their principle & operation, power rating, change over period. Installation of Inverters, Protection circuits used in inverters– battery level, over load, over charging etc. Various faults and its rectification. Three phase inverter circuits– principle and working. Installation of single phase & three phase Inverter. (18 hrs.)

		various test points. (04 hrs) 253. Make load test to measure backup time. (04 hrs) 254. Test Inverter under faulty condition & rectify fault. (08 hrs) 255. Perform all above experiments for three phase Inverter. (04 hrs) 256. Measure battery current when inverter is working on Battery Mode & measure load current. (06 hrs)	
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Detect the faults and troubleshoot Power supplies, SMPS, UPS and inverter.	**UPS** 257. Identify front panel control & indicators of UPS. (02 hrs) 258. Identify & understand the use of back panel sockets & connections. (03 hrs) 259. Connect Battery & load to UPS & test on battery mode. (03 hrs) 260. Measure whether battery current UPS is working on Battery Mode & measure load current. (02 hrs) 261. Open Top cover of UPS & identify isolator transformer & UPS transformer & additional circuit other than an inverter. (04 hrs) 262. Identify various circuit boards in UPS and monitor voltages at various test points. (03hrs)	Concept of UPS, Difference between Inverters and UPS. Basic block diagram of UPS & operating principle, explanation of rectifier, battery, inverter, static transfer switch. Types of UPS: Offline UPS, Online UPS, Line interactive UPS & their comparison UPS specifications. Load power factor & types of indications & protections UPS circuit description and working- controlling circuits, Microcontroller circuits, power circuits, charging circuits, alarm circuits, Indicator circuits. Three phase UPS Circuits. Installation of single phase & three phase UPS. (09 hrs.)

		263. Perform a load test to measure backup time. (03 hrs) 264. Test UPS under faulty condition & rectify fault. (03 hrs) 265. Perform all above experiments for three phase UPS. (02 hrs)	
Professional Skill 25Hrs; Professional Knowledge 09Hrs	Prepare fiber-optic setup and execute transmission and reception.	**Fiber optic** 266. Demonstrate the use of the fiber-optic trainer kit. (03 hrs) 267. Make optical fiber setup to transmit and receive analog and digital data. (04 hrs) 268. Demonstrate FM modulation and demodulation using the OFC trainer kit using audio signal and voice link.(06 hrs) 269. Demonstrate PWM modulation and demodulation using the OFC trainer kit using audio signal and voice link. (06 hrs) 270. Demonstrate PPM modulation and demodulation using the OFC trainer kit using audio signal and voice link. (06 hrs)	Introduction to optical fiber as a transmission Media, its advantages over other media, properties of optic-fiber, testing, losses, types of fiber-optic cables and specifications. Encoding of light. Fiber optic joints, splicing, testing and the related equipments/measuring tools, precautions to be taken laying of cables, safety aspects while handling optical cables. (09 hrs.)
Professional Skill 50Hrs;	Install a solar panel, execute tests and evaluate	**Solar Inverter** 271. Connect and test solar panel to the Inverter and	Need for renewable energy sources, Solar energy as a renewable resource.

Professional Knowledge 18Hrs	performance by connecting the panel to the inverter.	run the load. (04 hrs) 272. Mount a solar panel to a roof. (06hrs) 273. Wire a solar panel to a solar controller.(06 hrs) 274. Wire a solar controller to a battery storage station. (07 hrs) 275. Connect storage batteries to a power inverter. (07 hrs) 276. Wire a power inverter to an electrical service panel. (04 hrs) 277. Test circuits for voltages. (04 hrs) 278. Installation of Solar Inverter. (04 hrs) 279. Take the trainees to the nearest solar power installation and demonstrate various aspects to cover skills as specified above. (08 hrs)	Materials used in solar cells. Principles of conversion of solar light into electricity. Basics of photovoltaic cell. Types of solar cells. Mono crystalline and poly crystalline PV cells. Define components like Solar cell, Module, panel and Arrays. Factors that influence the output of a PV module. SPV systems and the key benefits. Difference between SPV and conventional power. Define solar charge controller or regulator and its role. Safety precautions while working with solar systems. (18 hrs.)
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Execute the operation of the different process sensor, identify, wire & test various sensors of different industrial processes by selecting appropriate test instruments.	**Sensor** 280. Identify & test different sensors such as RTDs, thermocouples, proximity sensors, inductive, capacitive& photoelectric), load cells, strain gauge & LVDT, Hall sensor, Tacho-generator. (10 hrs) 281. Test the functionality of all the sensors mentioned above using the trainer kit. (05 hrs) 282. Refer the data chart &	Basics of passive and active transducers – Role, selection and characteristics. Working principles of RTD, Thermocouple, LVDT, Strain gauge, Proximity sensor, Hall Sensor, Tacho-generator, optical sensors. Sensor voltage and current formats. (09 hrs.)

		record various parameter ranges in respect of the sensors mentioned above. (10 hrs)	
Professional Skill 25 Hrs; Professional Knowledge 09 Hrs	Assemble, test & troubleshoot various digital controlled of field devices and execute the result.	**Digital control of field devices Input Devices to develop START (Logic 1) and STOP (Logic 0) pulses** 283. Develop AC – DC SIGNAL CONVERTER using push to ON switch, centre tapped transformer type full wave rectifier, filter and a pot to get Logic 1 (+5V); (START pulse) view pulse on an oscilloscope. (05 hrs) 284. Develop AC – DC SIGNAL CONVERTER using push to ON switch, bridge type full wave rectifier working on 24 V AC, filter, pot, 12V DC reed relay and separate stabilized + 5V supply to get Logic 1; (START pulse) view pulse on an oscilloscope. (05hrs) 285. Develop AC – DC SIGNAL CONVERTER using push to OFF switch, center tapped transformer type full wave rectifier, filter and a pot to get Logic 0 (0V); (STOP pulse) view pulse on an oscilloscope. (05hrs) 286. Develop AC – DC SIGNAL CONVERTER using push to OFF switch, bridge type full	Digital/logical/on-off control of electrical machines and other actuators. Industrial control system: electro-magnetic control, static control; comparison; general block diagram; Information gathering section in the input section, Decision making section or logic section and Actuating device section or output section; advantages and disadvantages of static control over magnetic relay control; input devices for solid state logic contact bounce problem; Capacitive Switch Filters. (09 hrs.)

		wave rectifier working on 24 V AC, filter, pot, 12V DC reed relay and separate stabilized + 5V supply to get Logic 0 (0V); (STOP pulse) view pulse on an oscilloscope. (06hrs) 287. Develop AC – DC SIGNAL CONVERTER – using Optocoupler method, push to ON switch, bridge type full wave rectifier working on 24 V AC, filter, pot, optocoupler or LDR & Lamp source and separate stabilized + 5V supply to develop START pulse. (05 hrs)	
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	Perform speed control of DC machine and single phase and 3-phase AC machines.	**<u>Electrical control of AC/DC machines</u>** 288. Identify (unmarked) terminals of 3 phase induction motors. (04 hrs) 289. Construct a self hold contactor circuit and run a 3-Phase Induction Motor (4hrs) 290. Familiarize with different types of motor and identify the different parts. (04hrs) 291. Study & connect the motor and run (below 5hp) in star, note phase Voltage, line voltage and current. Study and connect and run the motor in Delta and note phase current line current. Phase voltage and	Fundamentals of AC 3 phase &single phase Induction motors, synchronous speed, slip, rotor frequency, torque – speed characteristics, Starters used for Induction motors, speed control of Induction motors Types of motors: Advantages &disadvantages among each other. DC Motors– types, working, torque speed characteristics, staring of DC Motors & change the DOR, 3 point and 4 point Starters, speed control of DC motor, Field flux control & armature current control.

		line voltage.(07 hrs) 292. Connect and operate an induction motor using DOL starter.(04 hrs) 293. Connect and run a 3-phase motor using manual and automatic star-delta starters.(04hrs) 294. Change the direction of rotation of Induction motor. (04 hrs) 295. Connect & run three phase induction motors in a sequence using contactor & relay. (04 hrs) 296. Construct, run, stop and jog in both directions of an induction motor. (04 hrs) 297. Understand all the information on a Motor template. (04 hrs) 298. Familiarize with different types of DC motors. (04 hrs) 299. Connect & run DC shunt motor using 3 point starter. (04 hrs) 300. Change the direction of rotation of DC motor. (04 hrs) 301. Control the speed of DC motor by armature control method. (04 hrs) 302. Control the speed of DC motor by the field control method. (04 hrs) 303. Construct the circuit for speed control of DC shunt	Brushless DC Motors. (27 hrs.)

		motor (phase control method). (04 hrs) 304. Construct the PWM circuit for the speed control of DC shunt motors. (04 hrs) 305. Control the speed of DC shunt motor using SCR chopper by using a trainer. (05 hrs)	
Professional Skill 75 Hrs; Professional Knowledge 27 Hrs	Install, configure and demonstrate the AC and DC drive to control the speed.	**AC Drives** 306. Study the AC Drive set up and its connections. (05 hrs) 307. Identify different cables and connectors used in the AC DRIVE setup. (05 hrs) 308. Identify various input and output terminals of the DRIVE unit, Operator panel and display unit.(05 hrs) 309. Familiarization with PMU & different terminals of Micro – Master AC Drive.(05 hrs) 310. Demonstration – Access parameter number & values. (05 hrs) 311. Familiarization with parameters. (05 hrs) 312. Parameter values for various operations. (05 hrs) 313. Commissioning parameter numbers and values. (05hrs) 314. Installation of AC Drive(similar to SIEMENS MM-420/440).(05hrs)	Block diagram of AC Drive – (Sources of supply – Converter/Rectifier – DC Link – Inverter –Motor Load) 1 phase & 3 phase rectifier circuits. Inverter – 1 phase Inverter 3 phase Inverter Switching circuit (Sequence and Switching timing control – PWM Technique & Switching Devices. Microprocessor/ Microcontroller) - VFD (Variable Frequency Drive) VVVF Control – (3 phase induction motor) Speed control. Introduction of PID controller. Installation of AC Drive/ Siemens Micro master Drive – MM-420/440 Commissioning/ Quick Commissioning of MM – 420/440 Micro – Master Drive – Programming (Parameterization)

		315. Familiarization with: Commissioning & Quick Commissioning(similar to SIEMENS MM-420/440). (05 hrs) 316. Reset to default values/ Factory setting values. (05 hrs) 317. MM Drive Programming/Parameterization for different control operations. (10 hrs) 318. ON/OFF, Forward/ Reverse, Jog (R)/Jog (L), braking and speed control. (10 hrs)	(27 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Install, configure and demonstrate the AC and DC drive to control the speed.	**DC Drives** 319. Familiarization with different parts and terminals of DC Drive. (08 hrs) 320. Familiarization with parameters and operation for accessing parameter number and values. (08 hrs) 321. Start up procedure demonstration. (08 hrs) 322. Parameterization for variation of motor speed through POT with Armature voltage feedback (with internal setting). (08hrs) 323. Parameterization – Control drive through POT with encoder feedback (with internal setting). (10hrs)	Tacho-generator/Encoder technical data Related to DC drive. Block diagram of DC Drive. Converter bank – Gate Trigger set circuit. Hardware description of DC Drive. Description of 6RA70 Siemens (or similar) master drive. Start up procedure (Quick Commissioning) Terminal Diagram of 6RA70 DC Drive Function of 6RA70. BICO Technology. Parameterization of DC Drive – 6RA70 – BICO Parameterization. (18 hrs.)

		324. Parameterization – Control the drive speed through external speed raise/ lower buttons. (08hrs)	
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Perform speed control of servo motors and test different industrial process circuit by selecting the suitable function.	**Servo Motor** 325. Construct a simple circuit to control servo motor using IC 555.(10 hrs) 326. Connect servo motor with drive & control its parameters. (10 hrs) 327. Connect the servo motor to computer for monitoring & controlling of various parameters. (10 hrs) 328. Parameter programming of servo motor. (10 hrs) 329. Various control method for controlling velocity & torque. (10 hrs)	Servo mechanism, Servo motor principal, Difference between motors & servo motor. Types of servo motor, AC & DC - brushless servo motor &permanent magnet servo motor construction & application. Control method for servo motor. Study of servo drive. (18 hrs.)
Professional Skill 50 Hrs; Professional Knowledge 18 Hrs	Install, test & control, the Electro Pneumatic actuators using various pneumatic valves.	**Electronic Pneumatics** 330. Identify different pneumatic and electro pneumatic components. (04hrs) 331. Construct and control a single acting cylinder. (04hrs) 332. Construct and control a double acting cylinder. (04hrs) 333. Construct and control single/double acting cylinder using series/ parallel circuits. (04hrs) 334. Construct and perform bidirectional control of a	Introduction to pneumatic power source and measure of compressed air, storage and transmission of compressed air, applications of pneumatics in the industries. Symbols of different pneumatic and electro-pneumatic components. Various supply elements such as compressors, reservoir, pressure regulating valve, service unit etc. Various input elements such as push button valves, roller lever valves,

		cylinder.(06hrs) 335. Construct and control, automatic return of a double acting cylinder. (06hrs) 336. Construct and control the oscillating motion of a double acting cylinder. (04 hrs) 337. Construct and control a latching circuit using single or double acting cylinder. (04 hrs) 338. Construct and control, automatic return initiated by a limit switch. (04 hrs) 339. Throttle a cylinder to adjust forward and return strokes. (06 hrs) 340. Adjust the pressure as per the requirements. (04 hrs)	proximity switches, Air barriers etc. Various pneumatic control elements, processing elements such as directional control valves, shuttle valves, non-return valves, pressure control valves, Timers and sequencers etc. Function and application of solenoid valves. Limit switches, memory valves, pressure dependent valves and time dependent valves. (18 hrs.)
Professional Skill 100 Hrs; Professional Knowledge 36 Hrs	Execute the operation of different indication on PLC modules and wire different field devices of PLC and configure the system and perform the suitable function.	**PLC** 341. Identify various indicators on PLC Modules and interpret.(15hrs) 342. Wire in various digital input and output devices to the respective modules. (10 hrs) 343. Wire analog input and output devices to the respective modules. (10hrs) 344. Connect and configure PLC hardware and the software. (15 hrs)	Evolution of control technology. Advantages of PLCs Modular architecture of PLCs, working principle of PLCs. Various modules and addressing Wiring of field devices to various modules, interpretation of indications on CPU and other modules Specification of PLC Modules Implementation of relays, timers and counters using

		345. Develop and run simple programs to read sensor status and to control various outputs. (15 hrs) 346. Force input and output devices using the software. (15 hrs) 347. Perform online editing of a rung/network. (10hrs) 348. Prepare data tables and monitor. (10hrs)	PLCs (36 hrs.)
Industrial Visit/ Project Work **Broad Areas:** a) Smoke detector. b) Water level sensor. c) Run a three phase motor using manual and automatic star-delta starters. d) Solar power inverter. e) Control single/double acting cylinder using series/parallel circuit. a) Simple programs to read sensor status and to control.			

SYLLABUS FOR CORE SKILLS
1. Workshop Calculation & Science(Common for two year 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			
TECHNICIAN POWER ELECTRONIC SYSTEMS (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	100 mm	12nos.
2.	Neon tester 500 V.	500 V	6 nos.
3.	Screw driver set	Set of 7	12nos.
4.	Insulated combination pliers	150 mm	6 nos.
5.	Insulated side cutting pliers	150mm	8 nos.
6.	Long nose pliers	150mm	6 nos.
7.	Soldering iron	25 Watt, 240 Volt	12nos.
8.	Electrician knife	100 mm	6 nos.
9.	Tweezers	150 mm	12 nos.
10.	Digital Multimeter	(3 3/4 digit),4000 Counts	12nos.
11.	Soldering Iron Changeable bits	15 Watt, 240 Volt	6 nos.
12.	De-soldering pump electrical heated, manual operators	230 V, 40 W	12nos.
B. SHOP TOOLS, INSTRUMENTS, EQUIPMENTS – For 2 (1+1) units no additional items are required			
Lists of Tools:			
1.	Steel rule graduated both in Metric and English Unit	300 mm	4 nos.
2.	Precision set of screwdrivers	T5, T6, T7	2 nos.
3.	Tweezers – Bend tip		2 nos.
4.	Steel measuring tape	3 meters	4 nos.
5.	Tools makers vice	100mm (clamp)	1 no.
6.	Tools maker vice	50mm (clamp)	1 no.
7.	Crimping tool (pliers)	7 in 1	2 nos.
8.	Magneto spanner set	8 Spanners	2 nos.
9.	File flat bastard	200 mm	2 nos.
10.	File flat second cut	200 mm	2 nos.
11.	File flat, smooth	200 mm	2 nos.
12.	Plier - Flat Nose	150 mm	4 nos.
13.	Round Nose pliers	100 mm	4 nos.
14.	Scriber straight	150 mm	2 nos.
15.	Hammer ball pen	500 grams	1 no.

16.	Allen key set (Hexagonal-set of 9)	1 - 12 mm, set of 24 Keys	1 no.
17.	Tubular box spanner	Set - 6 - 32 mm	1 set
18.	Magnifying lenses	75 mm	2 nos.
19.	Continuity tester		6 nos.
20.	Hacksaw frame, adjustable	300 mm	2 nos.
21.	Chisel - Cold - Flat	10 mm X 150 mm	1 no.
22.	Scissors	200mm	1 no.
23.	Handsaw 450mm	Hand saw - 450 mm	1 no.
24.	Hand Drill Machine Electric with Hammer Action	13 mm	2 nos.
25.	First aid kit		1 no.
26.	Bench Vice	Bench Vice - 125 mm	1 no. each
		Bench Vice - 100 mm	
		Bench Vice - 50 mm	
List of Equipments			
27.	Dual DC regulated power supply	30-0-30 V, 2 Amps	4 nos.
28.	DC Regulated Variable Programmable DC Power Supply	0-30V/3A	2 nos.
29.	LCR meter (Digital) Handheld		1 no.
30.	CRO Dual Trace	20 MHz (component testing facilities)	2 nos.
31.	Signal Generator with Digital Display for Frequency Amplitude	10 Hz to 100 kHz, 50/600 Ohms (output impedance)	2 nos.
32.	Battery Charger	0 - 6 - 9 - 12 - 24 , 15 Amps	1 no.
33.	Analog multimeter		4 nos.
34.	Clamp meter	0 - 10 A	2 nos.
35.	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.
36.	Dimmer starter	3 Amps	2 nos.
37.	Autotransformer	15 Amps	2 nos.
38.	Analog Component Trainer	Breadboard for Circuit design with necessary DC /AC power supply: • 8 pin ZIF socket • 16 pin ZIF socket • Resistor bank • Capacitor bank • Potentiometers • Diodes	4 nos.

		• Zener diodes • NPN Transistor • N-channel MOSFET • LED • Bread board • Ready to use Experimental Boards Lab Manual with list of experiments to perform various experiments	
39.	Milli Ammeter (AC)	0 – 200 mA	2 nos.
40.	Milli Ammeter (DC)	0 – 500 mA	2 nos.
41.	Op Amp trainer	• ±15V, ±12 and +5V fixed DC power supply • 8pin ZIF socket • 16 pin ZIF socket • Resistor bank • Capacitor bank • Potentiometers • Bread board • Built in oscillator: sine, square and tri-angular waveform	2 nos.
42.	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.
43.	Digital and Analog IC Tester		1 no.
44.	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.
45.	Rheostats various values and ratings		2 nos. Each
46.	POWER ELECTRONICS TRAINER With at least 6 nos. of application		4 no.

	board MOSFET Characteristics SCR Characteristics SCR Lamp Flasher SCR Alarm Circuit Series Inverter Single Phase PWM Inverter		
47.	Computers with LAN card, Blue-Ray drive and player, MS Office education version.	CPU: 32/64 Bit i3/i5/i7 or latest processor, Speed: 3 GHz or Higher. RAM:-4 GB DDR-III or Higher, Wi-Fi Enabled. Network Card: Integrated Gigabit Ethernet, with USB Mouse, USB Keyboard and Monitor (Min. 17 Inch.) Licensed Operating System and Antivirus compatible with trade related software.	4 nos.
48.	Laptops latest configuration		1 no.
49.	Laserjet Printer		1 no.
50.	Internet broadband connection		1 no.
51.	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.
52.	Different types of electronic and electrical cables, connectors, sockets, terminations		As required
53.	Different types of Analog electronic components, digital ICs, power electronic components, general purpose PCBs, bread board, MCB, ELCB		As required
54.	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, logs etc.	1 no.

55.	Soldering & De-soldering Station		1 no.
56.	SMD Soldering & De soldering Station with necessary accessories	SMD Rework Station: Soldering station: Output Voltage:26V – 40V AC Temp Range: 50 to 4800 C Desoldering Station: Output Voltage: 24V – 40V AC Vacuum Generator: Vacuum pump: double cylinder type Vacuum Pressure: 80 k Pa Suction flow: 15 L/min. Hot air station: Air flow: 1-9 L/min Temp:50 o 500 °C Hand piece of Hot air accessories	2 nos.
57.	DOL starter	½ HP	1 no.
58.	AC Motor Trainer Kit ¼ HP motor Single Phase Contactors Relays MCB DOL Starter		1 no.
59.	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.
60.	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	1 set

		6. DAQ: Data Acquisition to sense different sensor signals	
61.	Sensor Trainer Kit containing following Sensors 1. Thermocouple 2. RTD 3. Load Cell/ Strain Gauge 4. LVDT 5. Smoke Detector Sensors 6. Speed Sensor 7. Limit Switch 8. Photo sensors 9. Optocouplor 10. Proximity Sensor	Graphical touch LCD with inbuilt processor for viewing the output waveforms, Inbuilt DAQ, and standard processing circuits like Inverting , Non – Inverting, Power, Current, 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	2 nos.
62.	Various analog and digital ICs useful for doing project works mentioned in the digital and analog IC application modules		As required
63.	Different types of electronic and electrical cables, connectors, sockets, terminations.		As required
64.	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.
65.	Seven segments DPM trainer		6 nos.
66.	Precision set of screwdrivers-	T5, T6, T7	2 nos.
67.	SMPS of different make		4 nos.
68.	UPS trainer		As required.
69.	UPS		As required.
70.	Allen key screwdriver	5 no. of set	1 set
71.	Jacket stripper/ Coring tool for 500 series cable		1 no.
72.	Center conductor cleaner		1 no.

73.	Universal drop trimmer for RG 6/11 cables		1 no.
74.	F - connector tool for RG 6/11 cables		1 no.
75.	F – connector compression tool for RG 6/11 cables		1 no.
76.	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.
77.	LED lighting system	Measurement of Power, Voltage, Current, Power Factor and Light output performance of different lighting products like LED, CFL at variable input voltages 0 to 245V variable AC	2 sets
78.	DC shunt motor	1HP with 3 point starter	1 no.
79.	Tachometer	Digital type 10000RPM	2 nos.
80.	Rheostat	1Kohm	2 nos.
81.	3 phase induction motor	1Hp with DOL starter	1 no.
82.	Squirrel induction motor	5 HP with star-delta starter	1 no.
83.	1hp motor	DC drives trainer with phase control method	1 no.
84.	1hp motor	DC drive trainer with SCR chopper circuit	1 no.
85.	Programmable DC drive with motor	(Simoreg DC master) 6RA70	1 no.
86.	Solarpanel based Inverter	500VA	1 no.
87.	3 phase motor	1 HP, VVVF drive trainer	1 no.
88.	AC motor	1hp, AC drive (Siemens Micro master 420)	As required
89.	PLC Systems with digital I/P, O/P modules Trainer kit and software	6 Digital Inputs (24V DC). 4 Digital Outputs (24V DC) 2K Words of memory, 256	3 nos.

		words of register. Powerful features like built in Floating Point, Sub Routines etc. One RS232 C communication facility for PC interface. Three channels can be configured as follows, Pulse width modulation output or Pulse train output or High speed counter input.	
90.	Solenoid	24 V AC	4 nos.
91.	Lamp	24 V AC	6 nos.
92.	AC power supply	24 V, 50 Hz, 2 A	As required
93.	DC power supply	+12 V 2 A	2 nos.
94.	DC power supply	+5 V 2 A	2 nos.
95.	Electronic Pneumatics Trainer kit		2 nos.
96.	Servo Motor drivesTrainer kit		2 nos.
D. Shop Floor Furniture and Materials - For 2 (1+1) units no additional items are required.			
97.	Instructor's table		1 no.
98.	Instructor's chair		2 nos.
99.	Metal Rack	100cm x 150cm x 45cm	4 nos.
100.	Lockers with 16 drawers standard sizes		2 nos.
101.	Steel Almirah	2.5 m x 1.20 m x 0.5 m	2 nos.
102.	Black board/white board	12' x 4'	2 no. (one for lab and one classroom)
103.	Fire Extinguisher		2 nos.
104.	Fire Buckets		2 nos.
105.	Classroom furniture (dual desk)		12 nos.
106.	Lab tables (work bench)		6 nos.
107.	Stools for lab		24nos.

Note: -

1. *All the tools and equipment are to be procured as per BIS specification.*
2. *Internet facility is desired to be provided in the class room.*

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 contributed/ participated for finalizing the course curriculum of Technician Power Electronic Systems on 16.05.2017 at ITI Aundh, Pune, Maharashtra

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2.	Jai Prakash, Dy. Manager	Bharat Electronics Limited, Pune	Member
3.	Y.Raghvendhar, Dy. Manager	Bharat Electronics Limited, Pune	Member
4.	Dipak Ghule, Sr. Engineer	Micro Embedded Technologies, Pune	Member
5.	V. Ravi,C.E.O.	Anshuman Technologies Pvt. Ltd., Pune	Member
6.	N. Jagtap, Sr. Engineer	Anshuman Technologies Pvt. Ltd., Pune	Member
7.	Milind Dhule, Sr. Engineer	Scientech Technologies Pvt.Ltd Ganesh Mala, Sinhgad Rd, Pune	Member
8.	SachinKoravi, Sr. Engineer	Dynalog Didactic Solutions Pvt. Ltd.,Narhe - Pune - 41	Member
9.	Pravin S Deode, MD	Sap Engineers & Consultant, Pune-38	Member
10.	Amol Kadu, Sr. Engineer	NVIS Technologies Pvt.Ltd., Indore, Electronics Complex, Pardeshipura	Member
11.	Kunal Bondre, Sr. Engineer	Emerson Network Power (I) Pvt. Ltd.	Member
12.	Amar Phagwani, Sr. Enginner	Blue Star Limited, Wada Dist Thane	Member
13.	Smt S.N. Murmade, Sr. Engineer	IFB Ltd., Mumbai	Member
14.	Nissar Shaikh, Service Engineer	Samsung (I) Ltd., Mumbai	Member
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		Ltd.	
16.	Sarfaraz Alam, Sr. Engineer	Emerson Network Power (I) Pvt. Ltd.	Member
17.	Nasir Ali Shaikh, Sr. Engineer	Emerson Network Power (I) Pvt. Ltd.	Member
18.	Uday Apte, Div. Manager (Trg.)	Tata Motors, Sanand, Gujarat	Member
19.	DK Sharma, MD	Technology Exchange, Ahmedabad	Member
20.	Amalendu Jana, Manager (Technical)	Tata Telecommunications, Kolkata	Member
21.	L.K. Mukherjee, Deputy Director	CSTARI, Kolkata	Member
22.	HN Bargal, Training Officer	DVET, Mumbai	Member
23.	Meera Karad, Instructor	ITI, Aundh, Pune	Member
24.	P Bairagi, Training Officer	CSTARI, Kolkata	Member
25.	Mrs. Deblina Roy, Instructor	Don Bosco, Kolkata	Member
26.	Mrs. Keya Basu, Supervisor	ITI Tollygunge, Kolkata	Member

MEMBERS OF SECTOR MENTOR COUNCIL			
SNo.	**Name & Designation Sh/Mr/Ms**	**Organization**	**Mentor Council Designation**
1.	M.R.K. Naidu, Head (CR&D)	ECIL, Hyderabad	Chairman
2.	Pradeep Doshi, SVP	ESSCI, NewDelhi	Member
3.	T. Venkataswamy, Asstt. Engg.	BHEL, Hyderabad	Member
4.	A Prasanna Lakshmi, Faculty	BHEL, Hyderabad	Member
5.	T. Venkateswara Sharma, Sr.	BEL, Hyderabad	Member
6.	P. Chandrashekhar, MD	Techno Design Group, Hyderabad	Member
7.	S.CH. AppaRao,	BEL, Hyderabad	Member
8.	T. Ram Mohan Rao, Sr. Manager	BDL, Hyderabad	Member
9.	B Udaya Bhaskar Rao, DGM	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			
13.	R.L. Singh, DDG(T)	DGT, MOLE, New Delhi	Mentor
Members of Core Group			
14.	C.S. Murthy, DDT	ATI-EPI, Hyderabad	Team Leader
15.	C.H.Ravi , DDT	ATI-EPI, Mumbai	Member
16.	L.K. Mukherjee, DDT	CSTARI, Kolkata	Member
17.	N.R. Aravindan, JDT	NIMI, Chennai	Member
18.	C. Ramasubramanian, DDT	AHI, Bangalore	Member
19.	H.C. Goyal, DDT	ATI-EPI, Dehradun	Member
20.	Avinash Kishore, ADT	DGT, MOLE, NewDelhi	Member
21.	R. Malathi, TO	RVTI(W), Bangalore	Member
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27.	Z A Gadyal, JTO	ITI, Belgaum	Member
28.	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