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

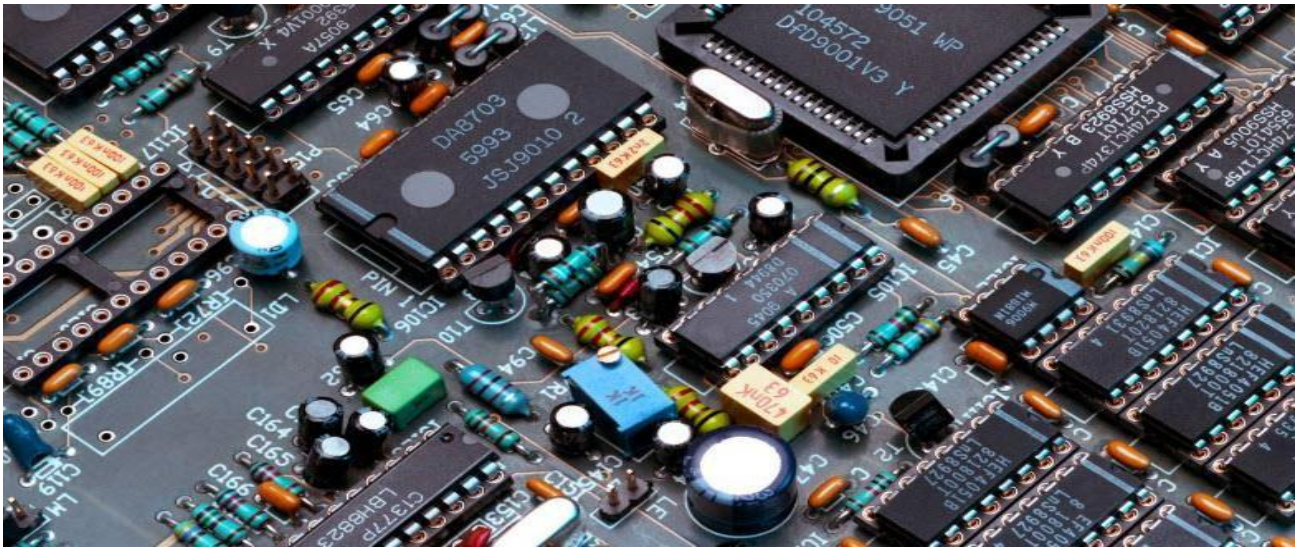
COMPETENCY BASED CURRICULUM

ELECTRONICS MECHANIC

(Duration: Two Years)

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL: 4



Sector – ELECTRONICS & HARDWARE

CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
Kolkata-700091

ELECTRONICS MECHANIC

(Engineering Trade)

(Revised in August 2025)

Version: 3.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL: 4

Directorate General of Training

Developed By

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CONTENTS

1. COURSE INFORMATION

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

FIRST YEAR: In the first year of the course, students will gain foundational knowledge and hands-on experience in essential workshop practices including fitting, riveting, and drilling with a strong emphasis on safety protocols. They will be introduced to electrical and electronic measurements using single range meters, calibration techniques, and the use of Digital Storage Oscilloscopes (DSO) to measure various parameters accurately. Practical skills in testing, servicing, and estimating repair costs for different types of batteries will be developed. Students will learn to measure AC/DC parameters using standard instruments, design and print Printed Circuit Boards (PCBs), and perform soldering and de-soldering operations on components such as switches, transformers, and PCBs. The curriculum includes testing electronic components, assembling and troubleshooting analog and digital circuits, and constructing circuits using operational amplifiers (IC 741) and linear integrated circuits (IC 555). Emphasis will also be placed on the use of electronic simulator software for analyzing circuit behavior and verifying characteristics of optoelectronic components and power electronic circuits, ensuring a well-rounded technical foundation.

SECOND YEAR: In the second year of the course, students will advance their technical proficiency by preparing, terminating, and testing various industry-standard electronic cables, and installing, configuring, and interconnecting computer systems with application software for diverse uses. Emphasis will be placed on identifying, soldering, and de-soldering SMD components and IC packages using appropriate tools while adhering to safety norms. Learners will construct and test electrical control circuits, assemble and evaluate commercial AM/FM receivers, and troubleshoot components in domestic and industrial programmable systems. They will interface LCDs, LEDs, and DPM panels with circuits, and work with sensors and transducers for IoT applications, gaining insights into IoT architecture. Further, they will explore robotics systems, plan and complete hands-on projects for domestic or commercial use, and work with fiber optic setups for data transmission. The curriculum includes fault detection and servicing of SMPS, UPS, and inverters; identification and testing of photovoltaic modules and charge controllers; and installation and performance evaluation of solar panels. Additionally, students will dismantle, analyze, and troubleshoot cell phones, and service LCD/LED/Smart TVs including remote modules. Supporting knowledge in engineering drawing, mathematics, and basic science will be integrated throughout to reinforce theoretical and practical learning outcomes.

2. TRAINING SYSTEM

2.1 GENERAL

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

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

Candidates need broadly to demonstrate that they are able to:

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

2.2 PROGRESSION PATHWAYS:

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

2.3 COURSE STRUCTURE:

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

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
Total		**1200**	**1200**
On the Job Training (OJT)/ Group Project*		150	150
Optional Courses**		240	240
Grand Total		**1590**	**1590**

** The trainee has to undergo 150 hours of mandatory OJT (On the Job Training) at nearby industry or wherever industry not available then group project has to be done with the supervision of the trade instructor for every year.*

*** Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for obtaining 10th/ 12th class certificate from NIOS along with ITI certification, or, short term courses for extra skills/knowledge.*

2.4 ASSESSMENT & CERTIFICATION:

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

a) The **Continuous Assessment** (Internal)during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.cstaricalcutta.gov.in or 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 DGT as per the guidelines. The pattern and marking structure is being notified by DGT from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months & one year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percentage for Trade Practical and Formative assessment are 60% & for all other subjects are 33%.

2.4.2 ASSESSMENT GUIDELINE:

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

Assessment will be evidence based comprising some of 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
- Computer based multiple choice question examination
- Practical Examination

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

Marks Allotted during Assessment	Performance Level	Evidence
Marks between 60% to 75%	For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 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.
Marks above 75% to 90%	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.
Marks Above 90%	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

Brief Description of Job Roles:

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

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

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

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

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

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

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

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

Cable Television Installer; installs cable television cables and equipment on customer's premises, using electrician's tools and test equipment: Measures television signal strength at utility pole, using electronic test equipment. Computes impedance of wire from pole to house to determine additional resistance needed for reducing signal to desired level. Installs terminal boxes and strings lead-in wires, using electrician's tools. Connects television set to cable system and evaluates incoming signal. Adjusts and repairs cable system to ensure optimum reception. May collect installation fees and explain cable service operation to subscriber. May clean and maintain tools, test equipment.

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

Television Repair Technician; job role is applicable to both Television manufacturing facilities as well as electronics service centers. This role pertains to rectify faults identified during testing of TV on in manufacturing process and providing after sales assistance and ensuring appropriate functioning of television sets. A TV repair technician identifies the section in the TV that is not functioning. If the problem identified is in the Printed Circuit Board (PCB), the technician identifies the specific fault in the PCB and corrects it. Replaces the dysfunctional PCB with a new one, if the damage identified requires fixing at the service centre. Plan and organize assigned work and detect & resolve issues during execution. Demonstrate possible solutions and agree tasks within the team. Communicate with required clarity and understand technical English. Sensitive to environment, self-learning and

productivity.

Reference NCO-2015:

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

Reference NOS:

a) ELE/N9470
b) ELE/N9401
c) ELE/N9472
d) ELE/N9403
e) ELE/N9402
f) ELE/N9530
g) ELE/N9516
h) ELE/N9517
i) ELE/N9404
j) ELE/N9476
k) ELE/N9438
l) ELE/N9518
m) ELE/N9519
n) ELE/N9405
o) PSS/N9401
p) PSS/N9402
q) ELE/N9520
r) SSC/N9408
s) ELE/N9521
t) ELE/N9407
u) ELE/N9408
v) ELE/N9522
w) ELE/N9529
x) ELE/N9506
y) ELE/N9505
z) ELE/N9524
aa) ELE/N9523
bb) ELE/N9409
cc) ELE/N9525
dd) ELE/N9526
ee) ELE/N9527
ff) ELE/N9528

4. GENERAL INFORMATION

Name of the Trade	**ELECTRONICS MECHANIC**
Trade Code	DGT/1005
NCO - 2015	7421.0100, 7421.0300, 7422.1100, 7422.1200. 7422.1300, 7422.1302, 7422.1400, 7421.1401, 7422.0801, 7421.0801
NOS Covered	ELE/N9470, ELE/N9401, ELE/N9472, ELE/N9403, ELE/N9402, ELE/N9530, ELE/N9516, ELE/N9517, ELE/N9404, ELE/N9476, ELE/N9438, ELE/N9518, ELE/N9519, ELE/N9405, PSS/N9401, PSS/N9402, ELE/N9520, SSC/N9408, ELE/N9521, ELE/N9407, ELE/N9408, ELE/N9522, ELE/N9529, ELE/N9506, ELE/N9505, ELE/N9524, ELE/N9523, ELE/N9409, ELE/N9525, ELE/N9526, ELE/N9527, ELE/N9528
NSQF Level	4
Duration of Craftsmen Training	Two Years
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF, AUTISM, SLD
Unit Strength (No. Of Student)	24 (There is no separate provision of supernumerary seats)
Space Norms	56 Sq. m
Power Norms	3.04 KW
Instructors Qualification for	
1. Electronics Mechanic Trade	B.Voc/Degree in Electronics / Electronics and Telecommunication/ Electronics and communication Engineering from AICTE/UGC recognized Engineering College/ university with one year of teaching or industry experience in Electronics field. **OR** 03 years Diploma in Electronics / Electronics and telecommunication/ Electronics and communication from AICTE /recognized board of technical education **two years of teaching or industry experience** in the Electronics field. **OR** NTC/NAC passed in the Trade of "Electronics Mechanic" with **three years of teaching or industry experience** in the Electronics field. **Essential Qualification:** Regular/ RPL variants of National Craft Instructor Certificate (NCIC) in "Electronics Mechanic" trade under DGT. **NOTE: Out of two Instructors required for the unit of 2 (1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.**
2. Workshop Calculation &	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering

Science	College/ university with **one-year of teaching or industry experience.** **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education with **two years' of teaching or industry experience.** **OR** NTC/ NAC in any one of the engineering trades with **three years' of teaching or industry experience.** **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in any one of the engineering trades or RoDA.
3. Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with **one-year of teaching or industry experience.** **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education with **two years' teaching or industry experience.** **OR** NTC/ NAC in any one of the engineering/ Draughtsman group of trades with **three years' of teaching or industry experience**. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in any one of the engineering trades or RoDA.
4. Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with **Two years' of teaching or industry experience with short term ToT Course** in Employability Skills conducted by DGT institutions. (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 conducted by DGT institutions.
5. Minimum age for Instructor	21 years
List of Tools and Equipment	As per Annexure – I

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

Sl. No.	NOS Code	Learning Outcome	Duration		
			Practical	Theory	Total
First Year					
1.	ELE/N9470	Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care & safety following safety precautions.	65	10	75
2.	ELE/N9401	Select and perform electrical/ electronic measurement of single range meters and calibrate the instrument under given conditions.	45	15	60
3.	ELE/N9472	Test & service different batteries used in electronic applications and record the data to estimate repair cost.	24	06	30
4.	ELE/N9403	Measure the various parameters by DSO and execute the result with standard one.	21	09	30
5.	ELE/N9402	Measure AC/DC using proper measuring instruments and compare the data using standard parameter.	50	10	60
6.	ELE/N9530	Design PCB & Print using PCB printing machine.	45	15	60
7.	ELE/N9516	Plan and execute soldering & de- soldering of various electrical components like Switches, PCB & Transformers for electronic circuits.	25	05	30
8.	ELE/N9517	Test various electronic components using proper measuring instruments and compare the data using standard parameter.	95	25	120
9.	ELE/N9517	Assemble simple electronic power supply circuit and test for functioning.	50	10	60
10.	ELE/N9404	Construct, test and verify the input/ output characteristics of various analog circuits.	90	15	105
11.	ELE/N9476	Plan and construct different power electronic circuits and analyse the circuit functioning.	70	20	90
12.	ELE/N9438	Select the appropriate opto electronics components and verify the characteristics in different circuit.	50	10	60

13.	ELE/N9518	Assemble, test and troubleshoot various digital circuits.	80	10	90
14.	ELE/N9519	Simulate and analyze the analog and digital circuits using electronic simulator software.	50	10	60
15.	ELE/N9405	Construct and test different circuits using ICs 741 operational amplifiers & ICs 555 linear integrated circuits and execute the result.	80	10	90
16.	PSS/N9401	Read and apply Engineering drawing for different application in the field of work.	-	30	30
17.	PSS/N9402	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	-	30	30
		Employability Skills	-	**120**	**120**
		Total	**840**	**360**	**1200**
		Second Year			
18.	ELE/N9520	Prepare, crimp, terminate and test various cables used in different electronics industries.	24	06	30
19.	SSC/N9408	Install, configure, interconnect given computer system(s) and demonstrate & utilize application packages for different application.	71	34	105
20.	ELE/N9521	Identify, place, solder and de- solder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup.	72	18	90
21.	ELE/N9407	Construct different electrical control circuits and test for their proper functioning with due care and safety.	20	10	30
22.	ELE/N9408	Assemble and test a commercial AM/ FM receiver and evaluate performance.	60	15	75
23.	ELE/N9522	Test, service and troubleshoot the various components of different domestic/ industrial programmable systems.	60	15	75
24.	ELE/N9529	Plan and Interface the LCD, LED, DPM panels to various circuits and evaluate performance.	25	05	30
25.	ELE/N9506	Execute the operation of different sensors, identify, wire & test various transducers of IOT Applications.	120	30	150
26.	ELE/N9505	Identify different IoT Applications with IoT	20	10	30

		architecture.			
27.	ELE/N9524	Identify, check constructional feature and function of Robot system.	08	07	15
28.	ELE/N9523	Plan and carry out the selection of a project, assemble the project and evaluate performance for a domestic/ commercial application.	90	15	105
29.	ELE/N9409	Prepare fibre optic setup and execute transmission and reception.	10	05	15
30.	ELE/N9525	Detect the faults and troubleshoot SMPS, UPS and inverter.	120	30	150
31.	ELE/N9526	Identify, Test and Photovoltaic cells, Modules, Batteries and Charge controllers. Install a solar panel, execute testing and evaluate performance by connecting the panel to the inverter.	60	15	75
32.	ELE/N9527	Dismantle, identify the various parts and interface of a cell phone to a PC. Estimate and troubleshoot.	30	15	45
33.	ELE/N9528	Identify, operate various controls, troubleshoot and replace modules of the LCD/LED TV/ Smart TV & its remote.	50	10	60
34.	PSS/N9401	Read and apply engineering drawing for different application in the field of work.	-	30	30
35.	PSS/N9402	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	-	30	30
		Employability Skills	-	**60**	**60**
		Total	**840**	**360**	**1200**
		Grand Total	**1680**	**720**	**2400**

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care &safety following safety precautions. (NOS: ELE/N9470)	• 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 under given conditions. (NOS: ELE/N9401)	• 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. (NOS: ELE/N9472)	• 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. Measure the various parameters by DSO and execute the result with standard one. (NOS: ELE/N9403)	• 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 USB to DSO and save the waveform and retrieve it in computer.
5. Measure AC/DC using proper measuring instruments and compare	• Construct a test lamp and use it to check mains healthiness. • Measure the gauge of the wire using SWG and outside micrometer.

the data using standard parameter. (NOS: ELE/N9402)	• Measure AC and DC voltages using multi meter. • Carryout mechanical zero setting of a meter. • Measure voltage and current using clamp meter.
6. Designing PCB and print using PCB Printing Machine. (NOS: ELE/N9530)	• Create a circuit schematic using software. • Explain the purpose and components of a PCB. • Describe common PCB materials and layers. • Convert schematic into PCB layout. • Route traces and place components effectively. • Generate Gerber files and G-code files for manufacturing. • Understand the operation and calibration of a PCB printing machine. • Execute the printing process safely. • Follow safety protocols during PCB printing.
7. Plan and execute soldering & de-soldering of various electrical components like Switches, PCB & Transformers for electronic circuits. (NOS: ELE/N9516)	• Plan work in compliance with standard safety norms. • Identify different types of mains transformers and test. • Identify the primary and secondary transformer windings and test the polarity. • Measure the primary and secondary voltage of different transformers. • Solder the given components. • Identify and test the variac. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
8. Test various electronic components using proper measuring instruments and compare the data using standard parameter. (NOS: ELE/N9517)	• Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan work in compliance with standard safety norms. • Identify the different types of resistors. • Measure the resistor values using colour code and verify the reading by measuring in multi meter. • Identify the power rating using size. • Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter. • Identify different inductors and measure the values using LCR meter. • Identify the different capacitors and measure capacitance of various capacitors using LCR meter. • Ascertain and select tools and materials for the job and make this available for use.

9. Assemble simple electronic power supply circuit and test for functioning. (NOS: ELE/N9517)	• 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 DSO and measure the D.C. & A.C. voltage, frequency and time period. • Construct and test a half & full wave rectifier 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.
10. Construct, test and verify the input/ output characteristics of various analog circuits. (NOS: ELE/N9404)	• 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.
11. Plan and construct different power electronic circuits and analyse the circuit functioning. (NOS: ELE/N9476)	• Construct and test of Transistor and JFET amplifiers, oscillators and multi vibrators. • Construct and test a UJT as relaxation oscillator. • Construct and test lamp dimmer using TRIAC/DIAC with safety. • Construct and test MOSFET, IGBT test circuit and apply for suitable operation with proper safety. • Construct and test the universal motor speed controller using SCR with safety. • Construct and test a switching circuits using optical devices.
12. Select the appropriate op to electronics components and verify the characteristics in different circuit. (NOS: ELE/N9438)	• Plan work in compliance with standard safety norms. • Identify the different types of LEDs and IR LEDs. • Measure the resistance, voltage, current through electronic circuit using multimeter. • Construct and test a circuit using photo transistor and verify its characteristics. • Identify photo coupler/ optical sensor input/output terminals and measure the quantum of isolation between the terminals.

13. Assemble, test and troubleshoot various digital circuits. (NOS: ELE/N9518)	• Illustrate to practice the digital trainer kit with safety. • Identify various digital ICs, test IC using digital IC tester and verify the truth table. • Construct and verify the truth table of all gates using NOR and NAND gates. • Construct an adder cum substractor circuits and verify the truth table. • Construct a decoder and encoder, multiplexer and de-multiplexer circuits and verify the truth table. • Construct a multiplexer and de-multiplexer and verify the truth table. • Construct and verify the truth table of various flip flop, counter and shift register circuits.
14. Simulate and analyze the analog and digital circuits using electronic simulator software. (NOS: ELE/N9519)	• Plan the work incompliance with standard procedure. • Prepare simple analog and digital electronic circuits using the simulator software. • Simulate and test the prepared analog and digital circuits. • Convert the prepared circuit into layout diagram. • Explore various trouble shooting and fault finding the resources provided in the simulation software.
15. Construct and test different circuits using ICs 741operational amplifiers & ICs 555 linear integrated circuits and execute the result. (NOS: ELE/N9405)	• Demonstrate analog trainer kit with safety precautions. • Identify various ICs, differentiate by code No. and test for their condition. • Construct and test various OPAMP circuits. • Construct and test R-2R ladder type digital to analog converter circuit. • Construct and test different configurations of 555 IC e.g. astable, monostable, bi-astable and VCO circuits.
16. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)	• Read & interpret the information on drawings and apply in executing practical work. • Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters. • Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/ parameters to carry out the work.
17. Demonstrate basic mathematical concept and principles to perform	• Solve different mathematical problems. • Explain concept of basic science related to the field of study.

practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)	
SECOND YEAR	
18. Prepare, crimp, terminate and test various cables used in different electronics industries. (NOS: ELE/N9520)	• Plan and work incompliance with standard safety norms. • Prepare, terminate and test various electronics cable using proper crimping tools.
19. Install, configure, interconnect given computer system(s) and demonstrate & utilize application packages for different application. (NOS: SSC/N9408)	• Plan, work in compliance with standard safety norms. • Select hardware and software component. • Install and configure operating systems and applications. • Integrate IT systems into networks. • Deploy tools and test programmes. • Avoid e-waste and dispose the waste as per the procedure.
20. Identify, place, solder and desolder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup. (NOS: ELE/N9521)	• Identify the various crimping tools for various IC packages. • Identify different types of soldering guns and choose the suitable tip for the application. • Practice the soldering and de-soldering the different active and passive components, IC base on GPCBs using solder, flux, pump and wick. • Make the necessary setting on SMD soldering station to solder and de-solder various IC's of different packages by following the safety norms. • Identify SMD components, de-solder and solder the SMD components on the PCB. • Check the cold continuity, identify loose/dry solder and broken track on printed wired assemblies and rectify the defects. • Avoid waste, ascertain unused materials and components for safe disposal.
21. Construct different electrical control circuits and test for their proper functioning with due care and safety. (NOS: ELE/N9407)	• Measure the coil winding of the given motor. • Prepare the setup and control an induction motor using a DOL starter by following the safety norms. • Construct a direction control circuit to change direction of an induction motor. • Connect an overload relay and test for its proper functioning.

22. Assemble and test a commercial AM/ FM receiver and evaluate performance. (NOS: ELE/N9408)	• Plan and select tools to assemble the receiver. • Modulate and demodulate various signals using AM and FM on the trainer kit and observe waveforms. • Construct and test IC based AM Receiver. • Construct and test IC based FM transmitter and receiver. • Modulate and demodulate a signal using PAM, PPM, PWM Techniques. • Troubleshoot and replace the faulty components. • Check the functionality of AM/FM receiver.
23. Test, service and troubleshoot the various components of different domestic/ industrial programmable systems. (NOS: ELE/N9522)	• Understand and interpret the procedure as per manual of Micro Controller Atmega 328 Arduino Uno. • Identity various ICs & their functions on the given Microcontroller Kit. • Understand different pins, ports of Atmega 328 Arduino UNO Board. • Install Arduino Uno IDE on computer. • Write data into RAM & observe its volatility. • Understand program structure and write a program to blink LED using example. • Identify the port pins of the controller & configure the ports for Input & Output operation. • Demonstrate entering of simple programs, execute & monitor the results.
24. Plan and Interface the LCD, LED, DPM panels to various circuits and evaluate performance. (NOS: ELE/N9529)	• Identify LCD/LED Display module and its decoder/driver ICs and display a word on a two line LCD/LED. • Measure/current flowing through a resistor and display it. • Measure/current flowing through a sensor and display it on a LCD/LED module (DPM). • Avoid waste and dispose the waste as per the procedures.
25. Execute the operation of different sensors, identify, wire & test various transducers of IoT Applications. (NOS: ELE/N9506)	• Ascertain and select tools, material for the job and make this available for use in the timely manner. • Plan work in compliance with safety norms. • Demonstrate possible solution and agree task within the team. • Identify sensors used in process industries such as RTDs, Temperature ICs, Thermocouples, proximity switches (inductive, capacitive and photo electric), load cells, strain gauge. LVDT by their appearance. • Identify sensors used with micro-controller for different applications of home automation, industry automation, office

	automation etc. Temperature sensor, Humidity Sensor, LDR, Joy Stick Module, Motion Sensor, TOUCH Sensor, Ultrasonic Sensor, Relay Module. • Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart. • Write a program and interface temperature & humidity sensor in real time with ATMEGA 328 controller and read the room temperature & humidity. • Measure temperature of a lit fire using RTD and record the readings referring to data chart. • Write a program to connect LDR with controller ATMEGA328 and switch on Light using relay interfacing in real time. • Measure the DC voltage of a LVDT. • Write a program to interface motion sensor and connect in real time with ATMEGA 328 and detect motion of a object. • Detect different objectives using capacitive, inductive and photoelectric proximity sensors. • Write programs to connect different sensors PIR, Accelerometer, GAS, Gyroscope, Thermistor with micro-controller ATMEGA 328 and in real time.
26. Identify different IoT Applications with IoT architecture. (NOS: ELE/N9505)	• Identify various IoT Applications in smart city viz. smart street light and smart water & waste management. • Recognize the functions of various IoT Technician (Smart City) (IoT) applications & their distinctive advantages. • Identify and explore different functional building blocks of IOT enabled system / application. • Explore signal flow into IOT enabled system/application as per the IOT architecture.
27. Identify, check constructional feature and function of Robot system. (NOS: ELE/N9524)	• Identify and connect Robot for welding/CNC machines. • Understand Robot operation and maintenance. • Awareness about cyber security and safety of Robot System.
28. Plan and carry out the Selection of a project, assemble the project and evaluate performance fora domestic/commercial applications. (NOS: ELE/N9523)	• Plan, analyze and estimate the cost of the particular project. • Identify the various tools required for the job. • Prepare the simple digital/ analog electronic circuit. • Simulate and test the prepared circuit. • Assemble and test the circuit.

29. Prepare fibre optic setup and execute transmission and reception. (NOS: ELE/N9409)	• 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.
30. Detect the faults and troubleshoot SMPS, UPS and inverter. (NOS: ELE/N9525)	• 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.
31. Identify, Test and verify characteristics of Photovoltaic cells, Modules, Batteries and Charge controllers. Install a solar panel, execute testing and evaluate performance by connecting the panel to the inverter. (NOS: ELE/N9526)	• Connect solar panels in series & parallel and measure voltage and current. • Charge & discharge a solar battery rated 12V, 100 Ah using • Battery charger by CV and CC method and Tabulate the observations during charging & discharging cycle. • Connect the charge controller (12V, 10A) with Solar battery (12V, 100Ah), Solar panel (75W) and DC load. • Test the charge controller working with the above circuit. • Select appropriate tools and equipment. • Install a solar panel to a roof. • Wire a solar panel to a solar controller. • Wire a solar controller to a battery storage station. • Connect storage batteries to a power inverter. • Wire a power inverter to an electrical service panel.

	• Connect and test solar panel to the Inverter and run the load. • Installation of Solar Inverter. • Demonstrate the installation with team.
32. Dismantle, identify the various parts and interface of a cell phone to a PC. Estimate and troubleshoot. (NOS: ELE/N9527)	• Understand and interpret repair procedure as per manual of cell phone and select appropriate tools & equipment for undertaking job. • Plan to repair and assemble the components used as per circuit diagram. • Dismantle, identify the parts and assemble different types of smart phones. • Interface the cell phone/smart phone to the PC and transfer the data and browse internet. • Flash the various brands of cell phone/smart phone (at least 3) and upgrade the OS. • Format the cell phone/smart phone for virus (approach the mobile repair shop/service centre). • Identify the defective parts and rectify.
33. Identify, operate various controls, troubleshoot and replace modules of the LCD/LED TV & its remote. (NOS: ELE/N9528)	• Ascertain and select tools and materials for the job and make this available for use in a timely manner. • Plan to Dismantle and assemble modules as per circuit diagram. • Identification and operate different Controls on LCD, LED TV. • Dismantle, Identify the parts of the remote control. • Trace and rectify the faults of a various remote controls. • Identify various connectors and connect the cable operator's external decoder (set top box) to the TV. • Comply with safety rules when performing the above operations. • Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
34. Read and apply engineering drawing for different application in the field of work. (NOS: PSS/N9401)	• Read & interpret the information on drawings and apply in executing practical work. • Read & analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters. • Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/ parameters to carry out the work.
35. Demonstrate basic	• Solve different mathematical problems

mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS: PSS/N9402)	• Explain concept of basic science related to the field of study

SYLLABUS FOR ELECTRONICS MECHANIC TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 65 Hrs.; Professional Knowledge 10 Hrs.	1. Perform basic workshop operations using suitable tools for fitting, riveting, drilling etc. observing suitable care & safety following safety precautions.	**Trade and Orientation** 1. Visit to various sections of the institute and identify location of various installations. 2. Identify safety signs for danger, warning, caution & personal safety message. 3. Use of personal protective equipment (PPE). 4. Practice elementary first aid. 5. Preventive measures for electrical accidents & steps to be taken in such accidents. 6. Use of Fire extinguishers.	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.
		Hand tools and their uses 7. Identify the different hand tools. 8. Selection of proper tools for operation and precautions in operation. 9. Care & maintenance of trade tools. 10. Practice safety precautions while working in fitting jobs. 11. Workshop practice on filing and hacks awing. 12. Practice simple fitting and drilling.	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. Introduction to Electro Magnetic Interference (EMI) and Electro Magnetic Compatibility (EMC)
Professional Skill 45 Hrs.;	2. Select and perform electrical/	**Basics of AC and Electrical Cables** 13. Identify the Phase, Neutral	Basic terms such as electric charges, Potential difference,

Professional Knowledge 15 Hrs.	electronic measurement of single range meters and calibrate the instrument under given conditions.	and Earth on power socket, use a testers to monitor AC power. 14. Construct a test lamp and use it to check mains healthiness. 15. Measure the voltage between phase and ground and rectify earthing. 16. Identify and test different AC mains cables. 17. Prepare terminations, skin the electrical wires /cables using wire stripper and cutter. 18. Measure the gauge of the wire using SWG/AWG and outside micrometer. 19. Refer table and find current carrying capacity of wires. 20. Crimp the lugs to wire end. 21. Measure AC and DC voltages using multi meter.	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.
		22. Identify the type of meters by dial and scale marking/ symbols. 23. Demonstrate various analog/ Digital measuring Instruments. 24. Find the minimum and maximum measurable range of the meter. 25. Carryout mechanical zero setting of a meter. 26. Check the continuity of wires, meter probes and fuse etc. 27. Measure voltage and current using clamp meter.	**Single range meters** Introduction to electrical and electronic measuring instruments. Basic principle and parts of simple meters. Specifications, symbols used in dial and their meaning.
Professional Skill 24 Hrs.; Professional	3. Test &service different batteries used in electronic	**Cells & Batteries** 28. Identify the +ve and -ve terminals of the battery. 29. Identify the rated output	**Cells & Batteries** Construction, types of primary and secondary cells/battery. Materials used, Specification

Knowledge 06 Hrs.	applications and record the data to estimate repair cost.	voltage and Ah capacity of given battery. 30. Measure the voltages of the given cells/battery using analog/ digital multimeter. 31. Charge and discharge the battery through load resistor. 32. Maintain the secondary Battery. 33. Measure the specific gravity of the electrolyte using hydrometer. 34. Test a battery and verify whether the battery is ready for use or needs recharging.	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.
Professional Skill 21 Hrs.; Professional Knowledge 09 Hrs.	4. Measure the various parameters by DSO and execute the result with standard one.	**Digital Storage Oscilloscope** 35. Identify the different front panel control of a DSO. 36. Measure the Amplitude, Frequency and time period of typical electronic signals using DSO. 37. Connect USB to DSO and save the waveform in USB and open it in computer and take print.	Advantages and features of DSO. Block diagram of Digital storage oscilloscope (DSO)/ and applications. Applications of DSO
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	5. Measure AC/DC using proper measuring instruments and compare the data using standard parameter.	**AC & DC measurements** 38. Use the multi meter (digital & analog) to measure the various functions (AC V, DC V, DC I, AC I, R). 39. Identify the different types of meter for measuring AC & DC parameters. 40. Identify the different controls on the DSO front panel and observe the function of each control. 41. Measure DC voltage, AC voltage, time period using	Introduction to electrical measuring instruments. Importance and classification of meters. MC and MI meters. Characteristics of meters and errors in meters. Multi meter, use of meters in different circuits. Care and maintenance of meters. Use of DSO, Function generator, LCR meter

		DSO sine wave parameters. 42. Identify the different controls on the function generator front panel and observe the function of each control.	
Professional Skill 45 Hrs.; Professional Knowledge 15 Hrs.	6. Design PCB & Print using PCB printing machine.	43. Convert schematics into PCB layouts, apply design rules, and generate Gerber files and understand the conversion of Gerber file to G-code. 44. Set up and run a PCB printing machine, including material loading, alignment, and basic troubleshooting. 45. Use tools to inspect for defects and perform continuity and functionality tests on completed PCBs. 46. Develop accurate circuit diagrams using PCB design software.	Fundamentals of PCB types, electronic components, and circuit schematic design. Students learn to use PCB design software for layout and Gerber file and G-Code generation. It explains PCB fabrication methods and the operation of PCB printing machines, including setup, alignment, and maintenance. Safety measures, ESD precautions, and environmental considerations are emphasized. Quality control techniques like inspection and testing are included, enabling learners to design, print, and troubleshoot PCBs effectively in a technical environment.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	7. Plan and execute soldering & de-soldering of various electrical components like Switches, PCB & Transformers for electronic circuits.	**Soldering/ De-soldering and Various Switches** 47. Practice soldering on different electronic components, small transformer and lugs. 48. Practice soldering on IC bases and PCBs. 49. Practice de-soldering using pump and wick. 50. Join the broken PCB track and test. 51. Identify and use SPST, SPDT, DPST, DPDT, tumbler, push button, toggle, piano switches used in electronic	Different types of soldering guns, related to Temperature and wattages, types of tips. Solder materials and their grading. Use of flux and other materials. Selection of soldering gun for specific requirement. Soldering and De-soldering stations and their specifications. Different switches, their specification and usage.

		industries. 52. Make a panel board using different types of switches for a given application.	
Professional Skill 95 Hrs.; Professional Knowledge 25 Hrs.	8. Test various electronic components using proper measuring instruments and compare the data using standard parameter.	**Active and Passive Components** 53. Identify the different types of active electronic components. 54. Measure the resistor value by colour code and verify the same by measuring with multimeter. 55. Identify resistors by their appearance and check physical defects. 56. Identify the power rating of carbon resistors by their size. 57. Practice on measurement of parameters in combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources. 58. Measurement of current and voltage in electrical circuits to verify Kirchhoff's Law. 59. Verify laws of series and parallel circuits with voltage source in different combinations. 60. Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter. 61. Identify different inductors and measure the values using LCR meter. 62. Identify the different capacitors and measure capacitance of various	Ohm's law and Kirchhoff's Law. Resistors; types of resistors, their construction & specific use, color-coding, power rating. Equivalent Resistance of series parallel circuits. Distribution of V & I in series parallel circuits. Principles of induction, inductive reactance. Types of inductors, construction, specifications, applications and energy storage concept. Self and Mutual induction. Behaviour of inductor at low and high frequencies. Series and parallel combination, Q factor. Capacitance and Capacitive Reactance, Impedance. Types of capacitors, construction, specifications and applications. Dielectric constant. Significance of Series parallel connection of capacitors. Capacitor behaviour with AC and DC. Concept of Time constant of a RC circuit. Concept of Resonance and its application in series and parallel circuit. Properties of magnets and their materials, preparation of artificial magnets, significance of electromagnetism, types of

		capacitors using LCR meter. 63. Identify and test the circuit breaker and other protecting devices. 64. Dismantle and identify the different parts of a relay. 65. Connect a timer relay in a circuit and test for its working. 66. Connect a contactor in a circuit and test for its working. 67. Construct and test RC time constant circuit. 68. Construct a RC differentiator circuit and convert triangular wave into square wave. 69. Construct and test series and parallel resonance circuit. 70. Use RC filters and make High pass and low pass filters.	cores. Relays, types, construction and specifications etc. Real time application of RC filters, High Pass and low pass.
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	9. Assemble simple electronic power supply circuit and test for functioning.	**Power Supply Circuits** 71. Test the given diode using multi meter and determine forward to reverse resistance ratio. 72. Measure the voltage and current through a diode in a circuit and verify its 73. forward characteristic. 74. Identify different types of transformers and test. 75. Identify the primary and secondary transformer windings and test the polarity. 76. Construct and test a half wave, full wave and Bridge rectifier circuit. 77. Measure ripple voltage,	Semiconductor materials, components, PN Junction, Forward and Reverse biasing of diodes. 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,

		ripple frequency and ripple factor of rectifiers for different load and filter capacitors. 78. Construct and test Zener based voltage regulator circuit. 79. Calculate the percentage regulation of regulated power supply.	Specifications and types of cores used. Step-up, Step down and isolation transformers with applications. Losses in Transformers.
		IC Regulators 80. Construct and test +3V, 5V, 12V fixed voltage regulator. 81. Identify the different types of fixed +ve and – ve regulator ICs and the different current ratings (78/79 series). 82. Observe the output voltage of different IC 723 metal/ plastic type. 83. Construct and test a 1.2V – 30V variable, +24V/4 mA output regulated power supply using IC LM317T.	Regulated Power supply using 78XX series, 79XX series. Op-amp regulator, 723 regulator, (Transistorized & IC based). Voltage regulation, error correction and amplification etc.
Professional Skill 90 Hrs.; Professional Knowledge 15 Hrs.	10. Construct, test and verify the input/ output characteristics of various analog circuits.	**Transistor** 84. Identify different transistors with respect to different package type, B-E-C pins, power, switching transistor, heat sinks etc. 85. Test the condition of a given transistor using ohm-meter. 86. Construct and test a transistor-based switching circuit to control a relay (use Relays of different coil voltages and Transistors of different β)	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.

		Amplifier 87. Construct and test fixed-bias, emitter-bias and voltage divider-bias transistor amplifier. 88. Construct and test a common emitter amplifier with and without bypass capacitors. 89. Construct and Test common collector/emitter follower amplifier. 90. Construct and test a two stage RC Coupled amplifier.	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, Alpha, beta, voltage gain, Concept of dB dBm. Feedback and its types.
		Oscillators 91. Demonstrate Colpitts oscillator, Hartley oscillator circuits and compare the output frequency of the oscillator by DSO. 92. Construct and test a RC phase shift oscillator circuit. 93. Construct and test a crystal oscillator circuits. 94. Demonstrate Astable, monostable, bistable circuits using transistors.	Introduction to positive feedback and requisites of an oscillator. Study of Colpitts, Hartley, Crystal and RC oscillators. Types of multi vibrators and study of circuit diagrams.
		Wave shaping circuits 95. Construct and test shunt clipper. 96. Construct and test series and dual clipper circuit using diodes. 97. Construct and test clamper	Diode shunt clipper circuits, Clamping / limiting circuits and Zener diode as peak clipper, uses their applications.

		circuit using diodes. 98. Construct and test Zener diode as a peak clipper.	
Professional Skill 70 Hrs.; Professional Knowledge 20 Hrs.	11. Plan and construct different power electronic circuits and analyse the circuit functioning.	**Power Electronic Components** 99. Identify different power electronic components, their specification and terminals. 100. Construct and test a FET Amplifier. 101. Construct a test circuit of SCR using UJT triggering. 102. Construct a simple dimmer circuit using TRIAC. 103. Construct UJT based free running oscillator and change its frequency.	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.
		MOSFET & IGBT 104. Identify various Power MOSFET by its number and test by using multimeter. 105. Construct MOSFET test circuit with a small load drivers. (Cloud Based Simulator) 106. Identify IGBTs by their numbers and test by using multimeter. 107. Construct IGBT test circuit with a small load.	MOSFET, Power MOSFET and IGBT, their types, characteristics, switching speed, power ratings and protection. Differentiate FET with MOSFET. Differentiate Transistor with IGBT.
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	12. Select the appropriate opto electronics components and verify the characteristics in different circuit.	**Opto Electronics** 108. Test LEDs with DC supply and measure voltage drop and current using multimeter. 109. Construct a circuit to switch a lamp load using photo diode. 110. Construct a circuit to switch a lamp load using photo transistor.	Working and application of LED, IR LEDs, Photo diode, photo transistor, their characteristics and applications. Optical sensor, opto-couplers, circuits with opto isolators. Characteristics of LASER diodes.

Professional Skill 80 Hrs.; Professional Knowledge 10 Hrs.	13. Assemble, test and troubleshoot various digital circuits.	**Basic Gates** 111. Verify the truth tables of all Logic Gate ICs by connecting switches and LEDs. 112. Construct and verify the truth table of all the gates using NAND and NOR gates. 113. Pc based universal ic tester cum programmer Use digital IC tester to test the various digital ICs (TTL and CMOS).	Introduction to Digital Electronics. Difference between analog and digital signals. Number systems (Decimal, binary, octal, Hexadecimal). BCD code, ASCII code and code conversions. Various Logic Gates and their truth tables.
		Combinational Circuits 114. Construct Half Adder circuit using ICs and verify the truth table. 115. Construct Full adder with two Half adder circuit using ICs and verify the truth table. 116. Construct the adder cum subtractor circuit and verify the result. 117. Construct and Test a 2 to 4 Decoder. 118. Construct and Test a 4 to 2 Encoder. 119. Construct and Test a 4 to 1 Multiplexer. 120. Construct and Test a 1 to 4 De Multiplexer.	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. Need for multiplexing of data. 1:4 line Multiplexer / De-multiplexer.
		Flip Flops 121. Identify different Flip-Flop (ICs) by the number printed on them. 122. Verify the truth tables of Flip-Flop ICs (RS, D, T, JK, MSJK) by connecting switches and LEDs. 123. Construct and test four bit latch using 7475.	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

		124. Construct and test R-S flip-flop using IC7400 with clock and without clock pulse.	data storage, data transfer and frequency division.
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	14. Simulate and analyze the analog and digital circuits using Electronic simulator software.	**Electronic circuit simulator** 125. Prepare simple digital and electronic circuits using the software. 126. Simulate and test the prepared digital and analog circuits. 127. Convert the prepared circuit into a layout diagram. 128. Prepare simple, power electronic and domestic electronic circuit using simulation software.	Study the library components available in the circuit simulation software. Various resources of the software.
Professional Skill 80 Hrs.; Professional Knowledge 10 Hrs.	15. Construct and test different circuits using ICs 741 operational amplifiers & ICs 555 linear integrated circuits and execute the result.	**Op – Amp & Timer 555 Applications** 129. Construct and test various Op-Amp circuits Inverting, Non-inverting and Summing Amplifiers. 130. Construct and test Differentiator and Integrator. 131. Construct and test a zero crossing detector. 132. Construct and test Instrumentation amplifier. 133. Construct and test a Binary weighted and R-2R Ladder type Digital-to-Analog Converters. 134. Construct and test Astable timer circuit using IC 555. 135. Construct and test mono stable timer circuit using IC 555. 136. Construct and test VCO	Block diagram and Working of Op-Amp, importance, Ideal characteristics, advantages and applications. Schematic diagram of 741, symbol. Non-inverting voltage amplifier, inverting voltage amplifier, summing amplifier, Comparator, zero cross detector, differentiator, integrator and instrumentation amplifier, other popular Op-Amps. Block diagram of 555, functional description w.r.t. different configurations of 555 such as monostable, astable and VCO operations for various application Duty cycle.

		(V to F Converter) using IC 555. 137. Construct and test 555 timers as pulse width modulator.	
ENGINEERING DRAWING			
Professional Knowledge ED -30 Hrs.	16. Read and apply Engineering drawing for different application in the field of work.	Introduction to Engineering Drawing and Drawing Instrument – • Conventions • Sizes and layout of drawing sheets • Title Block, its position and content • Drawing Instrument Free hand drawing of– • Geometrical figures and blocks with dimension • Transferring measurement from the given object to the free hand sketches. • Free hand drawing of hand tools. Drawing of Geometrical figures: • Angle, Triangle, Circle, Rectangle, Square, Parallelogram. • Lettering & Numbering – Single Stroke Symbolic representation– • Different Electronic symbols used in the related trades Reading of Electronic Circuit Diagram. Reading of Electronic Layout drawing. **Material Science** Types metals, types of ferrous and non-ferrous metals. Introduction of iron and cast iron.	
WORKSHOP CALCULATION & SCIENCE			
Professional Knowledge WCS -30 Hrs.	17. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion. Factors, HCF, LCM and problems. Fractions - Addition, substraction, multiplication & division. Decimal fractions - Addition, subtraction, multiplication & division. Solving problems by using calculator. **Square root, Ratio and Proportions, Percentage** Square and square root. Simple problems using calculator. Applications of Pythagoras theorem and related problems. Ratio and proportion. Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction. **Material Science**	

		Types metals, types of ferrous and non-ferrous metals. Introduction of iron and cast iron. **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals. Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales of temperature. **Basic Electricity** Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC, DC their comparison, voltage, resistance and their units Conductor, insulator, types of connections - series and parallel. Ohm's law, relation between V.I.R & related problems. Electrical power, energy and their units, calculation with assignments. Magnetic induction, self and mutual inductance and EMF generation Electrical power, HP, energy and units of electrical energy **Trigonometry** Measurement of angles Trigonometrical ratios Trigonometrical tables
Project work / Industrial visit **Broad Areas:** a) Delayed automatic power on circuit. b) Neon flasher circuit using IC 741 c) UJT act as a relaxation oscillator d) Up/down synchronous decade counter e) Portable continuity cum capacitor tester		

SYLLABUS FOR ELECTRONICS MECHANIC TRADE			
SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
Professional Skill 24 Hrs.; Professional Knowledge 06 Hrs.	18. Prepare, crimp, terminate and test various cables used in different electronics industries.	**Electronic Cables & Connectors** 138. Identify various types of cables viz. RF coaxial feeder, screened cable, ribbon cable, RCA connector cable, digital optical audio, video cable, RJ45, RJ11, Ethernet cable, mechanical splices, insulation, gauge, current capacity, flexibility etc. used in various electronics products, different input output sockets. 139. Prepare terminations, make UTP and STP cable connectors and test. 140. Identify suitable connectors, solder/crimp 141. /terminate & test the cable sets. 142. Check the continuity as per the marking on the connector for preparing the cable set. 143. Identify and select various connectors and cables inside the CPU cabinet of PC. 144. Identify the suitable connector and cable to connect a computer with a network switch and prepare a cross over cable. 145. to connect two network	Cable signal diagram conventions Classification of electronic cables as per the application w.r.t. insulation, gauge, current capacity, flexibility etc. Different types of connector & their terminations to the cables. Male / Female type DB connectors. Ethernet 10 Base cross over cables and pin out assignments, UTP and STP, SCTP, TPC, Coaxial. Different types of connectors Servo 0.1" connectors, FTP, RCA, BNC, HDMI Audio/video connectors like XLR, RCA (phono), 6.3 mm PHONO, 3.5 / 2.5 mm PHONO, BANTAM, SPEAKON, DIN, mini DIN, RF connectors, USB, Fire wire, SATA Connectors, VGA, DVI connectors, MIDI and RJ45, RJ11 etc.

Professional Skill 71 Hrs.; Professional Knowledge 34 Hrs.	19. Install, configure, interconnect given computer system(s) and demonstrate & utilize application packages for different application.	**Computer Hardware, OS, MS office and Networking** 146. Demonstrate various parts of the system unit and motherboard components. 147. Identify various computer peripherals and connect it to the system. 148. Boot the system from Different options. 149. Install OS in a desktop computer. 150. Install a Printer driver software and test for print outs. 151. Install antivirus software, scan the system and explore the options in the antivirus software. 152. Install various application software's. 153. Configure a wireless Wi-Fi network.	Basic blocks of a computer, Components of desktop and motherboard. Hardware and software, I/O devices, and their working. Different types of printers, HDD, DVD. Various ports in the computer. Windows OS MS widows: Starting windows and its operation, file management using explorer, Display & sound properties, screen savers, font management, installation of program, setting and using of control panel, application of accessories, various IT tools and applications. Concept of Internet, Browsers, Websites, search engines, email, chatting and messenger service. Downloading the Data and program files etc. **Computer Networking:-** Network features - Network medias Network topologies, 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, Laptop, IPad, and Mobile
Professional Skill 72 Hrs.;	20. Identify, place, solder and de-	**Basic SMD (2, 3, 4 terminal components)**	Introduction to SMD technology

Professional Knowledge 18 Hrs.	solder and test different SMD discrete components and ICs package with due care and following safety norms using proper tools/setup.	154. Identification of 2, 3, 4 terminal SMD components. 155. Identify different types of packages. 156. Prepare Bill Off Material (BOM) 157. De-solder the SMD components from the given PCB. 158. Solder the SMD components in the same PCB. 159. Identification of loose /dry solder, broken tracks on PCB, Cold continuity test on printed wired assemblies.	Identification of 2, 3, 4 terminal SMD components. types of packages Advantages of SMD components over conventional lead components. Soldering of SM assemblies - Reflow soldering. Tips for selection of hardware, Inspection of SM.
Professional Skill 20 Hrs.; Professional Knowledge 10 Hrs.	21. Construct different electrical control circuits and test for their proper functioning with due care and safety.	160. Test various Low potential motors. **Stepper Motor & BLDC Motor** 161. Test stepper motor & BLDC Motor. 162. Demonstrate working process of stepper motor & BLDC Motor in various Equipment.	What are a Stepper motor & BLDC Motor and its types. Stepper Motor & BLDC Motor working Principal. How to select a stepper motor & BLDC Motor Types of wiring of stepper motor. Stepper motor control by varying clock pulses. Advantage of stepper motor & BLDC Motor.
Professional Skill 60 Hrs.; Professional Knowledge 15 Hrs.	22. Assemble and test a commercial AM/ FM receiver and evaluate performance.	**Communication electronics** 163. Modulate and demodulate various signals using AM and FM on the trainer kit and observe waveforms. 164. Test IC based AM Receiver 165. Test IC based FM transmitter. 166. Test IC based AM transmitter and test the transmitter power. 167. Dismantle the given FM receiver set and identify	Radio Wave Propagation – principle, fading. Need for Modulation, types of modulation and demodulation. Fundamentals of Antenna, various parameters, types of Antennas & application. Introduction to AM, FM & PM. Block diagram of AM and FM transmitter. FM Generation & Detection. Digital

		different stages (AM section, audio amplifier section etc). 168. Modulate and Demodulate a signal using PAM, PPM, PWM Techniques.	modulation and demodulation techniques, sampling, quantization & encoding. Concept of multiplexing and de multiplexing of AM/ FM/ PAM/ PPM /PWM signals. A simple block diagram approach to be adopted for explaining the above mod/demod techniques.
Professional Skill 60 Hrs.; Professional Knowledge 15 Hrs.	23. Test, service and troubleshoot the various components of different domestic/ industrial programmable systems.	**Microcontroller ATMEGA 328** 169. Identify various ICs & their functions on the given Microcontroller Kit. 170. Identify various ICs, Pins, Ports and & their functions on the given Microcontroller Atmega 328 Arduini Uno Board. 171. Identify the address range of RAM & ROM. 172. Identify memory concept, boot loader of Atmega 328 microcontroller. 173. Measure the crystal frequency, connect it to the controller. 174. Identify the port pins of the controller & configure the ports for Input & Output operation. 175. Use 8051 microcontroller, connect 8 LED to the port, blink the LED with a switch. 176. Installation of Arduino IDE on computer 177. Use Atmega 328 microcontroller, connect LED to the port, blink the	Introduction Microprocessor & ATMEGA 328 Microcontroller Arduino Uno Board, architecture, pin details & the bus system. Function of different ICs used in the Microcontroller Kit. Differentiate microcontroller with microprocessor. Interfacing of memory to the microcontroller. Boot loading concept of Atmega 328 controller Installation of Arduino IDE on computer Understanding the compete menu and its functions of Arduino IDE Tool. How to connect and select Ardunio Board from Library. How to download different Libraray updates

		LED by writing a program. 178. Perform the initialization, load & turn on a LED with delay using Timer. 179. Perform the initialization, & blink LED with delay in program. 180. Perform the use of a Timer as an Event counter to count external events. 181. Demonstrate entering of simple programs, execute & monitor the results.	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. Comparative study of 8051 with 8052. Introduction to PIC Architecture.
Professional Skill 25 Hrs.; Professional Knowledge 05 Hrs.	24. Plan and Interface the LCD, LED, DPM panels to various circuits and evaluate performance.	**Digital panel Meter** 182. Identify LED Display module and its decoder/driver ICs. 183. Display a word on a two line LED. 184. Measure/current flowing through a resistor and display it on LED Module. 185. Measure/current flowing through a sensor and display it on a LED module (DPM). 186. Identify LCD Display module and its decoder/driver ICs. 187. Measure/current flowing through a resistor and display it.	Different types of seven segment displays, decoders and driver ICs. Concept of multiplexing and its advantages. Block diagrams of 7106 and 7107 and their configuration for different measurements. Use of DPM with seven segment display. Principles of working of LED. Different sizes of LEDs. Decoder/ driver ICs used with LEDs and their pin diagrams. Use of DPM with LED to display different voltage & current signals.
Professional Skill 120 Hrs.; Professional Knowledge 30 Hrs.	25. Execute the operation of different sensors, identify, wire & test various transducers of IoT Applications.	**Sensors, Transducers used in IoT Applications** 188. Identify sensors used in process industries such as RTDs, Temperature ICs, Thermocouples, proximity switches (inductive, capacitive and	Basics of passive and active transducers. Role, selection and characteristics. Sensor voltage and current formats. Thermistors/ Thermocouples - Basic principle, salient

		photo electric), load cells, strain gauge. LVDT PT 100 (platinum resistance sensor), water level sensor, thermostat float switch, float valve by their appearance. 189. Measure temperature of a lit fire using a Thermocouple and record the readings referring to data chart. 190. Measure temperature of a lit fire using RTD and record the readings referring to data. 191. Measure the voltage of a LVDT. 192. Detect different objectives using capacitive, inductive and photoelectric proximity sensors.	features, operating range, composition, advantages and disadvantages. Strain gauges/ Load cell – principle, gauge factor, types of strain gauges. Inductive/ capacitive transducers - Principle of operation, advantages and disadvantages. Principle of operation of LVDT, advantages and disadvantages. Proximity sensors – applications, working principles of eddy current, capacitive and inductive proximity sensors.
		Sensors used in IoT Applications, industry automation, Home Automation, Office Automation 193. Identify different sensors used in different above applications mentioned and commonly available 194. Perform Thermistor, LM35 Temperature, Humidity, interface them with Micro-controller ATMEGA 328. 195. Perform GAS, Smoke sensor and interface with Micro-controller ATMEGA 328. 196. Practice IR Sensor, LDR, Colour, Phototransistor interfacing with Micro-controller ATMEGA 328.	Basics of passive and active transducers. Role, selection and characteristics. Sensor voltage and current formats. Their function which parameter they sense and in which type of electronic signal the convert.

		197. Perform Ultrasonic, Gyroscope, Accelerometer interfacing with Micro-controller ATMEGA 328. 198. Perform Rain, Soil Moisture, Water Flow interfacing with Micro-controller ATMEGA 328.	
Professional Skill 20 Hrs.; Professional Knowledge 10 Hrs.	26. Identify different IoT Applications with IoT architecture.	199. Connect and test microcontroller ATMEGA 328 Arduino Uno to computer and execute sample programs. 200. Upload computer code to the physical board (Microcontroller) to blink a simple LED. 201. Write and upload computer code to the physical Micro controller to sound buzzer. 202. Circuit and program to Interface light sensor – LDR with Microcontroller to switch ON/OFF LED based on light intensity. 203. Set up & test circuit to interface potentiometer with Microcontroller and map to digital values for e.g. 0-1023.	Introduction to Internet of Things applications environment, smart street light and smart water & waste management. What is an IOT? What makes embedded system an IOT? Role and scope of IOT in present and future marketplace. Smart objects, Wired – Cables, hubs etc. Wireless – RFID, WiFi, Bluetooth etc. Different functional building blocks of IOT architecture. Introduction to Industry 4.0 and 5.0 skills required in electronic mechanic trade. What is IoT and IIoT technology and what are benefits? Understanding wireless sensors and communication with PC work station and cloud. Awareness about cyber security hardware operation, maintenance and safety.
Professional Skill 08 Hrs. Professional Knowledge	27. Identify, check constructional feature and function of Robot system.	204. Identify and connect Robot for welding/CNC machines. 205. Understand Robot operation and	Evolution of Robot, Applications of Robot for Industrial plants, Types and specification of Robot.

07 Hrs.		maintenance. 206. Awareness about cyber security and safety of Robot System.	Robot operation and configuration/programming, Safety and maintenance of Robots.
Professional Skill 90 Hrs.; Professional Knowledge 15 Hrs.	28. Plan and carry out the selection of a project, assemble the project and evaluate performance for a domestic/ commercial application.	207. Make simple projects/ Applications using ICs ATMEGA 328 Arduino Uno. Sample projects: • Laptop protector • Mobile cell phone charger • Battery monitor • Metal detector • Mains detector • Lithium iON charger • Smoke detector • Solar charger • Emergency light • Water level controller • Door watcher **(Instructor will pick up any five of the projects for implementation)**	Discussion on the identified projects with respect to data of the concerned ICs. Components used in the project.
		Digital IC Applications 208. Make simple projects/ Applications using various digital ICs (digital display, event counter, stepper motor driver etc.) • Duty cycle selector • Frequency Multiplier • Digital Mains Resumption Alarm • Digital Lucky Random number generator • Dancing LEDs • Count down timer • Clap switch • Stepper motor control • Digital clock • Event counter	Discussion on the identified projects with respect to data of the concerned ICs. Components used in the project.

		• Remote jammer **(Instructor will pick up any five of the projects for implementation)**	
Professional Skill 10 Hrs.; Professional Knowledge 05 Hrs.	29. Prepare fibre optic setup and execute transmission and reception.	**Fiber optic communication** 209. Identify the resources and their need on the given fiber optic trainer kit. 210. Perform fibre optic cable splicing, fibre optic cable mechanical splices, fault testing. 211. Practice OTDR.	Introduction to optical fiber, optical connection and various types optical amplifier, its advantages, properties of optic fiber, testing, losses, types of fiber optic cables and specifications. Encoding of light. Fiber optic joints, splicing, testing and the related equipment/ measuring tools. Precautions and safety aspects while handling optical cables.
Professional Skill 120 Hrs.; Professional Knowledge 30 Hrs.	30. Detect the faults and troubleshoot SMPS, UPS and inverter.	**SMPS and Inverter** 212. Identify the components/ devices and draw their corresponding symbols. 213. Dismantle the given stabilizer and find major sections/ ICs components. 214. List the defect and symptom in the faulty SMPS. 215. Measure / Monitor major test points of computer SMPS. 216. Troubleshoot the fault in the given SMPS unit. Rectify the defect and verify the output with load. Record your procedure followed for trouble shooting the defects. 217. Use SMPS used in TVs and PCs for Practice. 218. Install and test the SMPS in PC.	Concept and block diagram of manual, automatic and servo voltage stabilizer, o/p voltage adjustment. Voltage cut-off systems, relays used in stabilizer. Block Diagram of different types of Switch mode power supplies and their working principles. Inverter; principle of operation, block diagram, power rating, change over period. Installation of inverters, protection circuits used in inverters. Battery level, overload, over charging etc. Various faults and its rectification in inverter. Block diagram of DC-DC converters and their working principals.

		219. Install and test an inverter. 220. Troubleshoot the fault in the given inverter unit. Rectify the defects and verify the output with load. 221. Construct and test IC Based DC-DC converter for different voltages. 222. Construct and test a switching step down regulator using LM2576. 223. Construct and test a switching step up regulator using MC 34063.	
		UPS 224. Connect battery stack to the UPS. 225. Identify front panel control & indicators of UPS. 226. Connect Battery & load to UPS & test on battery mode. 227. Open top cover of a UPS; identify its isolator transformers, the UPS transformer and various circuit boards in UPS. 228. Identify the various test point and verify the voltages on these. 229. Identify various circuit boards in UPS and monitor voltages at various test points. 230. Perform load test to measure backup time.	Concept of Uninterrupted power supply. Difference between Inverters and UPS. Basic block diagram of UPS & operating principle. Types of UPS : Off line UPS, On line UPS, Line interactive UPS & their comparison UPS specifications. Load power factor & types of indications & protections Installation of single phase & UPS.
Professional Skill 60 Hrs.; Professional Knowledge	31. Identify, Test and Photovoltaic cells, Modules, Batteries and Charge	**Solar Power (Renewable Energy System)** 231. Wire a solar controller to a battery storage station. 232. Connect storage	Need for renewable energy sources, Solar energy as a renewable resource. Materials used for solar cells.

15 Hrs.	controllers. Install a solar panel, execute testing and evaluate performance by connecting the panel to the inverter.	batteries to a power inverter. 233. Connect and test solar panel to the Inverter and run the load. 234. Install a solar power to charge a rechargeable 12 V DC battery and find out the charging time. 235. Install a Solar Inverter.	Principles of conversion of solar light into electricity. Basics of photovoltaic's cell. Module, panel and Arrays. Factors that influence the output of a PV module. SPV systems and the key benefits. Difference between SPV and conventional power. Solar charge controller or regulator and its role. Safety precautions while working with solar systems.
Professional Skill 30 Hrs.; Professional Knowledge 15 Hrs.	32. Dismantle, identify the various parts and interface of a cell phone to a PC. Estimate and troubleshoot.	**Cell phones** 236. Dismantle, identify the parts and assemble different types of smart phones. 237. Dismantle the cell phone/smart phone remove the key pad and clean it, test for the continuity of the matrix/tracks. 238. Interface the cell phone/smart phone to the PC and transfer the data card. 239. Flash the various brands of cell phone/smart phone (at least 3). 240. Format the cell phone/ smart phone for virus (approach the mobile repair shop/ service centre). 241. Perform the interfacing of cell phone/smart phone to the PC and dismantle the cell phone and identify the power section and test its healthiness.	Introduction to mobile communication. Concept cell site, hand off, frequency reuse, block diagram and working of cell phones, cell phone features. GSM and CDMA technology. Use IEMI number to trace lost/misplaced mobile phone.

		242. Find out the fault of basic cell phone system. Rectify the fault in ringer section and check the performance. 243. Replace various faulty parts like mic, speaker, data/ charging/ audio jack etc.	
Professional Skill 50 Hrs.; Professional Knowledge 10 Hrs.	33. Identify, operate various controls, troubleshoot and replace modules of the LCD/LED TV/ Smart TV & its remote.	**LCD, LED & Smart TV** 244. Identify and operate different Controls on LCD, LED & Smart TV. 245. Identify components and different sectors of LCD, LED & Smart TV. 246. Dismantle; Identify the parts of the remote control. 247. Dismantle the given LCD/LED/ Smart TV to find faults with input stages through connectors. 248. Detect the defect in a LED/LCD/Smart TV receiver given to you. Rectify the fault. 249. Troubleshoot the faults in the given LED/ LCD/ Smart TV receiver. Locate and rectify the faults. 250. Test LED/LCD/ Smart TV after troubleshooting the defects. 251. Identify various connectors and connect the cable operator's external decoder (set top box) to the TV.	Difference between a conventional CTV with LCD & LED TVs. Principle of LCD and LED TV and function of its different section. Basic principle and working of 3D TV. IPS panels and their features. Different types of interfaces like HDMI, USB, RGB etc. TV Remote Control –Types, parts and functions, IR Code transmitter and IR Code Receiver. Working principle, operation of remote control. Different adjustments, general faults in Remote Control.
ENGINEERING DRAWING			
Professional Knowledge ED 30 Hrs.	34. Read and apply engineering drawing for different	• Reading of Electronics Sign and Symbols. • Sketches of Electronics components. • Reading of Electronics wiring diagram and Layout diagram. • Drawing of Electronics circuit diagram.	

	application in the field of work.	• Drawing of Block diagram of Instruments & equipment of trades.
WORKSHOP CALCULATION & SCIENCE		
Professional Knowledge WCS 30 Hrs.	35. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study.	**Algebra,** Addition, Subtraction, Multiplication & Divisions. Algebra– Theory of indices, Algebraic formula, related problems. **Estimation and Costing** Simple estimation of the requirement of material etc., as applicable to the trade. Problems on estimation and costing.
Project work / Industrial visit **Broad areas:** a) Remote control for home appliances b) Solar power inverter c) Musical light chaser d) 7 segment LED display decoder drive circuit		

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs. for 1st year + 60 Hrs. for 2nd year)

Learning outcomes, assessment criteria, syllabus and Tool List of Employability Skills is provided separately in www.cstaricalcutta.gov.in / www.bharatskills.gov.in / www.dgt.gov.in.

ANNEXURE-I

List of Tools & Equipment			
ELECTRONICS MECHANIC (for batch of 24 candidates)			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-12 is required additionally)			
1.	Connecting screwdriver	10 X 100 mm	12 Nos.
2.	Neon tester 500 V.	500 V	8 Nos.
3.	Screw driver set	Set of 7	12 Nos.
4.	Insulated combination pliers	150 mm	8 Nos.
5.	Insulated side cutting pliers	150 mm	10 Nos.
6.	Long nose pliers	150 mm	8 Nos.
7.	Soldering iron	25 Watt, 240 Volt	12 Nos.
8.	Electrician knife	100 mm	8 Nos.
9.	Tweezers	150 mm	12 Nos.
10.	Digital Multimeter	(3 3/4 digit) ,4000 Counts	12 Nos.
11.	Soldering Iron Changeable bits	15Watt, 240 Volt	8 Nos.
12.	De- soldering pump electrical heated, manual operators	230 V, 40 W	12 Nos.
B. SHOP TOOLS, INSTRUMENTS – For 2 (1+1) units no additional items are required			
Lists of Tools:			
13.	Steel rule graduated both in Metric and English Unit	300 mm,	4 Nos.
14.	Precision set of screw drivers	T5, T6, T7	2 Nos.
15.	Tweezers – Bend tip		2 Nos.
16.	Steel measuring tape	3 meter	4 Nos.
17.	Tools makers vice	100mm (clamp)	1 No.
18.	Tools maker vice	50mm (clamp)	1 No.
19.	Crimping tool (pliers)	7 in 1	2 Nos.
20.	Magneto spanner set	8 Spanners	2 Nos.
21.	File flat bastard	200 mm	2 Nos.
22.	File flat second cut	200 mm	2 Nos.
23.	File flat smooth	200 mm	2Nos.
24.	Plier - Flat Nose	150 mm	4 Nos.
25.	Round Nose pliers	100 mm	4 Nos.
26.	Scriber straight	150 mm	2 Nos.
27.	Hammer ball pen	500 grams	1 No.
28.	Allen key set (Hexagonal -set of 9)	1 - 12 mm, set of 24 Keys	1 No.
29.	Tubular box spanner	Set - 6 - 32 mm	1 set.
30.	Magnifying lenses	75 mm	2 Nos.

31.	Continuity tester		6 Nos.
32.	Hacksaw frame adjustable	300 mm	2 Nos.
33.	Chisel - Cold - Flat	10 mm X 150 mm	1 No.
34.	Scissors	200mm	1No.
35.	Handsaw 450mm	Hand Saw - 450 mm	1 No.
36.	Hand Drill Machine Electric with Hammer Action	13 mm	2 Nos.
37.	First aid kit		1 No.
38.	Bench Vice	Bench Vice - 125 mm	1 No. each
		Bench Vice - 100 mm	
		Bench Vice - 50 mm	
List of Equipment			
39.	Air Conditioner	Two-ton split ac	As required
40.	Multiple Output DC Power Supply	0- 30 volt, 3Ax2, Resolution 10mV/10Ma +/- 5v/1Amp +/- 15v/1Amp	4 Nos.
41.	DC Regulated Variable DC Power Supply	0-32V/3A, Display Resolution 10mV/10mA, Connectivity USB Device	2 Nos.
42.	LCR meter (Digital) Handheld		1 No.
43.	Digital Storage Oscilloscope	100MHz Two Channel, Sampling 1GSa/sec, 20Mpt, Alternate Trigger, Connectivity USB Host & Device, LAN, Display 7 Inch TFT	1 No
44.	Battery Charger	0 - 6 - 9 - 12 - 24 - 48 V, 10 Amp	1 No.
45.	Clamp meter	0 - 100 AC/DC	2 Nos.
46.	Function generator (Sine, Square, Triangle, Ramp, Pulse, and Modulation.)	1µHz -10MHz Function Generator, 125MSa/sec, 16k Memory,14-bit resolution Modulation AM, FM, PM, FSK, ASK, PWM, Sweep, Burst. Connectivity USB Host & Device	2 Nos. + 2 Nos.
47.	Dimmer starter	3 Amps	2 Nos.
48.	Autotransformer	15 Amps	2 Nos.
49.	Analog Component Trainer	Breadboard for Circuit design with necessary DC power supply: +5V,1A (Fixed); +12V, 500mA (Fixed); ±12V, 500mA (Variable) AC power Supply: 9V-0V-9V, 500mA Function Generator: Sine, Square, Triangle Modulating Signal Generator: Sine, Square, Triangle. Modules	4 Nos.

		• Diode Characteristics (Si, Zener, LED) • Rectifier Circuits • Diode as Clipper Circuit • Diode as Clamping Circuit • Zener as voltage regulator. • Transistor Type NPN & PNP and CE Characteristics • Transistor as a switch	
50.	Milli Ammeter (AC)	0 – 200 mA	2 Nos.
51.	Milli Ammeter (DC)	0 – 500 mA	2 Nos.
52.	Op Amp trainer	Fixed DC power supply: +12V Regulated; -12V Regulated; +5V Regulated; -5V Regulated Variable DC power supply: +1.5V to +10V Regulated using LM317; - 1.5V to -10V Regulated using LM337 Function Generator: Sine Wave, Square Wave, Triangular Wave (1KHz to 100KHz; 0-5Vpp) Op Amp IC: IC uA741 (2 Nos.)- All pins terminated by 2mm Banana Resistor Bank: SMD Resistance 1KV 1% 1/4W (5 Nos.), SMD Resistance 10KV 1% 1/4W (5 Nos.), SMD Resistance 100KV 1% 1/4W (5 Nos.) Diode: Diode 1N 4007 Capacitor Bank: Electrolyte Cap. 1mf/63V, Disc cap. 1nf/63V, Disc cap. 10nf/63V, Disc cap. 100nf/63V Variable Resistance bank: 1KΩ Single turn Potentiometer (2 Nos.), 10KΩ Single turn Potentiometer (2 Nos.), 100KΩ Single turn Potentiometer (2 Nos.), 1MΩ Single turn Potentiometer (2 Nos.)	2 Nos.
53.	Digital IC Trainer	Breadboard for Circuit design with necessary DC Power Supply +5 V/1 A +12V/1A, for. Clock Frequency 4 different steps, Data Switches: 8 Nos, LED Display: 8 Nos. (TTL), Seven Segment Display	4 Nos.

		Clock Frequency in steps 1Hz – 100KHz -	
54.	Universal IC Tester	Handheld Digital IC Tester Specification: Tests variety of Digital ICs such as 74 series,40/45 series of CMOS IC's Auto search facility of IC's 28 pin DIP ZIF socket 16 keys keypad 16x2 LCD Display 9V input voltage	1 No.
55.	Rheostats various values and ratings		2 Nos. each
56.	POWER ELECTRONICS TRAINER with at least 6 no's of application board MOSFET Characteristics SCR Characteristics SCR Lamp Flasher SCR Alarm Circuit Series Inverter Single Phase PWM Inverter	On board DC Power Supply: ±5V/500mA; ±12V/500mA; +15V/250mA; ±35V/250mA On board AC power Supply: 18V-0V-18V; 0V-15V On board firing circuit with Frequency range: 30Hz to 900Hz variable; Amplitude: 12V; PWM control, SCR Assembly: 4 SCRs Power Devices: IGBT, Circuit Components on Board: Electrolytic	4 Nos.
57.	Computers in the assembled form (including cabinet, motherboards, HDD, DVD, SMPS, Monitor, KB, Mouse, LAN card, Blu-Ray drive and player), education version.	Latest version as per availability	4 Nos.
58.	Internet of Things Explorer	open source or latest version	1 No.
59.	Wireless Communication modules for interfacing with microcontrollers a) RFID Card Reader b) Finger Print c) Zigbee d) GPS e) GSM f) Bluetooth g) WiFi	Atmega 328P Processor, 16MHz, 32 kB Flash 2 kB SRAM 1 kB EEPROM, ArduinoIDE Tool compatible with modules RFID, Finger Print, Zigbee, GPS, GSM, Bluetooth, Wifi	1 No.
60.	Laptops latest configuration	i5 and i7 and above configuration	1 No.
61.	Laser jet Printer	latest	1 No.
62.	Internet Broadband		1 No.

	Connection		
63.	Electronic circuit simulation software (open source)	Circuit Design and Simulation Software with more than 20000 various components PCB Design with Gerber and G Code Generation, 3D View of PCB, Breadboard View, Fault Creation and Simulation.	1 No.
64.	Different types of electronic and electrical cables, connectors, sockets, terminations.		As required
65.	Different types of Analog electronic components, digital ICs, power electronic components, general purpose PCBs, bread board, MCB, ELCB		As required
66.	SMD Soldering & De soldering Station with necessary accessories	With temperature controller Digital display	2 Nos.
67.	Electronics Maintenance work station	Workbench should have following Technical Specifications: 1. **Soldering & Desoldering Station:-** 60 W Desoldering : 70 watts **SMD Technology Kit :**SMD Identification Board 1 no. ,Proto BOARDS 2 no's each , Discrete Surface Mount ,SOP,SO ,Through Holes ,Chip Scale , SMD Soldering Jig 1 no. , SMD Soldering Iron 1 no. SMD components Resistors , Capacitors, Diodes , Transistors 10 no. each , Tweezers 2 no. Manual 1 no 2. **Soldering Smoke / Fume absorber** 3. **Electrical Outputs** 4. **Safety Circuit Breaker** 5. **DMM** 6. **LCR Meter** 7. **Soldering Magnifier Lamp** 8. **Test Point Microscope with USB Camera**	1 No.
68.	Frequency modulator, ASK, PSK,	FM Modulator Type: Reactance	2 Nos.

	FSK & AM and Demodulator trainer kit	Modulator, Varactor Modulator, VCO Based Modulator FM Demodulator type All 5 demodulation techniques	
69.	PAM, PPM, PWM trainer kit	**Natural, Flat-top, Sample & Hold** sampling methods in PAM. **Selectable sampling frequencies**: 8 kHz, 16 kHz; 32 kHz, 64 kHz. Built-in **signal generator** with 1 kHz & 2 kHz sine and square waves. **Voice communication** enabled On-board **AC amplifier** with adjustable gain and **DC output** (0–4V). **4th order low-pass filter, switchable faults**	2 Nos.
70.	AM/FM Commercial radio receivers		2 Nos.
71.	Microcontroller ATMEGA 328	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.
72.	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 LCD Display, Seven Segment, Motor DC, Stepper and Servo Motor	1 set
73.	Sensor Trainer Kit Containing following Sensors 1. Thermocouple 2. RTD 3. Load Cell/ Strain Gauge 4. LVDT 5. Smoke Detector Sensors 6. Speed Sensor	Temperature sensor, Humidity Sensor, LDR, Joy Stick Module, Motion Sensor, TOUCH Sensor, Ultrasonic Sensor, Relay Module,	2 Nos.

	7. Limit Switch 8. Photo sensors 9. Optocoupler 10. Proximity Sensor		
74.	Various analog and digital ICs useful for doing project works mentioned in the digital and analog IC applications modules		As required
75.	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.
76.	Seven segment DPM trainer	Three measurement sections- Voltage Measurement (both AC and DC), Current Measurement and Resistance Measurement. Signal Conditioning, AC to DC Conversion Sections, LED Display and Continuity tester should also available on this Demonstrator. Rotary Switches should be provided for the Function, Range and Decimal Selection.	6 Nos.
77.	LCD based DPM		6 Nos.
78.	SMPS		4 Nos.
79.	UPS trainer	PWM switching technology with its waveform study, Test points to measures the voltages of different sections Overall functioning of UPS Trainer, AVR transformer, UPS with load condition, Switched faults to enhance troubleshooting method	1No.
80.	UPS		04 no
81.	Mobile phone Trainer	4G /5G Dual SIM GSM Handset. Tx, Rx constellation signals, study of AT commands side keys, vibrator, and other user interface sections, IOT Enabled application Frequency measurement and band verification. Real time Mobile Operation	1 No.
82.	Smart phones of different make		4 Nos.

	(android)		
83.	Cell phone power source with charger chords for different cell phones		As required
84.	LED TV (Trainer kit)	24-inch full HD LED Color Television, PAL/ NTSC video formats, complete block diagram of a LED TV system, Study board indicating various sections of LED TV along with the test points of all sections including front panel controls and LVDS signals test points and switch faults. Trouble shooting in different sections.	1 No.
85.	LED TV (21”)		01 Nos.
86.	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.
C. Shop Floor Furniture and Materials - For 2 (1+1) units no additional items are required.			
87.	Instructor’s table		1 No.
88.	Instructor’s chair		2 Nos.
89.	Metal Rack	100cm x 150cm x 45cm	4 Nos.
90.	Lockers with 16 drawers standard size		2 Nos.
91.	Steel Almirah	2.5 m x 1.20 m x 0.5 m	2 Nos.
92.	Black board/white board		1 No.
93.	Fire Extinguisher	Arrange all proper NOCs and equipment from Municipal/Competent authorities.	

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.

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ANNEXURE-III

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