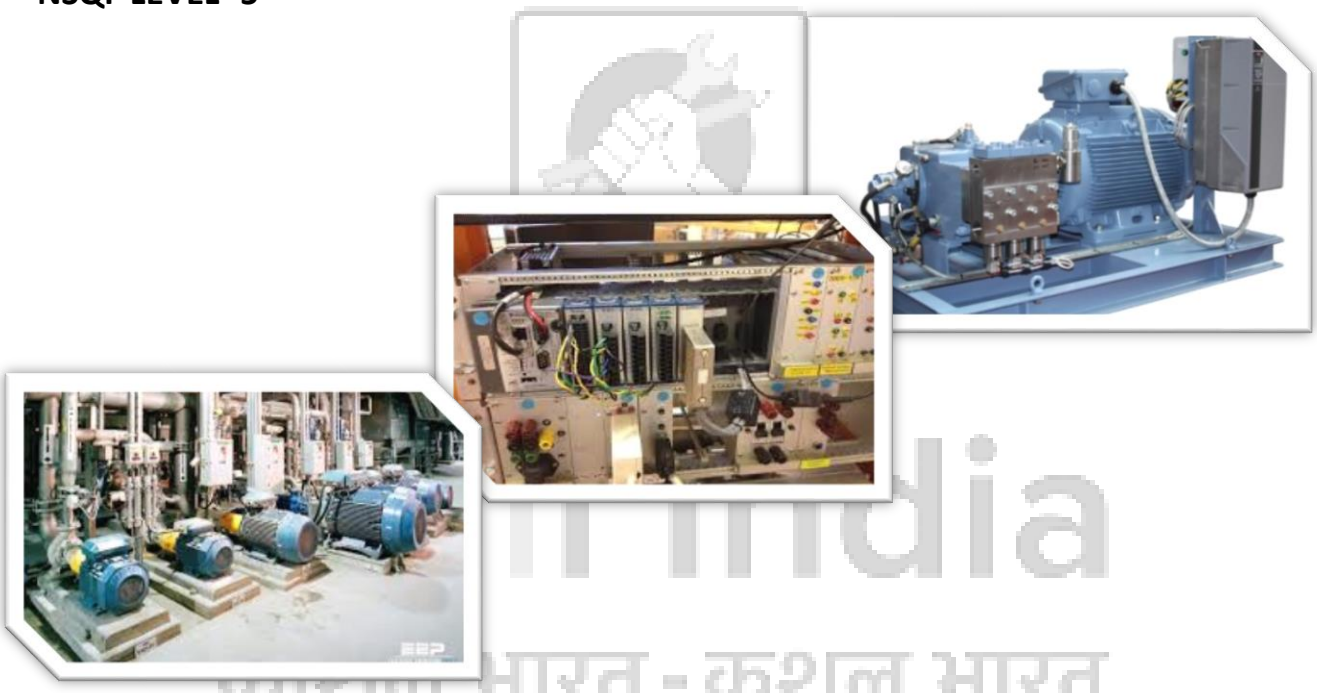
MECHANIC (ELECTRICAL POWER DRIVES)

COMPETENCY BASED CURRICULUM

(Duration: 2 Yrs.)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 5



SECTOR – Electrical (Including New and Renewable Energy)

सत्यमेव जयते

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

Directorate General of Training

Skill India
कौशल भारत-कुशल भारत

MECHANIC (ELECTRICAL POWER DRIVES)

(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

ACKNOWLEDGEMENT

The DGT sincerely expresses appreciation for the contribution of the Industry, State Directorate, Trade Experts 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.

Sl. No.	Name & Designation Sh./Mr./Ms.	Organization	Expert Group Designation
1.	Sanjay Kumar, Joint Director	CSTARI, Kolkata	Expert Member
2.	L.K. Mukherjee Dy Director	CSTARI, Kolkata	Expert Member
3.	Ketan Patel, Dy Director	RDAT, Mumbai	Expert member
4.	C. M. Diggewadi, Training Officer	RDAT, Mumbai	Expert member
5.	V V Sateesh Reddy, Training Officer	ATI, Hyderabad	Expert Member

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 National Council for Vocational Training (NCVT) to develop skilled manpower for the industry**.** There are four categories of apprentices namely**; trade apprentice, graduate, technician and technician (vocational) apprentices.**

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

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

1.2 Changes in Industrial Scenario

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

1.3 Reformation

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

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

2. 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 National Council of Vocational Training (NCVT). Craftsman Training Scheme (CTS) and Apprenticeship Training Scheme (ATS) are two pioneer programmes of NCVT for propagating vocational training.

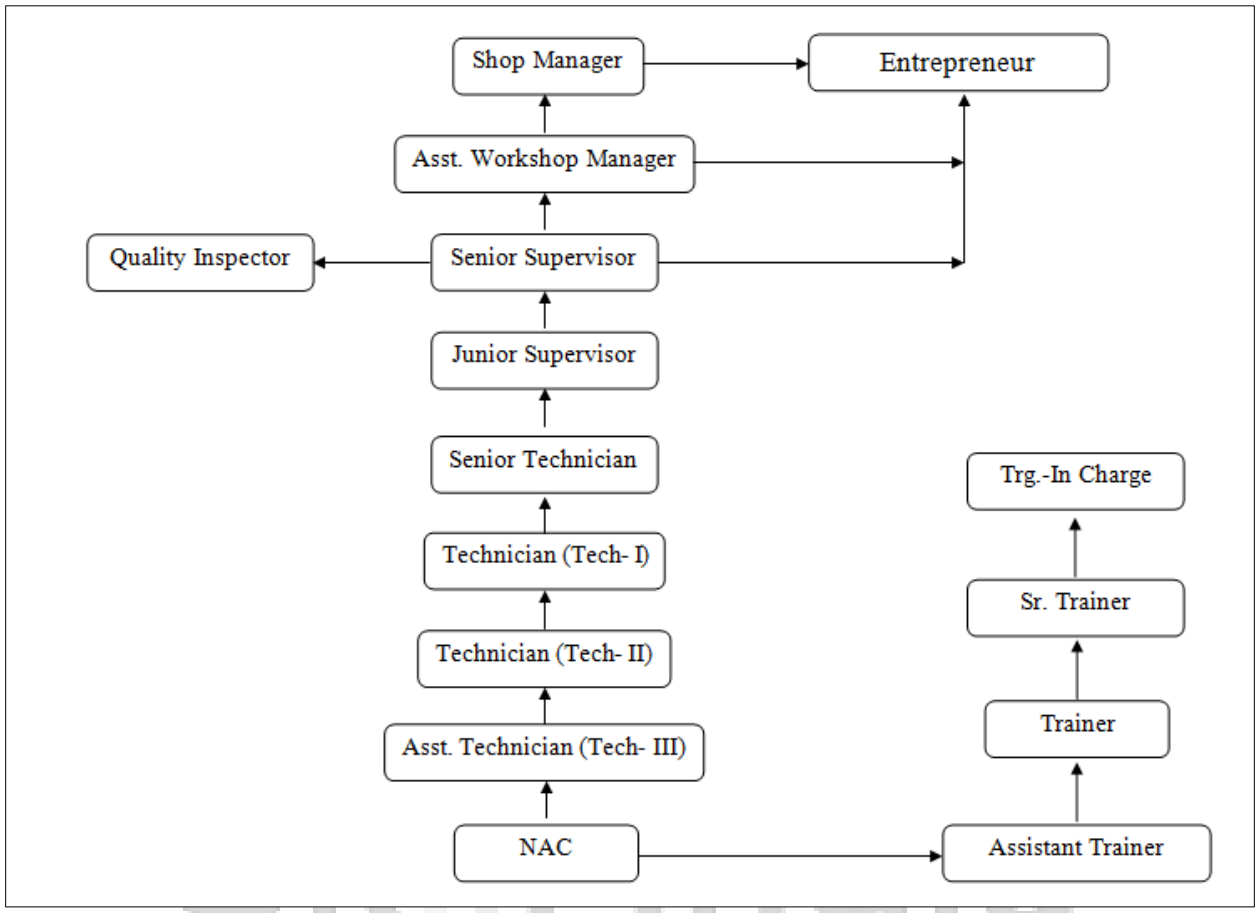
Mechanic (Electrical power drives) trade under ATS is one of the most popular courses delivered nationwide through different industries. The course is of two years (02 Blocks) duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional - 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 NCVT 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/finishing and 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:

- 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	**Block– I**	**-----**	**Block – II**	**------**
Practical Training (On - job training)	**----**	**Block – I**	**------**	**Block – II**

A. Basic Training

For 02 yrs. course (Engg.) :-(**Total 06 months:** 03 months in 1st yr. + 03 months in 2nd yr.)
For 01 yr. course (Engg.) :-(**Total 03 months:** 03 months in 1st yr.)

S No.	Course Element	Total Notional Training Hours	
		For 02 Yrs. course	**For 01 Yr. course**
1.	Professional Skill (Trade Practical)	550	275
2.	Professional Knowledge (Trade Theory)	240	120
3.	Workshop Calculation & Science	40	20
4.	Engineering Drawing	60	30
5.	Employability Skills	110	55
	Total (Including internal assessment)	**1000**	**500**

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.

For 01 yr. course (Engg.) :-(**Total 12 months**)

Notional Training Hours for On-Job Training: 2080 Hrs.

C. Total training hours:-

Duration	Basic Training	On-Job Training	Total
For 02 yrs. course (Engg.)	1000 hrs.	3120 hrs.	4120 hrs.
For 01 yr. course (Engg.)	500 hrs.	2080 hrs.	2580 hrs.

2.4 ASSESSMENT & CERTIFICATION:

The trainee will be tested for his 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. The Employability skills will be tested in first two semesters only.

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 (section-2.4.2). The marks of internal 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 NCVT 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 (section-2.4.2) before giving marks for practical examination.

2.4.1 PASS REGULATION

The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%. The candidate 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 internal assessments are to be preserved until forthcoming semester examination for audit and verification by examination body. The following marking pattern to be adopted while assessing:

Mechanic (Electrical Power Drives)

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 • Below 70% tolerance dimension/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% tolerance dimension/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% tolerance dimension/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:

MECHANIC (Electrical power drives) Read and interpret the blue print reading (Electrical layout Drawing as per BIS specification & standards),Carryout Installation, maintenance & repair works of Electrical AC/ DC machinery, lighting circuits and equipments used in industries. Practice on using fitting carpentry and sheet metal tools, Use of electrical instrument(analog/digital) like voltmeter, Ammeter, Wattmeter, Energy Meter, Wheatstone bridge, oscilloscope, Earth tester, Tong tester, Megger etc to measure to different electrical quantities, Carry out Wiring & Earthing System, Carried out break down, over hauling, routine & preventive maintenance of electrical machines and equipments, Operate, maintain and test the switch gears, circuit breakers, relays and transformer, Underground cable joining, testing & trouble shooting, Working of LT and HT Switch- gears and protective relays, Test, repair & maintenance of different types of components used in electrical machines, Test, repair & maintenance of different types of power supplies., Test, repair & maintenance of CVT, SCVS, SCVT, SMPS, Inverter etc, Uses, applications, repair & maintenance of AC & DC drives.

Electrical Fitter fits and assembles electrical machinery and equipment such as motors, transformers, generators, switchgears, fans etc., Studies drawings and wiring diagrams of fittings, wiring and assemblies to be made. Collects prefabricated electrical and mechanical components according to drawing and wiring diagrams and checks them with gauges, megger etc. to ensure proper function and accuracy. Fits mechanical components, resistance, insulators, etc., as per specifications, doing supplementary tooling where necessary. Follows wiring diagrams, makes electrical connections and solders points as specified. Checks for continuity, resistance, circuit shorting, leakage, earthing, etc. at each stage of assembly using megger, ammeter, voltmeter and other appliances and ensures stipulated performance of both mechanical and electrical components filled in assembly. Erects various equipment such as bus bars, panel boards, electrical posts, fuse boxes switch gears, meters, relays etc. using non-conductors, insulation hoisting equipment as necessary for receipt and distribution of electrical current to feeder lines. Installs motors, generators, transformer etc. as per drawings using lifting and hoisting equipment as necessary, does prescribed electrical wiring, and connects to supply line. Locates faults in case of breakdown and replaces blown out fuse, burnt coils, switches, conductors etc. as required. Checks, dismantles, repairs and overhauls electrical units periodically or as required according to scheduled procedure. May test coils. May specialize in repairs of particular equipment manufacturing, installation or power house work and be designated accordingly.

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:** 7412.0200 - **MECHANIC (Electrical power drives)**

4. NSQF LEVEL COMPLIANCE

NSQF level for Mechanic (Electrical power drives) 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 power drives) 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 POWER DRIVES)
NCO-2015	7412.0200
NSQF Level	Level – 5
Duration of Apprenticeship Training (Basic Training + On-Job Training)	Two years (02 Blocks each of one year duration).
Duration of Basic Training	a) Block –I : 3 months b) Block – II : 3 months **Total duration of Basic Training: 6 months**
Duration of On-Job Training	a) Block–I: 9 months b) Block–II : 9 months **Total duration of Practical Training: 18 months**
Entry Qualification	Passed 10th Class with Science and Mathematics under 10+2 system of Education or its equivalent
Selection of Apprentices	The apprentices will be selected as per Apprenticeship Act amended 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 trades of ITI.
Examination	The internal examination/ assessment will be held on completion of each block. Final examination for all subjects will be held at the end of course and same will be conducted by NCVT.
Rebate to Ex-ITI Trainees	01 year
CTS trades eligible for Mechanic (Electrical Power Drives) Apprenticeship	1. Electrician

Note:

- *Industry may impart training as per above time schedule for different block, however this is not fixed. The industry may adjust the duration of training considering the fact that all the components under the syllabus must be covered. However the flexibility should be given keeping in view that no safety aspects is compromised.*
- *For imparting Basic Training the industry to tie-up with ITIs having such specific trade and affiliated to NCVT.*

6. LEARNING OUTCOME

6.1 GENERIC LEARNING OUTCOME

The following are minimum broad Common Occupational Skills/ Generic Learning Outcome after completion of the Mechanic (Electrical power drives) course of 02 years duration under ATS.

Block 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 -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]*
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]*
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.

6.2 SPECIFIC LEARNING OUTCOME

Block – I

1. Observe & practice safety pre-cautions to be followed in the section/plant including need of special protective equipment. Practice providing First Aid.
2. Identify & use all hand tools.
3. Check the gauges of wire & select suitable wires for the required current rating. Practice wire joints & providing cable glands. Soldering practice.

4. Carryout fitting & carpentry jobs
5. Connect & measure voltage, current, resistance power & energy in DC & AC(1ph & 3ph) circuits.
6. Electrical wiring: Repair / replace switches, sockets, light points. Provide new points in PVC casing capping & PVC conduits.
7. Charging & maintenance of different type of Batteries. Checking specific gravity, voltage, condition monitoring of Battery Bank, assessment of high spots, on line isolation precautions etc.
8. Install pipe & plate earth stations. Measure earth resistance, improve the same & maintain earth stations. Earth Monitoring systems with reference to various standards, familiarization with health monitoring equipment.
9. Providing power supply to motors, equipments& appliances. Crimping the lugs, providing cable glands & connections.
10. Attending to minor faults in machines, their controls & appliances.
11. Replacing the bulbs, tubes, trouble shooting, repair & maintenance. Wire up in PVC casing & capping.
12. Assisting in operation & maintenance of Transformer substation, circuit breakers, batteries etc
13. Trouble shooting rectifiers, filters, power supplies, voltage stabilizers, controlled rectifiers. Identifying faulty thyristors in circuits, replacing them.
14. Provide light/socket points, for various equipments and appliances.
15. Decides the size of cable & provides power supply to machines &equipments, provide earth connections.
16. Testing the condition of DC motor Checking power input & output in DC drives. Replacing faulty components.

Block – II

17. Observe & practice safety pre-cautions to be followed in the section/plant including need of special protective equipment. Practice providing First Aid.
18. Connection & testing of single & three phase motor, Checking power input & output in AC drives. Replacing faulty components, Power factor correction using Synchronous motor.
19. Checking Electrical connections, locating faults and removal of faults in Air Compressor, AC plants, cranes, lifts, hoists, Operates & maintain Air compressor, AC plant, cranes, lifts, hoists.
20. Diesel Generating set: Operation, operating switch gears, trouble shooting & maintenance

    protective system for Generator, Care and maintenance of Alternator.

21. Underground cable joining, testing of underground cables, trouble shooting, Locating faults, open circuit, short circuit & leakage in cables, performing cable joints.
22. Operation of Control Room, Operation of Switchgear, Communication with different field and control devices, Reading of panel meter & filling log sheet.
23. Working of LT and HT Switch- gears and protective relays, Maintenance of transformer equipment such as : Oil gauge, Tap Changer, Bushes, Breather, Earth fault relay, Protective relay, etc, Installation operation and maintenance of oil circuit breaker, Air circuit breaker, SF6 circuit breaker, Vaccum circuit breaker, etc.
24. Identification & Testing of different active and passive components, To understand AC/DC conversion, repair & maintenance of 1ph controlled rectifiers, Repairing & maintenance of 3 ph. Controlled rectifiers, Repair and maintenance of various batteries charger in concerned industry.
25. Care & maintenance of different type of voltage source using Op-Amp, Application of different type of regulator IC.
26. Repair & maintenance of inverters, choppers, converters and cycle converters used in concerned industry, Understand & dismantle, repair and maintenance of 1 ph and 3 ph off- line and on-line UPS with the concerned industry, Repair & maintenance of CVTS and SMPS in concerned industry.
27. Understand the motors used in concerned industry and its testing methods, Motor controllers (starters) used for various motors, its circuits, To understand AC & DC drives, uses, their applications, repair & maintenance, Different type of Braking.
28. Connection and applications of various protective devices used in power supply system, Maintenance and repairing practice of different power supplies.
29. Knowledge of Quality assurance required in Electrical works. Energy saving concept.

***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

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 calculation & science in the field of study including basic	2.1 Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure, heat treatment, centre of gravity, friction.

electrical and	
apply in day to day work.*[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Trigonometry, Heat & Temperature, Levers & Simple machine, graph, Statistics, Centre of gravity, Power transmission, Pressure]*	2.2 Measure dimensions as per drawing
	2.3 Use scale/ tapes to measure for fitting to specification.
	2.4 Comply given tolerance.
	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-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components & different thread forms, Assembly drawing, Sectional views, Estimation of material, Electrical & electronic symbol]*	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, dial gauge, bevel protector and height gauge (as per tool list).
	4.2 Ascertain the functionality & correctness of the instrument.
	4.3 Measure dimension of the components & record data to analyse the with given drawing/measurement.
5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.	5.1 Explain the concept of productivity and quality tools and apply during execution of job.
	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.
SPECIFIC OUTCOME	
Block-I & II (Section:10)	
*Assessment Criteria i.e. the standard of performance, for each specific learning outcome mentioned under **block – I & block – II**(section: 10) must ensure that 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 a 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 must also ascertain that the candidate is responsible for own work and learning and some responsibility for other's work and learning.*	

8. SYLLABUS

BASIC TRAINING (Block – I)

Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	Implementation of various safety measures in the shop floor. Visit to different sections of the Institute/ establishment. Demonstration of elementary first aid. Artificial Respiration. Practice on use of fire extinguishers. **Occupational Safety & Health.** **Importance of housekeeping & good shop floor practices.** Health, Safety and Environment guidelines, legislations & regulations as applicable. Disposal procedure of waste materials like cotton waste, metal chips/burrs etc. Basic safety introduction, Personal protective Equipment(PPE):- Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. Preventive measures for electrical accidents & steps to be taken in such accidents. Use of Fire extinguishers.	**Occupational Safety & Health** Basic safety introduction, Personal protection:- Basic injury prevention, Basic first aid, Hazard identification and avoidance, safety signs for Danger, Warning, caution & personal safety message. Use of Fire extinguishers. Visit & observation of sections. Various safety measures involved in the Industry. Elementary first Aid. Concept of Standard **Soft Skills**: its importance and Job area after completion of training. Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept & its application. Response to emergencies eg; power failure, fire, and system failure.
2	Familiarization with signs and symbols of Electrical accessories.	Fundamental of electricity: Fundamental terms- Current, Voltage definitions, AC, DC, Phase, Neutral, Earth. Units & effects of electric current.
3	Skinning the cables Demonstration & Practice on bare conductors joints--such as rat tail, Britannia, straight, Tee, Western union Joints Practice in soldering & brazing Practice on crimping thimbles, Lugs.	Solders, flux and soldering technique. Resistors types of resistors & properties of resistors. Introduction of National Electrical Code. Explanation, Definition and properties of conductors, insulators and semi-conductors.

	Demonstration and identification of types of cables. Demonstration & practice on using standard wire gauge & micrometer.	Types of wires & cables, standard wire gauge. Specification of wires & Cables-insulation & voltage grades- Low , medium & high voltage
4	Verification of Ohm's Law, Measuring unknown resistance Verification of laws of series and parallel circuits. Experiment on poly phase circuits. Current, voltage, power and power factor measurement in single & poly-phase circuits. Measurement of energy in single and poly-phase circuits. - Use of phase sequence meter. Practice on three phase four wire system for understanding phase and line voltage & current.	**Ohm's Law -** Simple electrical circuits and problems. Reading of simple Electrical Layout. **Resistors -**Law of Resistance. Series and parallel circuits & related calculation. **Alternating Current -**Comparison and Advantages D.C and A.C. Related terms Frequency, Instantaneous value, R.M.S. value Average value, Peak factor, form factor, sine wave, phase and phase difference. Inductive and Capacitive reactance, Impedance (Z), power factor (p.f). Active and Reactive power. Single Phase and three-phase system etc. Power consumption in series and parallel, P.F. etc. Concept three-phase Star and Delta connection. Line and phase voltage, current and power in a 3 phase circuits with balanced and unbalanced load. Three phase four wire system Use of power analyzer, measurement of THd, Harmonics due to digital switching.
5	Demonstration of trade hand tools. Use, care & maintenance of various hand tools. Practice on installation and overhauling common electrical accessories as per simple Electrical circuit / Layout. Make test board.	Identification of Trade-Hand tools-Specifications Common Electrical Accessories, their specifications in line with NEC 2011-Explanation of switches lamp holders, plugs and sockets. Developments of domestic circuits, Alarm & switches, with individual switches, Two way switch .Security surveillance, Fire alarm, MCB, ELCB, MCCB. Series –parallel testing board & use.

6	Identification of parts of battery. Practice on Battery Charging, Preparation of battery charging, Testing of cells, Installation of batteries, Charging of batteries by different methods. Routine care & maintenance of Batteries	**Chemical** effect of electric current-Principle of electrolysis. Faraday's Law of electrolysis Lead acid cell-description, methods of charging-Precautions to be taken & testing equipment, Different types of lead acid cells. Sealed Maintenance free Batteries, Solar battery. Load & back up time calculation
7	**Practice on Earthing**- different methods of earthing. Measurement of Earth resistance by earth tester. Testing of Earth Leakage by ELCB and relay.	**Earthing**- Principle of different methods of earthing & selection. i.e. Pipe, Plate, etc Importance of Earthing. Improving of earth resistance Earth Leakage circuit breaker (ELCB).
8	**Diodes**-symbol - Tests - Construct & Test Half wave rectifier ckt. Full wave rectifier ckt. Bridge rectifier ckt. Measurement & calculation of electrical parameters using C.R.O. Different wave shapes of rectifiers and their values using C.R.O. Identification of terminals, construction & Testing of transistor. Operation, maintenance & troubleshooting of inverter, Voltage stabilizer, DC regulated power supply, UPS, etc	**Basic electronics**- Semiconductor energy level, atomic structure 'P' type and 'N' type. Type of materials –P-N-junction. Classification of Diodes – Reverse and Forward Bias, Heat sink. Specification of Diode PIV rating. Explanation and importance of D.C. rectifier circuit. Half wave, Full wave and Bridge circuit. Filter circuits-passive filter. Working principle and uses of an oscilloscope. Types of transistors & its application. Specification and rating of transistors.
9	Practice in casing, Capping and Conduit wiring. Testing of wiring installation by meggar. -Fixing of calling bells/buzzers. Identification & demonstration on conduits and accessories & their uses, cutting , threading & laying Installation, Testing, Maintenance and Repairing of wiring. Application of fuses, relay, MCB, ELCB.	**Electric wirings**, I.E. rules. Types & selection of wirings both domestic and industrial. Specifications for wiring. Grading of cables and current ratings. Principle of laying out in domestic wiring. Estimate the cost of wiring system Voltage drop concept. **Wiring system -** P.V.C., concealed system. Specifications, standards for conduits and accessories - Power Wiring

		- Control Wiring - Information Communication - Entertainment Wiring. Testing of wiring installation by meggar Study of Fuses, Relays, Miniature circuit breakers (MCB), ELCB, etc.
10-11	Prepare simple electromagnet and find the polarity Identification of the parts of a D.C. machine. No load & Load performance of a different type of DC generator. Calculation of regulation & efficiency. Connect, start, run and reverse a different type of DC motor. Load performance test on different type of DC motor& calculation of efficiency. Speed of a DC motor by different method. Maintenance, troubleshooting & servicing of DC machines. Overhaul a DC machine.	**D.C. Machines –** **Magnetism**- classification of magnets, methods of magnetizing, magnetic material **Electromagnetism-** Solenoid, field around conductors carrying current, polarity, screw-rule, right- hand grip rule, advantages and application of electromagnet. General concept of Electrical Machines. **Principle of D.C. generator.** Use of Armature, Field Coil, Polarity, Yoke, Cooling Fan, Commutator, slip ring Brushes, Laminated core. Explanation of **D.C. Generators**-types, parts-Practical uses. Description of series, shunt and compound generators and their selection. Types of D. C. Motor. Starters used in D.C. motors Types of speed control of DC motors in industry. Application of D.C. motors. Care, Routine & preventive maintenance.
12	Identification of types of transformers. Connection of transformers, Transformation ratio, testing of transformer, calculate the losses & efficiency. Use of Current Transformer (C.T.) and Potential (Voltage) transformer (P.T.) Testing of single phase and Three Phase Transformers - Cleaning, maintenance, testing and changing of oil.	Working principle of **Transformer,** losses & efficiency. classification C.T., P.T. Instrument and Auto Transformer(Variac), Construction, Single phase and Poly phase. Type of Cooling for transformer. Protective devices. Components, Auxiliary parts i.e. breather, Conservator, buchholz relay, other protective devices. Transformer oil testing and Tap changer (off load and on load). Dry type transformer. Bushings and termination.

13	Identify & select different type of Instruments. Use of **-P**MMC , MI meter, Multi-meter(Digital/Analog) , Wattmeter, P F meter, Energy meter, Frequency meter, Phase sequence meter, Digital Instruments, etc Range extension of meters.	**Electrical Measuring Instruments -** -types, indicating types PMMC & MI meter (Ammeter, Voltmeter) -Range extension -Multimeter(Digital/Analog) -Wattmeter - P.F. meter - Energy meter (Digital/analog) –Insulation Tester (Megger), Earth tester. -Frequency meter -Phase Sequence meter -Multimeter –Analog and Digital -Tong tester -Techometer.
	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.*

BASIC TRAINING (Block – II)

Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1-2	Identification of parts and terminals of AC motors. Connection, starting, running of AC motors using Starters. Load test & efficiency calculation. Rotor resistance starter, etc Speed control of Induction motors by various methods. Practical application of A.C. motors. Connection of single phase motor, identification, testing, running and reversing. Maintain, service and trouble shoot the single phase motor. Install a single phase motor. Overhauling of AC motors.	**Three phase Induction motor** – Working principle –Production of rotating magnetic field, Squirrel Cage Induction motor, Slip-ring induction motor. Control & Power circuit of starters D.O.L Starter, Forward /Reverse starter, Star /Delta starter, Autotransformer starter, Rotor resistance starter, etc Single phasing preventer. Application of Induction Motor Care, Routine & preventive maintenance. **Single phase induction motor-** Working principle, different method of starting and running (capacitor start, permanent capacitor, capacitor start & run, shaded pole technique). FHP motors, Repulsion motor, stepper motor, Application of single phase motor.
3	Connect, start and run a 3 phase synchronous motor Practice for Power factor correction.	**SYNCHRONOUS MOTOR -** Working principle, effect of change of excitation and load. Power factor correction of industrial load
4-5	Identification of parts and terminals of Alternator. Connection, starting, running of Alternator. Practice on alternators, voltage Building,, Parallel operation & load sharing. Practice on installation, running and maintenance of Alternators.	**Alternator** Explanation of alternator, working principle, voltage build-up, loading, Regulation. Types of prime mover, phase sequence, Parallel operation & load sharing. Specification of alternators function & working supply distribution by change over switch, its control, Auto start circuit , maintenance
6-7	Prepare layout plan, single line diagram of different type of power plant.	**POWER GENERATION :** Generation sources of energy, Comparison of energy resources. Types of fuels. Advantages of liquid fuel & solid fuel. Various ways of electrical power generation. • Thermal • Hydro electric •

	Schematic of a overhead and domestic service line. Test the underground cables for open, short circuit & ground fault and also check insulation resistance. Prepare layout plan and single line diagram of transmission /Distribution system. Trouble shooting and servicing of LT circuit breaker. Connect feeder cable/ service line to the bus bar. Test /Check different type of protection relay.	Nuclear • Non-Conventional Overhead Lines: Main components of overhead lines- Types of power line Low voltage line medium Voltage line & high voltage line Voltage standard Conductor materials, line supports, Insulators, types of Insulators **Under Ground Cable :** Construction of cables. Types of cable faults and their location. **DISTRIBUTION OF POWER** Function and equipment used in substation. Classification of distribution system-AC distribution, Overhead v/s underground distribution system. Essential features of switchgears. Isolator, Switch gear equipments, bus-bar arrangement, Short circuit, faults in power system. **Circuit breakers** – Introduction & Classification of circuit breakers
8-9	Identification of terminals, Simple circuits containing UJT for triggering, FET as an amplifier, power control circuits by SCR, DIAC, TRIAC, IGBT. Assemble different types of rectifier with filter circuit & calculate its ripple factor. Assembles various voltage stabilizers using transformer. Assemble protection circuit used in power supply.	Study of active and passive components used in power supply. Power electronic devices: SCR, DIAC, TRIAC, Power MOSFET, IGBT AC to DC converter (Rectifiers & ripple filters) Constant current & voltage source. AC Voltage stabilizer Linear voltage regulator & its types (Transistorized & IC regulator) Reliability Test / Regulation test of DC power supplies. Stabilizer with using electronic circuit. Protection circuit used in power supply.
10-11	Assemble different type of inverters circuit & its measurements. Assemble battery charger circuit used in inverter with protection circuit. Assemble Online/Offline UPS & its measurements. Test & measurements of given SCR	DC to AC converter, Basic Principle & types of inverter, its different blocks & oscillators circuits. Function and working of choppers Types of chopper circuits. Battery chargers & its protection circuit. UPS working principles of-line & On line

	power supply circuit. Test & measurements of given SMPS. Test, faultfinding & repair of given power supply.	UPS circuit used in UPS. Various circuits used in servo controlled voltage stabilizers. SCR power supply circuit. SMPS circuit and its types. Fault finding & their remedies.
12	Logic gates & circuits. Testing input & output status.	Digital Electronics: Binary numbers, Logic gates & combinational circuits.
13	Speed control using DC & AC drives. Repair & maintenance of DC & AC drives.	Types of Electric drives-Individual, group and multi motor drives. Introduction to DC & AC drives, uses & their applications, AC & DC Drives- various types according to application, speed variation. Selection of motors for specific application-Braking- Features of good braking system- Types of Braking. Advantages of- Electric braking-Plugging, Dynamic and Regenerative braking-As applied to various motors
	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

Block – 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, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems 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 in electronics mechanics trades
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 :** - Lines, polygons, ellipse, etc. - geometrical figures and blocks with dimension . - Transferring measurement from the given object to the free hand sketches.

Block – 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**
3.		**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.
4.	**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.
5.	**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.
6.	**Simple exercises related to trade related Test Papers. Solution of NCVT test papers.**	

9.2 EMPLOYABILITY SKILLS

(DURATION: - 110 HRS.)

Block – 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. Case study/Exercise
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. Case study/Exercise
Facing Interviews	Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview
Behavioral Skills	Organizational Behavior Problem Solving Confidence Building Attitude Decision making Case study/Exercise
Block – II **Duration – 55 hrs.**	
4. Entrepreneurship Skills **Duration : 15 Hrs.**	**Marks : 06**
Concept of Entrepreneurship	Entrepreneurship- Entrepreneurship - Enterprises:-Conceptual issue Entrepreneurship vs. Management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.
Project Preparation & Marketing analysis	Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of Product Life Cycle (PLC), Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement,

	Marketing Mix.
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	Definition, Necessity, Meaning of GDP.
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, Vibro-acoustic 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. of safety, health, welfare under legislation 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 Housekeeping, Practice of good Housekeeping.
Quality Tools	Basic quality tools with a few examples

10. DETAILS OF COMPETENCIES (ON-JOBTRAINING)

BROAD LEARNING TO BE COVERED IN INDUSTRY FOR MECHANIC (ELECTRICAL POWER DRIVES) TRADE:

1. Safety and best practices /Basic Industrial Culture (5S, KAIZEN, etc.)
2. Record keeping and documentation
3. Preparation of control and power circuits of all electrical motors
4. Assembling of different types of motors including drives as per requirement and check functionality.
5. Carryout maintenance of different electrical motors including servo drives & pneumatics system.

Note: Actual training will depend on the existing facilities available in the establishments.

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

Block – I

1. Observe & practice safety pre-cautions to be followed in the section/plant including need of special protective equipment. Practice providing First Aid.
2. Identify & use all hand tools.
3. Check the gauges of wire & select suitable wires for the required current rating. Practice wire joints & providing cable glands. Soldering practice.
4. Carryout fitting & carpentry jobs
5. Connect & measure voltage, current, resistance power & energy in DC & AC(1ph & 3ph) circuits.
6. Electrical wiring: Repair / replace switches, sockets, light points. Provide new points in PVC casing capping & PVC conduits.
7. Charging & maintenance of different type of Batteries. Checking specific gravity, voltage, condition monitoring of Battery Bank, assessment of high spots, on line isolation precautions etc.
8. Install pipe & plate earth stations. Measure earth resistance, improve the same & maintain earth stations. Earth Monitoring systems with reference to various standards, familiarization with health monitoring equipment.
9. Providing power supply to motors, equipments& appliances. Crimping the lugs, providing cable glands & connections.
10. Attending to minor faults in machines, their controls & appliances.
11. Replacing the bulbs, tubes, trouble shooting, repair & maintenance. Wire up in PVC casing & capping.

12. Assisting in operation & maintenance of Transformer substation, circuit breakers, batteries etc
13. Trouble shooting rectifiers, filters, power supplies, voltage stabilizers, controlled rectifiers. Identifying faulty thyristors in circuits, replacing them.
14. Provide light/socket points, for various equipments and appliances.
15. Decides the size of cable & provides power supply to machines &equipments, provide earth connections.
16. Testing the condition of DC motor Checking power input & output in DC drives. Replacing faulty components.

Block – II

17. Observe & practice safety pre-cautions to be followed in the section/plant including need of special protective equipment. Practice providing First Aid.
18. Connection & testing of single & three phase motor, Checking power input & output in AC drives. Replacing faulty components, Power factor correction using Synchronous motor.
19. Checking Electrical connections, locating faults and removal of faults in Air Compressor, AC plants, cranes, lifts, hoists, Operates & maintain Air compressor, AC plant, cranes, lifts, hoists.
20. Diesel Generating set: Operation, operating switch gears, trouble shooting & maintenance
    protective system for Generator, Care and maintenance of Alternator.
21. Underground cable joining, testing of underground cables, trouble shooting, Locating faults, open circuit, short circuit & leakage in cables, performing cable joints.
22. Operation of Control Room, Operation of Switchgear, Communication with different field and control devices, Reading of panel meter & filling log sheet.
23. Working of LT and HT Switch- gears and protective relays, Maintenance of transformer equipment such as : Oil gauge, Tap Changer, Bushes, Breather, Earth fault relay, Protective relay, etc, Installation operation and maintenance of oil circuit breaker, Air circuit breaker, SF6 circuit breaker, Vaccum circuit breaker, etc.
24. Identification & Testing of different active and passive components, To understand AC/DC conversion, repair & maintenance of 1ph controlled rectifiers, Repairing & maintenance of 3 ph. Controlled rectifiers, Repair and maintenance of various batteries charger in concerned industry.
25. Care & maintenance of different type of voltage source using Op-Amp, Application of different type of regulator IC.
26. Repair & maintenance of inverters, choppers, converters and cycle converters used in concerned industry, Understand & dismantle, repair and maintenance of 1 ph and 3 ph

off- line and on-line UPS with the concerned industry, Repair & maintenance of CVTS and SMPS in concerned industry.

27. Understand the motors used in concerned industry and its testing methods, Motor controllers (starters) used for various motors, its circuits, To understand AC & DC drives, uses, their applications, repair & maintenance, Different type of Braking.
28. Connection and applications of various protective devices used in power supply system, Maintenance and repairing practice of different power supplies.
29. Knowledge of Quality assurance required in Electrical works. Energy saving concept.

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 POWER DRIVES)			
LIST OF TOOLS AND EQUIPMENT for Basic Training (For 20 Apprentices)			
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit Sl. 1-18 is required additionally)			
Sl. no.	**Name of the Tool &Equipments**	**Specification**	**Quantity**
1	Steel rule	150 mm	21 nos.
2	Pliers insulated	150 mm	21 nos.
3	Pliers side cutting	150 mm	21 nos.
4	Screw driver	100 mm	21 nos.
5	Screw driver	150 mm	21 nos.
6	Electrician connector, screw driver insulated handle thin stem	100 mm	21 nos.
7	Heavy duty screw driver	200 mm	21 nos.
8	Electrician screw driver thin stem insulated handle	250 mm	21 nos.
9	Punch centre	150 mm X 9 mm	21 nos.
10	Double bladed electrician knife		21 nos.
11	Neon Tester		21 nos.
12	Rule steel	300 mm	21 nos.
13	Saw tenon	250 mm	21 nos.
14	Hammer, cross peen with handle	115 grams	21 nos.
15	Hammer ball peen. With handle	0.75 kg	21 nos.
16	Firmer chisel wood	12 mm	21 nos.17
17	Gimlet	6 mm.	21 nos.18
18	Bradwal		21 nos.
19	Scriber	150 mm X Ø 4 mm (Knurled centre position)	21 nos.
20	Pincer	150 mm	21 nos.
B : INSTRUMENTS & GENERAL SHOP OUTFIT			
1	C- clamp	100mm, 150mm, 200mm	2 Nos. each

2	Adjustable spanner	150mm, 300mm	2 Nos. each
3	Blow lamp	0.5 ltr	1
4	Melting pot		1
5	Ladel		1
6	Chisel cold firmer	25mm x 200 mm	2
8	Chisel	25mm & 6 mm	2 Nos. each
9	Hand drill machine	0 to 6 mm capacity	2
10	Portable electric drill machine	12 mm capacity	1
11	Pillar Electric Drill machine	12 mm capacity	1
12	Allen key set		2 sets
13	Oil can	0.12 ltr	1
14	Grease gun		1
15	Out side Micrometer	0 to 25 mm	2
16	Motorised Bench grinder		1
17	Rawl plug tool & bit		2 sets
18	Pulley puller		2
19	Bearing puller		2
20	Pliers Gas	150 mm	2
21	Thermo meter	0-100 deg C	1
22	Scissors blade	150mm	2
23	Crimping tool		2 sets
24	Wire stripper	20 Cm	2
25	Chissel cold flat	12mm	2
26	Mallet hard wood	0.5Kg	2
27	Drill hand brace	0 to 100 mm	1
28	Drill S.S. Twist block	2 mm, 5 mm 6 mm	3 sets
29	Hacksaw frame	200mm & 300mm adjustable	2 each
30	Try square	150 mm blade	2
31	Outside & inside divider caliper	150 mm	2 each
32	Pliers flat nose	150mm	4
33	Pliers round nose	100 mm	4
34	Tweezers	100mm	4
35	Snip straight & bent	150mm	2 each
36	Double ended spanner set metric		2 sets
37	Vice Hand	150 mm jaw	2
38	Plane, smoothing cutters	50mm	2
39	Gauge, wire imperial		2

40	File,	flat 200mm 2nd cut	8
41	File half round	200 mm 2nd cut	4
42	File round	200mm 2nd cut	4
43	File flat	150mm rough	4
44	File flat	250mm bastard	4
45	File flat	250mm smooth	4
46	File	Rasp half round 200 mm bastard	4
47	Soldering iron	25 W, 65 W, 125 W	2 each
48	Copper bit soldering iron	0.25 kg	2
49	Desoldering gun		4
50	Hand vice	50mm jaw	4
51	Bench vice	100mm jaw	6
52	Pipe cutter to cut pipes	upto 5cm dia	2
53	Pipe cutter to cut pipes	above 5 cm dia	1
54	Stock & die set	for 20mm to 50 mm GI pipe	1
55	Stock & dies conduit		1
56	Multimeter (analog),	0-1000 M ohm, 2.5 to 500V	2
57	Digital Multimeter	(3 ½ digits)	2
58	Digital Multi meter	(4 ½ digits)	2
59	AC voltmeter	MI 0-500V	2
60	Milli Voltmeter centre zero	100-0-100 mV	1
61	DC milli Ammeter	0-500 mA	1
62	Ammeter	MC 0-5A, 0-15-25A	1 each
63	AC Ammeter	MI 0-5A, 0-15-25A	1 each
64	KiloWatt meter	0-1-3 KW	1
65	AC Energy meter,	single phase 5A, 3 ph 15 A	1 each
66	Power factor meter	single phase	1
67	Frequency meter		1
68	Wheat stone bridge complete with galvanometer and battery		1
69	DC power supply	0-100V, 5 Amp	2
70	Rheostats	0-1 ohm 5A, 0-10 ohm 5A, 0-25 ohm 1A, 0-300 ohm 1A	1 each
71	Digital Tachometer		1
72	Growler		1
73	Tong tester / clamp meter	0-100 Amp. AC	1
74	Meggar	500V	1

75	Oscilloscope dual trace	30 MHz	1
76	Function Generator		1
77	Hygrometer		1
78	Hydro meter		1
79	Current transformer	415 V, 50 Hz , CT Ratio 10/5A,	1
80	Potential Transformer,	415/110 V	1
81	Relays – Over current, under voltage, etc	. 3 volt, 100 amp.	1
82	Contactor	3phase,440volt,16amp.2 NO &2 NC auxiliary contacts	3
83	Contactor	3 phase, 440 volt, 32 amp.2NO&2NCauxiliary contacts	3
84	Limit Switch		2
85	Rotary Switch	16A	2
86	Laboratory type induction coil	6 volt to 800-10,000 volt	2
87	Cut out, reverse current, over load, under voltage relays		1
88	Knife switch DPDT fitted with fuse terminals	16 amp	1
	Knife switch TPDT fitted with fuse terminals	16 amp	1
	Numerical relays		1
	Portable temperature indicator	(0-200 Deg C)	1
	Motor Checker		1
	M.C.B	. 16 amp.	1
	LCR meter		2
C : GENERAL MACHINERY INSTALLATIONS			
1.	Voltage Stabilizer,	input 15-230 V AC, Output 220 V AC	1
2.	DC starter	3 point	1
3.	DC starter	4 point	1
4.	Electrical Machine Trainer: suitable for demonstrating the construction & functioning of different types of DC machines & AC machines	(single phase & 3 phase). Should be fitted with brake arrangement, Dynamometer, Instrument panel & power supply unit	1
5.	Motor generator (AC to DC):	consisting of : Squirrel cage	1 set

	foundation bolts & flexible coupling. Induction motor rating: 5 KW, 400V, 50 Hz, 3 ph. DC shunt generator rating: 3.5 KW, 220V	induction motor with star delta starter & directly coupled to DC shunt generator & switch board mounted with regulator, air breaker, ammeter, voltmeter, knife blade switches & fuses, set complete with case iron & plate, fixing bolts,	
6.	Used DC generators –	series, shunt & compound type, (for overhauling practice)	1 each
7.	DC shunt motor	2 – 2.5 KW, 220V with control panel	1
8.	DC series motor coupled with mechanical load,	2 KW, 220V	1
	DC compound motor with starter & switch,	2.5 KW, 220V,	1
9.	Single phase Transformer, core type, air cooled,	1 KVA, 240/115-50-24-12 V, 50Hz	3
10.	3 phase transformer, shell type, oil cooled with all mounting,	3 KVA, 415/240V, 50 Hz (Delta /Star)	2
11.	D.C. compound generatorwith control panel including filed rheostat, voltmeter, ammeter and circuit breaker	,2.5 K.W. 250 V	1
12.	Motor generator (DC to AC) set consisting of Shunt motor with starting compensator & switch directly coupled to AC generator with exciter & switch board mounted with regulator, breaker, ammeter, voltmeter, frequency meter, knife blade switch & fuses etc. Set complete with cast iron bed plate, fixing bolts, foundation bolts & flexible coupling. Shunt motor	Rating- 5KW, 220V. AC generator rating – 3 ph, 4 wire, 3.5 KVA, 400/230 V, 0.8 pf, 50 Hz	1 set
13.	AC squirrel cage induction motor with star delta starter & triple pole Iron clad switch fuse.	2 to 3 HP, 3 ph, 400V, 50 Hz	1

Mechanic (Electrical power drives)

14.	AC 3 ph wound slip ring motor with starter & switch,	5 HP, 400V, 50 Hz	1
15.	Motor A.C. series with mechanical load	type 230V, 50 cycles, ¼ HP	1
16.	Single phase capacitor motor with starter switch	1 HP, 230 V, 50 Hz	1
17.	Universal motor with starter / switch	230 V, ¼ HP, 50 Hz	1
18.	Stepper Motor with digital controller.		1
19.	Starters for 3-phase,. A.C. motors a) Direct on line starter b) Star delta starter with manual, semi-auto and automatic c) Auto transformer type starter	400 V, 50 cycles, 2 to 5 H.P	1 each
20.	Ceiling fan	230 volt 1200 mm	1
21.	Inverter	1 KVA with 12 V battery, input 12 V DC, Output 220V AC	1
22.	Thyristor /IGBT controlled DC motor Drive, with tachogenerator feedback arrangement,	1 HP	1 set
23.	Thyristor / IGBT controlled AC motor Drive with VVVF control, ,	3 ph, 2 HP	1 set
24.	Battery charger		1
25.	variable Auto Transformer	1 Ph	1
26.	Load bank,	5 KW. lamp / heater type	1
27.	Brake test arrangement with 2 spring balance,	0 to 25 Kg rating	1
28.	Discreet component trainer		2
29.	Oil testing kit		1
30.	Diesel generator set, , AC 3 phase with change over switch, over current circuit breaker and water-cooled with armature, star-delta connections.	5 KVA, 44 volt	1
31.	UPS	Online	2
32.	UPS	Offline	2
33.	CVT		2
34.	SMPS		2

35.	Transistor Tester		2
36.	IC Tester		2
37.	Microprocessor Kit		1
38.	IC Trainer	Digital	1
39.	Function Generator		1
40.	Voltage Stabilizer, input	15-230 V AC, Output 220 V AC	1

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: **MECHANIC (Electrical power drives)**

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		20
2.	Set square celluloid 45^o	(250 X 1.5 mm)	20
3.	Set square celluloid 30^o-60^o	(250 X 1.5 mm)	20
4.	Mini drafter		20
5.	Drawing board IS: 1444	(700mm x500 mm)	20
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.)		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 INTERNAL 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 :	**Semester:**		**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 internal assessment Marks**	**Result (Y/N)**
Maximum Marks (Total 100 Marks)			**15**	**5**	**10**	**5**	**10**	**10**	**5**	**10**	**15**	**15**		
1														
2														