MECHANIC ELECTRICAL MAINTENANCE (INDUSTRIAL AUTOMATION)

COMPETENCY BASED CURRICULUM

(Duration: 2 Yrs.)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 5

SECTOR – POWER

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

MECHANIC ELECTRICAL MAINTENANCE (INDUSTRIAL AUTOMATION)

(Revised in 2018)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL - 5

Developed By

Ministry of Skill Development and Entrepreneurship
Directorate General of Training
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
EN-81, Sector-V, Salt Lake City,
Kolkata – 700 091

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

Co-ordinator for the course: Shri S.D. Lahiri, Director CSTARI, Kolkata

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CONTENTS

1. BACKGROUND

1.1 Apprenticeship Training Scheme under Apprentice Act 1961

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

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

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

1.2 Changes in Industrial Scenario

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

1.3 Reformation

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

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

2. TRAINING SYSTEM

2.1 GENERAL

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

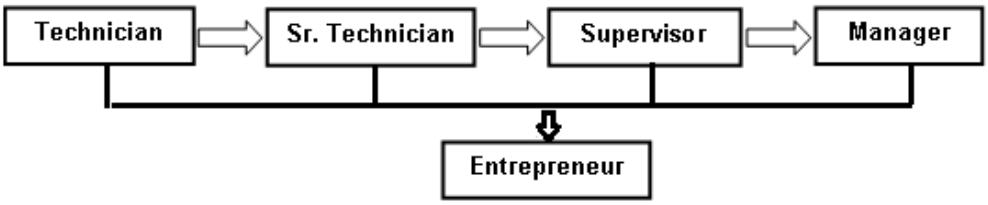
Mechanic Electrical Maintenance (Industrial Automation) trade under ATS is one of the most popular courses delivered nationwide through different industries. The course is of two years duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional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

Broadly candidates need to demonstrate that they are able to:

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

2.2 CAREER PROGRESSION PATHWAYS:

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



2.3 COURSE STRUCTURE:

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

Total training duration details: -

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

A. Basic Training

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

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

B. On-Job Training:-

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

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

C. Total training hours:-

Duration	Basic Training	On-Job Training	Total
For 02 yrs. course (Engg.)	1000 hrs.	3120 hrs.	4120 hrs.

2.4 ASSESSMENT & CERTIFICATION:

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

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

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

2.4.1 PASS REGULATION

The minimum pass percentage is 40% for each Theory Examination (except for Employability Skill, it is 34%) and 60% marks for each Trade practical Examination. The candidate should pass in each subject conducted under All India Trade Test.

2.4.2 ASSESSMENT GUIDELINE

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

behavioral attitude, sensitivity to environment and regularity in training. The sensitivity towards OSHE and self-learning attitude are to be considered while assessing competency.

Assessment will be evidence based comprising the following:

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

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

Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • Between 60-70% accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b)Weightage in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A good level of neatness and consistency in

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

3. JOB ROLE

Brief description of Job roles:

Automation Specialist is responsible for providing support to production operations through maintenance of process control systems installed at shop floor for various manufacturing processes.

Maintenance Technician Electrical is responsible for providing assistance to the maintenance technicians in maintaining the Electrical/electronic systems of equipment and machinery.

Reference NCO Code 2015:

i) 7412.0101 - Automation Specialist
ii) 3113.0102 - Maintenance Technician Electrical

4. NSQF LEVEL COMPLIANCE

NSQF level for Mechanic Electrical Maintenance (Industrial Automation) trade under ATS: **Level 5**

As per notification issued by Govt. of India dated- 27.12.2013 on National Skill Qualification Framework total 10 (Ten) Levels are defined.

Each level of the NSQF is associated with a set of descriptors made up of five outcome statements, which describe in general terms, the minimum knowledge, skills and attributes that a learner needs to acquire in order to be certified for that level.

Each level of the NSQF is described by a statement of learning outcomes in five domains, known as level descriptors. These five domains are:

a. Process
b. Professional knowledge,
c. Professional skill,
d. Core skill and
e. Responsibility.

The Broad Learning outcome of Mechanic Electrical Maintenance (Industrial Automation) trade under ATS mostly matches with the Level descriptor at Level- 5.

The NSQF level-5 descriptor is given below:

Level	Process Required	Professional Knowledge	Professional Skill	Core Skill	Responsibility
Level 5	Job that requires well developed skill, with clear choice of procedures in familiar context.	Knowledge of facts, principles, processes and general concepts, in a field of work or study.	A range of cognitive and practical skills required to accomplish tasks and solve problem by selecting and applying basic methods, tools, materials and information.	Desired mathematical skill, understanding of social, political and some skill of collecting and organizing information, communication.	Responsibility for own work and learning and some responsibility for other's works and learning.

5. GENERAL INFORMATION

Name of the Trade	Mechanic Electrical Maintenance (Industrial Automation)
NCO - 2015	7412.0101, 3113.0102
Trade Code	DGT/3196
NSQF Level	Level – 5
Duration of Apprenticeship Training (Basic Training + On-Job Training)	Two years
Duration of Basic Training	a) BT –I : 3 months b) BT – II : 3 months **Total duration of Basic Training: 6 months**
Duration of On-Job Training	a) OJT–I: 9 months b) OJT–II : 9 months **Total duration of Practical Training: 18 months**
Entry Qualification	Passed 10th Class Examination under 10+2 system of Education or its equivalent.
Selection of Apprenticeship	The apprentices will be selected as per Apprenticeship Act amended from time to time.
Instructors Qualification for Basic Training	As per ITI instructors qualifications as amended time to time for the specific trade.
Infrastructure for Basic Training	As per related trade of ITI
Examination	The internal examination/ formative assessment will be held on completion of each Year. Final examination for all subjects will be held at the end of course and same will be conducted by DGT.
Rebate to Ex-ITI Trainees	01 year
CTS trades eligible for Apprenticeship	Broad Based Basic Training in Industrial Automation Sector under Centre of Excellence Scheme and Advanced Module of Centre of Excellence Scheme in Electrical Maintenance for Automation in Industrial Automation sector.

Note:

- *Industry may impart training as per above time schedule for different OJT, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However, the flexibility should be given keeping in view that no safety aspects are compromised.*

- *For imparting Basic Training, the industry to tie-up with ITIs having such specific trade and affiliated to DGT*

6. LEARNING OUTCOME

6.1 SPECIFIC LEARNING OUTCOME

The following are minimum broad Specific Learning Outcome after completion of the *Mechanic Electrical Maintenance (Industrial Automation)* course of 02 years duration under ATS.

1st Year:

1. Comply with safety pre-cautions in the section/plant including need of special protective equipment & provision of First Aid.
2. Take care of maintenance of common tools & equipment used in Industries.
3. Identify motors and generators, screw motors and stepper motors.
4. Perform operation of conveyors systems, skid conveyor Lift, magnetic lift, screw conveyor VFD.
5. Identify DOL & Star delta starter, built in starter motors, different types of circuit breaker.
6. Identify field instruments, limit switches, proxy switches and apply different types of sensors.
7. Check industrial wiring diagrams, maintain electrical switches and configure hydraulic and pneumatic systems.
8. Troubleshoot electrical equipments and maintain main control panel and power distribution panel.

2nd Year:

9. Execute the operation of different indication on PLC modules, wire different field devices of PLC, configure the system and perform suitable function.
10. Measure earth resistance with reference to various standards, troubleshoot the same & maintain earth stations.
11. Perform cable jointing, testing of cables, trouble shooting, locating faults, testing of open circuit, short circuit & leakage in cables.
12. Install, configure and demonstrate the AC and DC drive to control the speed.
13. Identify transformer parts, carry out transformer inspection and check transformer connections.
14. Operate and maintain transformer substations, circuit breakers, batteries etc.

6.2 GENERIC LEARNING OUTCOME

The following are minimum broad Common Occupational Skills/Generic Learning Outcome after completion of the MECHANIC ELECTRICAL MAINTENANCE (INDUSTRIAL AUTOMATION) course of 02 years duration under ATS.

Year I & II:-

1. Recognize & comply safe working practices, environment regulation and housekeeping.
2. Understand and explain different mathematical calculation & science in the field of study including basic electrical. [Different mathematical calculation & science – Units & Measurements, Material Science, Mass .Weight and Density, Ratio & Proportion, Work, Power and Energy, Algebra, Heat & Temperature, Mensuration, Basic Electricity, Simple machines Transmission of power, Trigonometry – Definition.]
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. [Different engineering drawing-Lines, Isometric views, switch circuits, bridge circuits, Reading of drawing, Free hand Sketches of hand tools used for MECHANIC ELECTRICAL MAINTENANCE (INDUSTRIAL AUTOMATION).]
4. Select and ascertain measuring instrument and measure dimension of components and record data.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
8. Plan and organize the work related to the occupation.

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

7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

SPECIFIC LEARNING OUTCOME	
LEARNING OUTCOMES	**ASSESSMENT CRITERIA**
1st Year 1. Comply with safety pre-cautions in the section/plant including need of special protective equipment & provision of First Aid. 2. Take care of maintenance of common tools & equipment used in Industries. 3. Identify motors and generators, screw motors and stepper motors. 4. Perform operation of conveyors systems, skid conveyor Lift, magnetic lift, screw conveyor VFD. 5. Identify DOL & Star delta starter, built in starter motors, different types of circuit breaker. 6. Identify field instruments, limit switches, proxy switches and apply different types of sensors. 7. Check industrial wiring diagrams, maintain electrical switches and configure hydraulic and pneumatic systems. 8. Troubleshoot electrical equipments and maintain main control panel and power distribution panel. **2nd Year** 9. Execute the operation of different indication on PLC modules, wire different field devices of PLC, configure the system and perform suitable function. 10. Measure earth resistance with reference to various standards, troubleshoot the same & maintain earth stations. 11. Perform cable jointing, testing of cables, trouble shooting, locating faults, testing of open circuit, short circuit & leakage in cables. 12. Install, configure and demonstrate the AC and DC drive to control the speed. 13. Identify transformer parts, carry out transformer inspection and check transformer connections. 14. Operate and maintain transformer substations, circuit breakers, batteries etc.	*Assessment Criteria for each specific learning outcome mentioned under **1st year & 2nd year** (section: 10) ensures the trainee achieves well developed skill with clear choice of procedure in familiar context.* *Assessment criteria should broadly cover the aspect of –* ***Planning** (Identify, ascertain, estimate etc.); **Execution** (perform, illustration, demonstration etc. by applying –* *1) a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information* *2) Knowledge of facts, principles, processes, and general concepts, in the field of work or study* *3) Desired Mathematical Skills and some skill of collecting and organizing information, communication) and **Checking/ Testing** to ensure functionality during the assessment of each outcome.* *The assessments parameters also ascertain that the candidate is responsible for own work and learning and some responsibility for other's work and learning.*

GENERIC LEARNING OUTCOME	
LEARNING OUTCOMES	**ASSESSMENT CRITERIA**
1. Recognize & comply safe working practices, environment regulation and housekeeping.	1.1 Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	1.2 Recognize and report all unsafe situations according to site policy.
	1.3 Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1.4 Identify, handle and store / dispose off dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.
	1.5 Identify and observe site policies and procedures in regard to illness or accident.
	1.6 Identify safety alarms accurately.
	1.7 Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.
	1.8 Identify and observe site evacuation procedures according to site policy.
	1.9 Identify Personal Productive Equipment (PPE) and use the same as per related working environment.
	1.10 Identify basic first aid and use them under different circumstances.
	1.11 Identify different fire extinguisher and use the same as per requirement.
	1.12 Identify environmental pollution & contribute to avoidance of same.
	1.13 Take opportunities to use energy and materials in an environmentally friendly manner
	1.14 Avoid waste and dispose waste as per procedure
	1.15 Recognize different components of 5S and apply the same in the working environment.
2. Understand, explain different mathematical	2.1 Explain concept of basic science related to the field such as Material science - Properties of

	calculation & science in the field of study including basic electrical and apply in day to day work. *[Different mathematical calculation & science – Units & Measurements, Material Science, Mass .Weight and Density, Ratio & Proportion, Work, Power and Energy, Algebra, Heat & Temperature, Mensuration, Basic Electricity, Simple machines Transmission of power, Trigonometry – Definition.]*		materials, Ferrous & non-ferrous metals, etc.
		2.2	Mass, weight, Density, Specific Gravity etc.
		2.3	Use scale/ tapes to measure as per specification..
		2.4	Calculate area / volume of the materials
		2.5	Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
		2.6	Ensure dimensional accuracy of assembly by using different instruments/gauges.
		2.7	Explain basic electricity, insulation & earthing.
3.	Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Lines ,Isometric views, switch circuits, bridge circuits, Reading of drawing, Free hand Sketches of hand tools used for MECHANIC ELECTRICAL MAINTENANCE (INDUSTRIAL AUTOMATION).]*	3.1	Read & interpret the information on drawings and apply in executing practical work.
		3.2	Read & analyse the specification to ascertain the material requirement, tools, and machining /assembly /maintenance parameters.
		3.3	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
4.	Select and ascertain measuring instrument and measure dimension of components and record data.	4.1	Select appropriate measuring instruments such as micrometers, vernier calipers, Analogue / Digital Multimeter & Oscilloscope etc. (as per tool list).
		4.2	Ascertain the functionality & correctness of the instrument.
		4.3	Measure dimension of the components & record data to analyse them with given drawing/measurement.
5.	Explain the concept in productivity, quality tools,	5.1	Explain the concept of productivity and quality tools and apply during execution of job.

	and labour welfare legislation and apply such in day to day work to improve productivity & quality.	5.2	Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws.
		5.3	Knows benefits guaranteed under various acts
6.	Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	6.1	Explain the concept of energy conservation, global warming, pollution and utilize the available recourses optimally & remain sensitive to avoid environment pollution.
		6.2	Dispose waste following standard procedure.
7.	Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	7.1	Explain personnel finance and entrepreneurship.
		7.2	Explain role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.
		7.3	Prepare Project report to become an entrepreneur for submission to financial institutions.
8.	Plan and organize the work related to the occupation.	8.1	Use documents, drawings and recognize hazards in the work site.
		8.2	Plan workplace/ assembly location with due consideration to operational stipulation.
		8.3	Communicate effectively with others and plan project tasks.
		8.4	Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.

8. SYLLABUS

BASIC TRAINING (BT – I) **Duration: (03) Three Months**		
Week No.	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
1	**WORKSHOP PRACTICES** Safety signs, Lifting and shifting of equipments/instruments, Extinguishing of fire, General Workshop safety. Familiarization with tools & equipment used in Industries.	Scope of workshop practice. Symbols on sign boards. Material handling and storage in the workshop Safety practice - fire extinguisher, Health, hygiene and safe working habits. Do's and don'ts. Identification, specification, uses and maintenance of hand tools and measuring and test instruments. Electrical instruments-Introduction, Types, deflecting type, recording type instruments, Moving coil & moving iron instrument. Construction, working properties, Connection of voltmeter, Ammeter, wattmeter, Megger, earth tester, Energy meter, Hotwire instruments, frequency meter, multimeter (Both analog &digital)
2	Study of Analogue / Digital Multimeter & Oscilloscope operations. Measurement of voltage, current, power and energy in the given simple circuit. Identify and measure voltage of dry battery and cells using Multimeter. Measure DC quantity & sine wave parameters using oscilloscope.	**Fundamentals of Electricity** - Meaning & definition of various terms, units and relationship between voltage, current, power and energy. Common DC sources – Cells & Batteries. Series and parallel connection of DC sources. Electrical supply system – single phase and three phase. Principle of production of AC – single phase and three phase AC alternators. DC generators. Electrical symbols as per BIS standards.
3	Identification and testing of motor parts such as field coil (both shunt & series),	DC machines – Classification – Self excited & Separately excited Dc

	armature etc. Measurement of DC resistance of shunt & series field and armature. Study of Characteristics of DC motors with varying load. No load and Full load Vs Speed characteristics. Study of Armature & Field control using rheostat and test of Direction of Rotation. Measurement of speed using tachometer. Testing of insulation resistance using Megger. Testing of armature using Growler. Checking of carbon brushes for its condition. Troubleshooting & Maintenance of DC motors.	motors, Terms used in DC Motor – Torque, flux, Speed, Back – emf , armature current, etc. Relation between torque, flux and armature current in DC motor, Torque-Speed characteristics etc . Construction and Parts of DC machines - series, shunt and compound and their applications. Types of armature winding, armature circuit resistance, commutation & commutator segments, brushes and their functions. Speed control methods of DC motors – Armature voltage control and Field voltage control. Fault finding, Care & maintenance of DC motors.
5	Practical applications of skid conveyor Lift, magnetic lift. Screw conveyor VFD. Operation of conveyors systems. Different application of VFD.	VFD - principle, working, applications, and characteristics. Conveyors- principle, types and application in industries.
6	Interpreting the microprocessor IC number, package, pin details. Interpreting the supporting IC's for Microprocessor based system using Trainer kit. Operating procedure and basic commands of 8085 – 8 bit microprocessor trainer kit. Practice on simple Assembly language programming. Demonstration on interfacing of Switches, thermocouple & flow meter, LED's, Relays, Stepper Motor, DC Motor etc.	**Microprocessor with applications in Process control** - Intel 8085 8-bit microprocessor, Architecture, pins / signals details, addressing methods, instructions classifications. Interfacing Logic devices and I/O Interfacing techniques. Introduction to microcontrollers – features, applications in process control industries.
7	Identification of AC motors 1-ph & 3ph squirrel cage induction motor & slip ring motors. Starting of Induction motor & reversing. Dismantling & Assembling of single phase & 3phase Squirrel cage induction motors. Testing of various types of Single & 3 phase AC motors. Measurement of slip & power factor at various loads. Speed control of induction motors. Fault finding exercises. Care and maintenance of AC motors.	AC Motors - Construction & Principle of operation. Comparison of AC & DC motors for its Advantages and Disadvantages. 1 phase & 3 phase AC induction motors, types and their characteristics. Starting & Running of AC motors using starters. Reversing of motors. Slip-Torque characteristics. Synchronous Motor and their applications. Low power AC Motors such as shaded pole, Repulsion type, universal Motors

		etc. Speed control methods of AC Motors – Significance of Variable frequency control. Fault diagnosis procedure & Maintenance of AC Motors.
8	Drawing block diagram of pneumatic system, Layout of pneumatic control lab, Drawing the block diagram of reciprocating piston compressor and its parts, Dismantling and assembly of reciprocating piston compressor.	Introduction to pneumatics- Definition, force, pressure and its units; Physical Fundamentals: - Air composition, definition of atmospheric pressure, absolute pressure, gauge pressure; Safety requirements for pneumatic systems; Air compressors:- Principle operation of reciprocating compressor and applications; Air receiver; Functional description of pressure gauge, FRL (Filter, regulator, lubricator) service unit.
9	Drawing block diagram of hydraulic system, identification of hydraulic components. Simple calculation using hydrostatic principle.	Basic Hydraulics: Pascal's law; Application of hydraulics – brief description of stationary and mobile hydraulics; Principle of hydraulic system- hydrostatic , Hydrodynamic , Block diagram of hydraulic circuit- power supply section, power control section, driver section; Differentiate between pneumatic & hydraulic symbols for actuators, Directional control valves, pressure control valves.
10	Measurement of voltage and No-load current, while running the DC motor in forward and reverse direction. Testing of different types of starters used to start and run AC/DC Motors. Wiring & testing of Electrical circuits with AC/DC motor using different types of starters. Verification of proper working by testing at various check points in the circuit. Fault finding exercises & Maintenance of Starters.	Stud of Starters to start Electric motors. Reverse & forward control circuits. DOL starters, 3 and 4 point starters, Star-Delta starters-Manual, Semi-Automatic & Fully Automatic starters. Types of timers – electronic, pneumatic & thermal. Working of latching & interlocking circuits. Reading line diagrams. Fault finding methods and maintenance of protective devices.
11	Application of Field instruments. Limits switch, proxy switches. Applications of different types of sensors.	Switches, sensors and different types of field instruments and their working principle.

	Maintenance of electrical switched and hydraulics and pneumatics system.	Fundamentals of hydraulic and pneumatic. Energy converter, Fluid conditioner, Control valves. Basics of proportional and servo valves, its electrical and electronic circuitry, control and feedback systems.
12	Selection of wires and cables. Simple wiring practice. Exercise on wire joints and crimping. Practice on Soldering & Desoldering.	Wires and cables; specification, selection and use in electrical Wiring, connectors, lugs, various types of wire joints, crimping, SWG, soldering; precautions to be adopted while solder various composition of solder wires, fluxes and their uses. Characteristics, properties and uses of bakelite, PVC, Porcelain etc.
13	**Assessment/Examination 03 days**	

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

BASIC TRAINING (BT – II) **Duration: (03) Three Months**		
Week No.	**Professional Skills (Trade Practical)**	**Professional Knowledge (Trade Theory)**
1	Application of PLC and maintenance of PLC panel. Maintenance of Bus bar. Rating of it, accessories maintenance. Maintain Digital & Analog IO Data and Display.	Fundamental of PLC and SCADA and its advantages.
2	Practical earthing system. Observation of operation of generating Station. Visit & study of power station. Study of power S/S maintenance practices.	Requirement of earthing in electrical equipments and different installation system. Generation, Transmission & Distribution of electricity, Type of generating station, Types of Power station, Maintenance of power S/S,O/H line system, Underground cable system, Types of cables.
3- 4	Study of different parts of AC single phase motor. Speed control through electrical& electronic regulator. Simulation of faults & their solution. Lab on different components of DC motor. Lab on speed control of DC motor. Lab on Commutator/carbon brush checking. Lab on carbon brush changing.	Electric Drive : Classification of load and motor according to their speed/ torque characteristics and drive performance characteristics. Behavior of drive system during change of slate. Modern drive system: concept of open and closed loop system DC drive: single and four quadrant control. AC single phase motor, principle & working, Why not self starting, ceiling fan working, regulating speed through electrical/electronic regulator, common. Problems of single phase motor, Other applications. DC Motor-Parts, Different types of DC motor, Application, speed control, characteristics curves, Maintenance, Commutator /carbon brush checking, Common problems of DC motor & troubleshooting.
5	Lab demo of different types of batteries. Study of battery- charging practices. Study of S/S battery maintenance.	Cells & Batteries, Electrolysis, Faradays laws of electrolysis, Electroplating, PD & EMF difference, Secondary cell& primary cell difference, Battery charging fundamentals, Defects in battery:- Sulphation, Buckling of

		plates, sedimentation, Power S/S battery maintenance.
6	Maintenance of AC & DC solenoid. Maintenance of motorized valves.	Working principle of solenoid and different application in industries.
7	Maintenance of UPS batteries.	Principle and advantages of UPS system.
8-9	Connection of motor& electrical control circuit for different system. Study of lift electrical circuits. Maintenance & troubleshooting.	Selection of motors, Advantage of electric drive, Motors used for different types of drives, Electric traction system, Lifts.
10	Study of Transformer parts. Lab on transformer inspection. Lab on transformer connections.	Transformer- Types, Construction/parts, Principles, Transformation ratio, Buchholz relay, efficiency, cooling, Current transformer, potential transformer, Parallel running of 3 phase transformer, Different transformer connections, Transformer inspection, Maintenance, troubleshooting.
11	**Project Work**	
12	**Revision & Examination**	
13	**Assessment/Examination 03days**	

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

9. SYLLABUS - CORE SKILLS

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

BT – I		
Sl. No.	**Workshop Calculation and Science (Duration: - 20 hrs.)**	**Engineering Drawing (Duration: - 30 hrs.)**
1.	**Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units.	**Engineering Drawing: Introduction and its importance** - Viewing of engineering drawing sheets. - Method of Folding of printed Drawing Sheet as per BIS SP:46-2003 **Drawing Instruments** : their Standard and uses - Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips
2.	**Fractions & Simplification**: Fractions, Decimal fraction, Addition, Subtraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple Simplification using BODMAS.	**Lines :** - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line - Methods of Division of line segment
3.	**Square Root:** Square and Square Root, method of finding out square roots, Simple problem using calculator.	**Drawing of Geometrical Figures**: Definition, nomenclature and practice of - - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements
4.	**Ratio &Proportion:** Simple calculation on related problems.	**Lettering and Numbering** as per BIS SP46-2003: - Single Stroke, Double Stroke,

		inclined, Upper case and Lower case.
5.	**Percentage:** Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	**Free Hand sketch:** Hand tools and measuring instruments used Electrician trade
6.	**Material Science** : properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and Non-Ferrous metals, introduction of Iron, Cast Iron, Wrought Iron, Steel, difference between Iron and Steel, Alloy steel, carbon steel, stainless steel, Non-Ferrous metals, Non-Ferrous Alloys.	**Free hand drawing of :** - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension - Transferring measurement from the given object to the free hand sketches.

BT – II		
Sl. No.	**Workshop Calculation and Science (Duration: - 20 hrs.)**	**Engineering Drawing (Duration: - 30 hrs.)**
1.	**Mass, Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals	**Symbolic Representation** (as per BIS SP:46-2003) of : - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints. - Electrical and electronics element - Piping joints and fittings
2.	**Work, Power and Energy**: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	**Construction of Scales and diagonal scale** **Three phase Induction motor :** Free hand sketching of Slip-ring and Squirrel cage Induction motor. Typical wiring diagram for drum controller operation of A.C. wound rotor motor.
3.	**Algebra:** Addition, Subtraction, Multiplication, Division, Algebraic formula, Linear equations (with two variables).	Drawing the schematic diagram of Autotransformer starter, DOL starter and Star Delta Starter. Drawing the schematic diagram of A.C. motor speed control by SCR /AC Drive.
4.	**Mensuration:** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle. Volume of solids – cube, cuboid, cylinder and Sphere. Surface area of solids – cube, cuboid, cylinder and Sphere.	**Distribution of Power** Types of insulator used in over head line. (Half sectional views) Different type of distribution systems and methods of connections. Layout diagram of a substation. Single line diagram of substation feeders.
5.	**Magnetism:** Introduction to magnetic material for permanent magnet, temporary magnet etc. Magnetic field, flux density, permeability, susceptibility – explanation and units of the above terms. Electromagnet (Solenoid) – practical applications.	**Alternator:** Tracing of panel wiring diagram of an alternator. Drawing the schematic diagram of automatic voltage regulators of A.C. generators.
6.	**Number System:** decimal and binary, Octal hexa decimal. BCD code, conversion from decimal to binary and vice-versa, all other conversions. Practice on conversions.	**Control Panel** Practice in reading panel diagram.
7.	**Heat & Temperature**: Heat and	Draw the circuit diagram of various

	temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.	types of rectifiers, amplifiers, oscillators, power supplies, multi vibrators. Draw the circuits of shift registers, counters, digital clock, multiplexer.
8.	Speed Vs frequency relationship of AC Motors. Torque/Speed relationship and load current calculations in AC motor. Percentage error calculation in AC Motors.	Draw the symbols for various electrical measuring instruments, switches, fuse, protective and controlling devices in electrical circuits. Draw the bridge circuits (Wheat stone, wien bridge, 2-wire, 3-wire, 4-wire, RTD configuration).
9.	Relation between torque, flux and Armature current in DC motor, Torque Vs speed calculations. Armature control and field control problems in DC motors.	----------

9.2 EMPLOYABILITY SKILLS
(DURATION : - 110 HRS.)

BT – I (Duration – 55 hrs.)	
1. English Literacy	Duration: 20 Hrs. Marks : 09
Pronunciation	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)
Functional Grammar	Transformation of sentences, Voice change, Change of tense, Spellings.
Reading	Reading and understanding simple sentences about self, work and environment
Writing	Construction of simple sentences Writing simple English
Speaking / Spoken English	Speaking with preparation on self, on family, on friends/ classmates, on know, picture reading gain confidence through role-playing and discussions on current happening job description, asking about someone's job habitual actions. Cardinal (fundamental) numbers ordinal numbers. Taking messages, passing messages on and filling in message forms Greeting and introductions office hospitality, Resumes or curriculum vita essential parts, letters of application reference to previous communication.
2. I.T. Literacy	Duration: 20 Hrs. Marks : 09
Basics of Computer	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.
Computer Operating System	Basics of Operating System, WINDOWS, The user interface of Windows OS, Create, Copy, Move and delete Files and Folders, Use of External memory like pen drive, CD, DVD etc, Use of Common applications.
Word processing and Worksheet	Basic operating of Word Processing, Creating, opening and closing Documents, use of shortcuts, Creating and Editing of Text, Formatting the Text, Insertion & creation of Tables. Printing document. Basics of Excel worksheet, understanding basic commands, creating simple worksheets, understanding sample worksheets, use of simple formulas and functions, Printing of simple excel sheets.
Computer Networking and Internet	Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet,

	Concept of Internet (Network of Networks), Meaning of World Wide Web (WWW), Web Browser, Web Site, Web page and Search Engines. Accessing the Internet using Web Browser, Downloading and Printing Web Pages, Opening an email account and use of email. Social media sites and its implication. Information Security and antivirus tools, Do's and Don'ts in Information Security, Awareness of IT - ACT, types of cyber crimes.
3. Communication Skills	Duration: 15 Hrs. Marks : 07
Introduction to Communication Skills	Communication and its importance Principles of Effective communication Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication -characteristics, components-Para-language Body language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort.
Listening Skills	Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening. Triple- A Listening - Attitude, Attention & Adjustment. Active Listening Skills.
Motivational Training	Characteristics Essential to Achieving Success. The Power of Positive Attitude. Self awareness Importance of Commitment Ethics and Values Ways to Motivate Oneself Personal Goal setting and Employability Planning.
Facing Interviews	Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview.
Behavioral Skills	Problem Solving Confidence Building Attitude.
BT – II Duration – 55 hrs.	
4. Entrepreneurship Skills	Duration: 15 Hrs. Marks : 06
Concept of	Entrepreneur - Entrepreneurship - Enterprises:-Conceptual issue

Entrepreneurship	Entrepreneurship vs. management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.
Project Preparation & Marketing analysis	Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of PLC, Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.
Institutions Support	Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.
Investment Procurement	Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.
5. Productivity	Duration: 10 Hrs. Marks : 05
Benefits	Personal / Workman - Incentive, Production linked Bonus, Improvement in living standard.
Affecting Factors	Skills, Working Aids, Automation, Environment, Motivation - How improves or slows down.
Comparison with developed countries	Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.
Personal Finance Management	Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.
6. Occupational Safety, Health and Environment Education	Duration: 15 Hrs. Marks : 06
Safety & Health	Introduction to Occupational Safety and Health importance of safety and health at workplace.
Occupational Hazards	Basic Hazards, Chemical Hazards, Vibroacoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.
Accident & safety	Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety

	measures.
First Aid	Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person.
Basic Provisions	Idea of basic provision legislation of India. Safety, health, welfare under legislative of India.
Ecosystem	Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.
Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
Energy Conservation	Conservation of Energy, re-use and recycle.
Global warming	Global warming, climate change and Ozone layer depletion.
Ground Water	Hydrological cycle, ground and surface water, Conservation and Harvesting of water.
Environment	Right attitude towards environment, Maintenance of in - house environment.
7. Labour Welfare Legislation	Duration: 05 Hrs. Marks : 03
Welfare Acts	Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.
8. Quality Tools	Duration: 10 Hrs. Marks : 05
Quality Consciousness	Meaning of quality, Quality characteristic.
Quality Circles	Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to starting Quality Circles, Steps for continuation Quality Circles.
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of House-keeping, Practice of good Housekeeping.
Quality Tools	Basic quality tools with a few examples.

10. DETAILS OF COMPETENCIES (ON-JOB TRAINING)

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

OJT – I

1. Comply with safety pre-cautions in the section/plant including need of special protective equipment & provision of First Aid.
2. Take care of maintenance of common tools & equipment used in Industries.
3. Identify motors and generators, screw motors and stepper motors.
4. Perform operation of conveyors systems, skid conveyor Lift, magnetic lift, screw conveyor VFD.
5. Identify DOL & Star delta starter, built in starter motors, different types of circuit breaker.
6. Identify Field instruments, limit switches, proxy switches and apply different types of sensors.
7. Check industrial wiring diagrams, maintain electrical switches and configure hydraulic and pneumatic systems.
8. Troubleshoot electrical equipments and maintain main control panel and power distribution panel.

OJT – II

9. Execute the operation of different indication on PLC modules, wire different field devices of PLC, configure the system and perform suitable function.
10. Measure earth resistance with reference to various standards, troubleshoot the same & maintain earth stations.
11. Perform cable jointing, testing of cables, trouble shooting, locating faults, testing of open circuit, short circuit & leakage in cables.
12. Install, configure and demonstrate the AC and DC drive to control the speed.
13. Identify Transformer parts, carry out transformer inspection and check transformer connections.
14. Operate and maintain transformer substations, circuit breakers, batteries etc.

Note:

1. Industry must ensure that above mentioned competencies are achieved by the trainees during their on job training.

2. In addition to above competencies/ outcomes industry may impart additional training relevant to the specific industry.

ANNEXURE – I

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

MECHANIC ELECTRICAL MAINTENANCE (INDUSTRIAL AUTOMATION)			
LIST OF TOOLS AND EQUIPMENT for Basic Training (For 20 Apprentices)			
A. TRAINEES TOOL KIT			
Sl. no.	**Name of the Tool &Equipments**	**Specification**	**Quantity**
1.	Transducers trainer kits		21 Nos.
2.	Photo voltaic cell & Eddy Current Sensors		3 Nos. each
3.	RTDs	PTs, Copper and Nickel etc.	21 Nos.
4.	Ovens		21 Nos.
5.	Thermo couple	J, K, T, N, E, B, R & S types	21 Nos.
6.	Pyrometer	radiation & optical	2 Nos. each
7.	Strain gauge and load cells		21 Nos.
8.	LVDT		21 Nos.
9.	RVDT		21 Nos.
10.	Smoke detector		21 Nos.
11.	Humidity sensor		21 Nos.
12.	Rotary shaft encoder		21 Nos.
13.	Tachometer		21 Nos.
14.	Photo diode/ transistor		21 Nos.
15.	Vibration Analyzer		21 Nos.
16.	Electrical actuator		21 Nos.
17.	DMMs		10 Nos.
18.	Thermometers		21 Nos.
19.	Power suppliers	0 to 30V	21 Nos.
20.	Screw driver set		21 Nos.
21.	Star screw driver		21 Nos.
22.	Pliers		21 Nos.
23.	Cutters		21Nos.
24.	Liquid filled in steel thermometer		4 Nos.
25.	Vapour filled in steel thermometer		4 Nos.
26.	Bimetal type thermometer (digital)		4 Nos.
27.	Liquid filled thermostat (digital)		4 Nos.

28.	PC based Data Acquisition System		2 Nos.
29.	Thermo wells & Temperature ICs		5 Nos. each
30.	Constant temperature bath with mv calibrator		1 No.
31.	Smart transmitters	resonant	4 Nos.
32.	U tube manometer		4 Nos.
33.	Well type manometer		4 Nos.
34.	Micro type manometer		4 Nos.
35.	Inclined tube manometer		4 Nos.
36.	Digital manometer/ calibrator		4 Nos.
37.	Bourdon type pressure gauges		6 Nos.
38.	Diaphragm seal pressure gauges		4 Nos.
39.	Vaccum, Pirani and Penny type gauges		1 No. each
40.	Low pressure diaphragm & pressure gauges		4 Nos.
41.	Low pressure capsule & pressure gauges		4 Nos.
42.	Digital pressure gauges		6 Nos.
43.	Pressure indicator transmitter		6 Nos.
44.	Digital bar graph indicator	U based	6 Nos.
45.	Smart pressure & Differential transmitter		4 Nos.
46.	Dead weight tester transmitter		4 Nos.
47.	Low pressure calibrator		4 Nos.
48.	Computer aided pressure calibrator system		1 No.
49.	Process scanner		4 Nos.
50.	Air compressor		2 Nos.
51.	Vaccum pump		2 Nos.
52.	Quantity flow meters/ positive displacement flow meters		6 Nos.
53.	Differential flow system using orifice/ annubar / flow nozzles		4 Nos.
54.	Rotameter		4 Nos.
55.	Turbine flow meter		2 Nos.
56.	Electromagnetic flow meter		2 Nos.
57.	Ultrasonic & vertex type built in compensation flow meter		2 Nos. each

58.	Thermal dispersion gas and liquid flow meters		2 Nos.
59.	Flow indication/ totalizers	U based	2 Nos.
60.	Smart DP flow meter transmitter		4 Nos.
61.	Sight glasses for liquid level measurement		4 Nos.
62.	Different type of level switches		6 Nos.
63.	Level indicators & transmitter for liquid level (different type)		6 Nos.
64.	Conductivity type level sensor based indicating system		2 Nos.
65.	Ultrasonic level measurement system for liquid		2 Nos.
66.	Level controllers	Massonil	2 Nos.
67.	Digital barometer pressure indicator		4 Nos.
68.	Smart level DP transmitters		2 Nos.
69.	Microprocessor based recorders for flow, pressure & level		20 Nos.
70.	Proximity, sensors/ switches for flow, level, pressure measurement		6 Nos.
71.	Pneumatic secondary recorders	3 pneumatic + 1 paper less	21 Nos.
72.	Pneumatic control valves (two valves with positioner)	butterfly type, On/ Off and ball type with I/P converters	6 Nos.
73.	PC based temperature controller		1 No
74.	pH meter and conductivity		2 Nos.
75.	Sensors for pH and conductivity		2 Nos.
76.	Level sensor	displacement plus flow type	2 Nos. each
B : INSTRUMENTS & GENERAL SHOP OUTFIT			
77.	Advanced PC Based Automatic Process Trainer with accessories		4 Nos.
78.	PC Based Temperature Controller		1 No.
79.	Humidity Controller		1 No.
80.	Automatic Process Control Trainer for Pressure, Flow & Level		1 No. Each
81.	Pneumatic PID Controller		4 Nos.
82.	Pneumatic Process Simulator		2 Nos.
83.	Pneumatic Transmitter for Pressure, Flow and Level		2 Nos. Each

84.	Pneumatic Control Valves		6 Nos.
85.	Microcontroller based universal controller, temperature, pressure, flow and level		8 Nos.
86.	Pneumatic Recorder		4 Nos.
87.	Microcontroller based strip chart recorder		2 Nos.
88.	Microcontroller based circular chart recorder		2 Nos.
89.	PC Based Recorder		2 Nos.
90.	Stepper motor control valves		4 Nos.
91.	Electrically operated solenoid		4 Nos.
92.	Smart transmitter		2 Nos.
93.	I to P, P to I converters		2 Nos. Each
94.	Single phase converter		4 Nos.
95.	PCI Based General purpose Add on Card system	▪ 16 Analog channels ▪ 8 digital channels ▪ 2/4 counter/ timer channels ▪ power supply – 2 channels ▪ DAC – 2 channels	1 system
96.	Advanced Software package	or VI	As required
97.	Interface	IEEE -488, RS - 232	As required
98.	Signal conditioning tools		As required
99.	Sensors (i) Temperature, pressure, flow and level (ii) General purpose sensors		4 Nos. As required
100.	Personal computers / Lap Top - Advanced version with colour monitor, key board, mouse and printer		10 Nos.
101.	Power supplies	AC/DC adjustable	10 Nos.
102.	LCD Projector		1 No.
103.	Laser Printer		1 No.
104.	PC Maintenance tools		As required
105.	V.I. Hardware/Software tool list		1 No.
106.	Laboratory tools		As required
107.	Computer chairs / tables		11 Nos. Each
108.	Chairs/tables for trainees		20 Nos. Each

109.	Air conditioning of the lab		As required
110.	Stabilizer and On-line condition		1 KVA
111.	Civil work to establish V.I. lab (face lift)		As required
112.	Photo copier		1 No.
113.	PLCs with different makes - Analog/Digital with I/Os		8 Nos. each
114.	Computer software for programs and simulate PLC systems		As required
115.	Computer - Advanced version with colour monitor, keyboard, mouse and printer		10 Nos.
116.	Laser printer		2 Nos.
117.	AC/DC power supply (adjustable)		10 Nos.
118.	Digital multimeters		10 Nos.
119.	Stabilizer and on-line conditioner	1 KVA	10 Nos.
120.	Simulators and models for PLC		8 Nos.
121.	Laboratory type compressor		1 No.
122.	Different types of solenoids, switches, cylinders, pistons, actuators, relays, sensor, processor, motors, flashers, speaker, modules		As required
123.	Dual trace oscilloscope		8 Nos.
124.	EPROM Eraser		2 Nos.
125.	LCD Projector		1 No.
126.	PC Maintenance tools		As required
127.	Air-conditioning of the lab		To be done
128.	Laboratory tools		As required
129.	Chairs/tables for trainees		As required
130.	HMI, OP & TP with necessary software's		4 Nos.
131.	SCADA software	150 Tags	4 Nos.
132.	Networking Hardware		4 Sets.
C : Safety Equipment			
133.	Industrial safety hat		4
134.	Industrial safety shoe	different size	4
135.	Fall arrest personnel safety belt		4
136.	Life line rope - nylon braided made from high tenacity multifilament yarn	13 mm dia.	4
137.	Safety net 3 x 3 meter		2
138.	Head lamp 3 W with battery		2

139.	Fire Extinguisher	CO_2, 2 KG	2
140.	Fire Buckets	With Stand	2
D. Furniture & Accessories			
141.	Instructor's table		1
142.	Instructor's chair		2
143.	Working Bench	2.5 m x 1.20 m x 0.75 m	4
144.	Metal Rack	100cm x 150cm x 45cm	4
145.	Lockers	with 16 drawers standard size	2
146.	Almirah	2.5 m x 1.20 m x 0.5 m	1
147.	Black board/white board		1

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: MECHANIC ELECTRICAL MAINTENANCE (INDUSTRIAL AUTOMATION)

LIST OF TOOLS& EQUIPMENTS FOR -20APPRENTICES

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

2) Infrastructure:

A : TRAINEES TOOL KIT			
Sl. No.	**Name of the items**	**Specification**	**Quantity**
1.	Draughtsman drawing instrument box		21
2.	Set square celluloid	45^o (250 X 1.5 mm)	21
3.	Set square celluloid	30^o-60^o (250 X 1.5 mm)	21
4.	Mini drafter		21
5.	Drawing board	700mm x500 mm IS: 1444	21
B : Furniture Required			
Sl. No.	**Name of the items**	**Specification**	**Quantity**
1.	Drawing Board		20
2.	Models : Solid & cut section		as required
3.	Drawing Table for trainees		as required
4.	Stool for trainees		as required
5.	Cupboard (big)		01
6.	White Board (size: 8ft. x 4ft.)	(size: 8ft. x 4ft.)	01
7.	Trainer's Table		01
8.	Trainer's Chair		01

Tools &Equipments for Employability Skills		
Sl. No.	**Name of the Equipment**	**Quantity**
1.	Computer (PC) with latest configurations and Internet connection with standard operating system and standard word processor and worksheet software	10 Nos.
2.	UPS - 500VA	10 Nos.
3.	Scanner cum Printer	1 No.
4.	Computer Tables	10 Nos.
5.	Computer Chairs	20 Nos.
6.	LCD Projector	1 No.
7.	White Board 1200mm x 900mm	1 No.
Note: - Above Tools &Equipments not required, if Computer LAB is available in the institute.		

ANNEXURE-II

FORMAT FOR FORMATIVE ASSESSMENT

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

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