

# INSTRUMENT MECHANIC (STEEL PLANT)

COMPETENCY BASED CURRICULUM

(Duration: 2 Yrs.)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 5



**SECTOR – PRODUCTION & MANUFACTURING**



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

# **INSTRUMENT MECHANIC (STEEL PLANT)**

(Revised in 2018)

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**NSQF LEVEL - 5**

**Skill India**  
कौशल भारत - कुशल भारत

Developed By

Ministry of Skill Development and Entrepreneurship  
Directorate General of Training  
**CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE**  
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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 to the following industries/organizations who have contributed valuable inputs in revising the curricula through their expert members:

TATA STEEL, Jamshedpur

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

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## ***Instrument Mechanic (Steel Plant)***

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**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 22<sup>nd</sup> 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.



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### **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.

Instrument Mechanic (Steel Plant) trade under ATS is one of the 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.

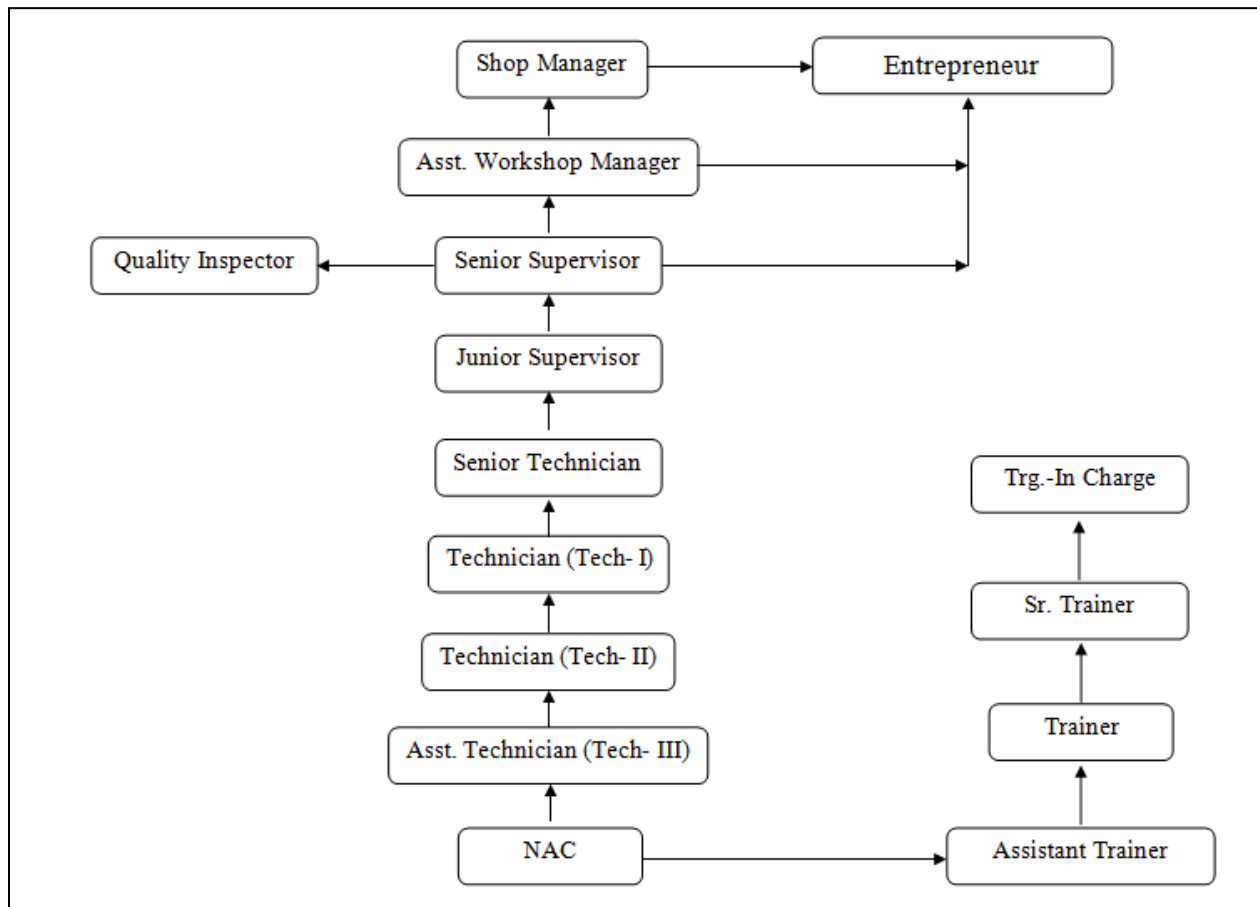
**Broadly candidates need to demonstrate that they are able to:**

- 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/assembly as per drawing for functioning, identify and rectify errors in job/assembly.
- Document the technical parameters related to the task undertaken.

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### 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

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### A. Basic Training

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

For 01 yr. course (Engg.) :-(**Total 03 months:** 03 months in 1<sup>st</sup> 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
	<b>Total (Including internal assessment)</b>	<b>1000</b>	<b>500</b>

### B. On-Job Training:-

For 02 yrs. Course (Engg.) :-( **Total 18 months:** 09 months in 1<sup>st</sup> yr. + 09 months in 2<sup>nd</sup> 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
<b>For 02 yrs. course</b> (Engg.)	1000 hrs.	3120 hrs.	4120 hrs.
<b>For 01 yr. course</b> (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.

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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:

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Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
<p>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.</p>	<ul style="list-style-type: none"> <li>• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment</li> <li>• Below 70% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards.</li> <li>• A fairly good level of neatness and consistency in the finish</li> <li>• Occasional support in completing the project/job.</li> </ul>
(b) Weightage in the range of above75% - 90% to be allotted during assessment	
<p>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.</p>	<ul style="list-style-type: none"> <li>• Good skill levels in the use of hand tools, machine tools and workshop equipment</li> <li>• 70-80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards.</li> <li>• A good level of neatness and consistency in the finish</li> <li>• Little support in completing the project/job</li> </ul>
(c) Weightage in the range of above 90% to be allotted during assessment	
<p>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.</p>	<ul style="list-style-type: none"> <li>• High skill levels in the use of hand tools, machine tools and workshop equipment</li> <li>• Above 80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards.</li> <li>• A high level of neatness and consistency in the finish.</li> <li>• Minimal or no support in completing the project.</li> </ul>

**Brief description of Job roles:**

**Technician Instrumentation** Technician Instrumentation dismantles removes and replaces a range of instruments and faulty peripheral components down to unit and component level, setting up test equipment, troubleshooting components of instruments, calibrating them and also preparing service reports and accurately documenting parts replacement and repair.

**Functional Tester** is responsible for checking functions of manufactured industrial equipment such as UPS, inverter, energy meter, PLC, oscilloscope, control panel. The individual at work tests specified functions of every product being assembled on the production line.

**Calibrator (Instrument and Apparatus)** tests and calibrates controlling, indicating, and measuring instruments and devices, such as monochromators, pressure regulators, tachometers, temperature controls, and thermometers, to ensure specified operating performance, using hand tools, testing and calibrating instruments and equipment, and precision measuring instruments: Reads quality control manual and testing specifications to obtain data to test or calibrate specific devices. Selects and installs accessories, such as adapters, indicating gauges, or holding devices on test or calibration fixture, and connects instrument or device to fixture, according to specifications, using hand tools. Sets controls to regulate factors, such as current flow, timing cycle, pressure, temperature, or vacuum, according to specifications, and activates test or calibration equipment. Observes readings on meters and gauges, and other displays and performance of the device or instrument to identify functional defects and determine calibration requirements. Adjusts calibration mechanisms to obtain specified operational performance of the device or instrument, using hand tools and precision measuring and calibrating instruments and equipment. Applies sealing compound on calibration mechanism to prevent readjustment of settings and loss of calibration. Rejects malfunctioning devices and routes devices to specified department for rework or salvaging of parts. May disassemble instrument or device to determine cause of defective operation and notify supervisory personnel of findings.

**Calibration Technician** sets, adjusts, validates or verifies mechanical, pneumatic, hydraulic, electrical, electronic, measuring and control instruments using reference standards in accordance with predetermined standard procedures.

**Automation Specialist** Individuals at this job are responsible for providing support to production operations through maintenance of process control systems installed at shop floor for various manufacturing processes

**Reference NCO:**

1. 7311.0101- Technician Instrumentation
2. 7543.0801 - Functional Tester
3. 7311.1000 - Calibrator (Instrument and Apparatus)
4. 7311.1001 - Calibration Technician
5. 7412.0101 - Automation Specialist

## **4. NSQF LEVEL COMPLIANCE**

NSQF level for Instrument Mechanic (Steel Plant) 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 Instrument Mechanic (Steel Plant) trade under ATS mostly matches with the Level descriptor at Level- 5.

The NSQF level-5 descriptor is given below:

<b>Level</b>	<b>Process Required</b>	<b>Professional Knowledge</b>	<b>Professional Skill</b>	<b>Core Skill</b>	<b>Responsibility</b>
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**

<b>Name of the Trade</b>	INSTRUMENT MECHANIC (STEEL PLANT)
<b>NCO-2015</b>	7311.0101, 7543.0801, 7311.1000, 7311.1001, 7412.0101
<b>NSQF Level</b>	Level – 5
<b>Duration of Apprenticeship Training</b> (Basic Training + On-Job Training)	Two years (02 Blocks each of one year duration).
<b>Duration of Basic Training</b>	a) Block –I : 3 months b) Block – II : 3 months <b>Total duration of Basic Training: 6 months</b>
<b>Duration of On-Job Training</b>	a) Block–I: 9 months b) Block–II : 9 months <b>Total duration of Practical Training: 18 months</b>
<b>Entry Qualification</b>	Passed 10 <sup>th</sup> Class with Science and Mathematics under 10+2 system of Education or its equivalent
<b>Selection of Apprentices</b>	The apprentices will be selected as per Apprenticeship Act amended time to time.
<b>Instructors Qualification for Basic Training</b>	As per ITI instructors qualifications as amended time to time for the specific trade.
<b>Infrastructure for Basic Training</b>	As per related trade of ITI
<b>Examination</b>	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.
<b>Rebate to Ex-ITI Trainees</b>	01 year
<b>CTS trades eligible for Instrument Mechanic (Steel Plant) Apprenticeship</b>	Instrument Mechanic

**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.

**6.1 GENERIC LEARNING OUTCOME**

The following are minimum broad Common Occupational Skills/ Generic Learning Outcome after completion of the Instrument Mechanic (Steel Plant) 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, Fractions & Simplification, Mass ,Weight and Density, Material Science, Ratio &Proportion, Percentage, Pressure]*
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Layout, Symbol, scales, Different Projections, Machined components & different thread forms, Estimation of material, Electrical & electronic symbol P&I drawing symbols]*
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. Identify and test the different types of cables, wires. Skin and crimp the cable and conductors using proper tools in electronic and instrumentation industry. Make different joints of wires.
2. Identify, test of various types of DC machines .Dismantle and assemble of a DC machine. Identify terminals, connections, run and reverse the direction of rotation of DC motors.
3. Identify, connect and test of various types of transformers (single phase, 3 phase, CT, PT etc) and its parts. Measure various parameters (voltage, current, losses, regulation, efficiency etc) of transformer.
4. Identify and test of various induction motors (single and 3 phase) ,connection in star delta, overhauling of fan motors, connect, run and reverse of single-phase motors.
5. Perform panel wiring by using contactors relays etc. for automatic star-delta, autotransformer, rotor-resistance and forward-reverse D.O.L. starters.
6. Test and run small programs on Microprocessor/Microcontroller.
7. Identify, test , and measure using different sensor and transducers like LVDT, strain gauge, Capacitive gauges, Thermocouples, RTDs, Thermistors etc.
8. Dismantle, assemble and calibration of transmitters, indicators, gauges, regulators and switches used for pressure, temperature, flow , level and other measurement. Operate and test the different types of pressure calibrators (dead weight and comparator), temperature calibrator.
9. Install and Configure of smart transmitters using HART and other configurations.
10. Calibration and testing of control valve, I/P converter and valve positioners.
11. Connect , Operate, tune and configure PID controller in different modes.
12. Determination of process characteristics of a process on simulator/ instrumentation tutors.
13. Identify different modules, parts and connections of PLC and DCS. Development and test of simple programmes involving bit level instructions, timers and counters, simple data manipulation instructions.
14. Parameterization of AC drives.

#### **Block – II**

1. Identify various components and connection on single line diagram of interconnected industrial power supply system.
2. Parameterization of digital relay and numerical relay.

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3. Install operate and test of process components such as filter, pumps, float switch, valves, actuators etc.
4. Operation of proportional and servo valves, functions of control and feedback components.
5. Connect and test simple pneumatic and hydraulic circuit.
6. Assemble, test and calibration checking of pneumatic PT/DT, indicator, recorder, controller and control valves.
7. Test and operation of chemical instruments like gas analyzers, liquid analyzers-pH and conductivity meters etc.
8. Setting communication link, debugging, forcing, maintenance and troubleshoot of PLC and DCS systems.
9. Calibration of various types of process instruments and preparation of calibration report using various methods and different types of electronic, pneumatic and hydraulic calibrators.
10. Impulse line laying and connection with transmitters and control valves. Instrument interconnection using cable, JBs and terminals. Practice on different types of terminations.
11. Calibration of ammeter, voltmeter, wattmeter and energy meters. Preparation and correction curves calibration records.
12. Polarity marking of CT. Measurement of voltage current, power and energy using CT and PT
13. Practice different type of knots & hitches used in material handling such as Reaving sets of pulley block, Splicing of manila rope, Inspection of wire rope, Use of mechanical & hydraulic systems (jack, rope puller, chain puller, chain block, winch ), Inspection of tools and tackles, Loading, unloading and shifting of common and uncommon shapes of material. Hand signal used in rigging.
14. Demonstrate on Emission and pollution control equipment, dust handling & disposal system, effluent treatment plants, emission monitoring equipment.

**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	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,

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field of study including basic electrical and	heat treatment, centre of gravity, friction.
apply in day to day work. <i>[Different mathematical calculation &amp; science -Work, Power &amp; Energy, Algebra, Geometry &amp; Mensuration, Trigonometry, Heat &amp; Temperature, Fractions &amp; Simplification, Mass, Weight and Density, Material Science, Ratio &amp; Proportion, Percentage, Pressure]</i>	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. <i>[[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, Different Projections, Machined components &amp; different thread forms, Assembly drawing, Estimation of material, Electrical &amp; electronic symbol P&amp;I drawing symbols]</i>	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	5.1 Explain the concept of productivity and quality tools and apply during execution of job.
	5.2 Know the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive

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work to improve productivity & quality.	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.
<b>SPECIFIC OUTCOME</b>	
<b><u>Block- I &amp; II (Section:10)</u></b>	
<p><i>Assessment Criteria i.e. the standard of performance, for each specific learning outcome mentioned under <b>block – I &amp; II</b> (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 <b>Planning</b> (Identify, ascertain, estimate etc.); <b>Execution</b> (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 <b>Checking/ Testing</b> 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.</i></p>	

**BASIC TRAINING (Block – I)****Duration: (03) Three Months**

Week No.	Professional Skills	Professional Knowledge
1.	<p>Plant visit to observe steel making process and machineries used in steel plant.</p> <p>Use of Personal Protective Equipment.</p> <p>Rules &amp; regulation of the institute.</p>	<p>Familiarization with the Institute &amp; steel industry.</p> <p>Machinery used in the trade and type of work done by the trainees in the trade.</p> <p>Importance of safety, general safety precautions observed in the Institute and in the section.</p> <p>Importance of the trade &amp; trade training, Related instructions &amp; subjects to be taught.</p> <p>Salient features of Apprentices' Act.</p> <p>Introduction to general, behavioral and road safety.</p> <p>Overview of steel manufacturing process.</p>
2.	<p>Usage of First aid box and practice of Cardiopulmonary Resuscitation (CPR).</p> <p>Usage of</p> <ul style="list-style-type: none"> <li>- Fire extinguishers</li> <li>- Safety appliances- personal protective equipment (PPEs), gas detector, gas mask, oxygen pack etc. (specific to steel industries)</li> </ul>	<p>Introduction of first aid.</p> <p>Causes and type of fires, fire precautions, precautions against outbreak of fire, different type of fire extinguishers and their uses.</p> <p>Precautions while working at height.</p> <p>Gas safety.</p> <p>Electrical safety</p> <p>Quality- brief introduction of improvement techniques followed in the organization- Small group activities (SGA), Quality Circle (QC) and its tools.</p>
3.	<p><b>Hacksawing</b> - Marking lines, cut metals pieces of different profiles and sections by hack-sawing (straight, inclined &amp; curved line) to an accuracy of 0.5 mm.</p> <p><b>Filing</b> - Parallel filing practice on flat surface, Marking practice of straight, and parallel and curved lines with odd leg calipers, steel rule, dividers, Scriber. Filing flat, square, steps and contour surfaces to an accuracy of 0.2 mm.</p> <p><b>Drilling &amp; Reaming</b> - Use of drilling</p>	<p>Classification, constructional and functional details of different type of bench and machine vices. Care of vices.</p> <p>Classification, construction and functional detail of hammers.</p> <p>Classification, construction and functional detail of following cutting tools: Chisels, Hacksaw, Files, Drills, Reamers, Scrapers, Taps &amp; Dies.</p> <p>Classification, construction and functional detail of following bench tools: Steel rule, Try square, Calipers, Divider, Centre punch, Surface plate, V-Block and Trammel.</p>

## Instrument Mechanic (Steel Plant)

	<p>machine for drilling through &amp; blind holes, Reaming of drilled hole by hand reamer.</p>	<p>Marking media, marking blue, Prussian blue, red lead, chalk and their special application, description.</p> <p>Measuring Instruments: Micrometer (outside and inside) – working principle, use and care, Calculation of least count. Vernier calipers, principle, graduations, reading, use and care.</p> <p>Elements of mechanical components: bearing, coupling and keys.</p> <p>Basic knowledge of gear and gear boxes.</p> <p>Leveling and alignment of electrical machine.</p> <p>Lubrication related to electrical machines.</p>
4.	<p>Demonstration and use of electrical measuring instruments with safety aspects.</p> <p>Verification of Ohm's law.</p> <p>Verification of law of series and parallel circuits.</p> <p>Verification of Kirchhoff's law.</p> <p>Measure resistance by using voltmeter and ammeter, post-office box, AVO meter, Standard resistance comparison, bridge, megger and potentiometer.</p> <p>Demonstration and identification of different types of cables, wires.</p> <p>Examination and checking of cables and conductors.</p> <p>Practice on using tools like cutting pliers, screw drivers, skinning the cable, joint practice on single strand.</p> <p>Demonstration and practice on bare conductor joints.</p>	<p><b>Fundamentals of electricity</b>, electron theory, concept of free electrons and difference between conductor, insulator and semi-conductor.</p> <p>Definition and units of voltage, current, resistance, power and energy.</p> <p><b>Ohm's law</b>, simple electrical circuits and problems. Resistance- series and parallel, laws of resistance, temperature co-efficient of resistance, work, power and energy.</p> <p>Kirchhoff's current &amp; voltage laws and application, Wheatstone bridge and its application, Simple problems.</p> <p>Use of common electrical measuring instruments and related safety aspects.</p> <p>Types of <b>wire and cables</b>, their specification, insulation and voltage grade, Standard wire gauge, Common electrical accessories, their functions and specifications viz. switches, plugs, lamp holders, sockets. Development of electrical circuits used in workshop.</p> <p>Related Safety aspects.</p>
5.	<p>Perform experiments to draw B-H curve.</p> <p>Prepare simple electromagnet and find the polarity.</p> <p>Experimenting Faraday's laws, Lenz's law, Fleming's rules, self and mutual inductance</p> <p>Determining hysteresis loss and eddy current loss.</p>	<p><b>Magnetism</b>- classification of magnets, methods of magnetizing, magnetic material, Coulomb's law, permeability, Ferro, Para and diamagnetic materials.</p> <p><b>Electromagnetism</b>- Solenoid, field around conductors carrying current, polarity, screw-rule, right-hand grip rule, advantages and application of electromagnet.</p> <p><b>Magnetic series and parallel circuits</b>, B-H curves, hysteresis loop, hysteresis loss, eddy</p>

## Instrument Mechanic (Steel Plant)

		<p>current, eddy current loss, equations and problems.</p> <p><b>Principles of electromagnetic induction</b>, Faraday's laws, Lenz's law, Fleming's Rules, Related safety aspects.</p>
6.	<p>Connect the capacitors in series and parallel and measure different values.</p> <p>Observation of charging and discharging of capacitors, its testing.</p> <p>Grouping of dry cells for a specific voltage and current.</p> <p>Battery charging- Prepare electrolyte for lead- acid storage battery; charge the battery using different methods, Check for battery condition.</p> <p>Routine care and maintenance of batteries.</p>	<p>Self-inductance, mutual-inductance, their co-efficient, equations and problems .</p> <p><b>Joule's law of heating</b>, Joule's equivalent, heating appliances and elements.</p> <p><b>Electrostatics</b>- terms and definitions, Coulomb's law, capacitors, charging and discharging of capacitors, energy stored.</p> <p><b>Chemical effect of electricity</b> – principle of electrolysis, Faraday's laws. Applications of electrolysis, Basic principles of electroplating.</p> <p>Principle and construction of simple voltaic cell.</p> <p><b>Secondary cells</b> principle, types, lead-acid cells.</p>
7.	<p>Application of CRO/DSO</p> <p>Observation of different types of AC waves and measurement of their different parameters by oscilloscope.</p>	<p><b>Alternating Current</b>- comparison between DC and AC, its related terms, waveform, frequency and phase, instantaneous, RMS, average values.</p> <p>Resistance, inductance and capacitance in AC circuits, reactance and impedance, power factor, vector diagram, active and reactive power. Simple problems.</p> <p>Related safety aspects.</p>
8.	<p><b>AC series and parallel circuits</b></p> <p>Determining L for a coil and choke and C for a capacitor.</p> <p>Observation of 3-phase voltages and measurement of voltage, connections in star &amp; delta.</p> <p>Demonstration of three-phase load and measurement of voltage, current power &amp; power factor in 3-phase circuit.</p>	<p><b>AC series and parallel circuits</b> – RL, RC and RLC. Power factor and resonance.</p> <p><b>Poly phase systems</b>, its advantages over single-phase system.</p> <p><b>Power and power factor in 3-phase circuits</b>, active and reactive power, methods of improvement of power factor. Balanced and unbalanced loads.</p>
9-10	<p>Verification of working principle and characteristic of different sensors and transducers covered in theory class viz.</p> <p>LVDT, Strain gauge, Capacitive</p>	<p><b>Process measurement</b></p> <p>Objectives of the instrumentation, system of units and standards of measurement.</p> <p><b>Instrument terminology</b> – accuracy, precision, resolution, sensitivity, span, range, error,</p>

## Instrument Mechanic (Steel Plant)

<p>gauges, Thermocouples, RTDs, Thermistors etc.</p> <p>Familiarization with working of dead weight tester, pneumatic calibrator, temperature calibrator and other calibrators.</p> <p>Dismantling, assembly, overhauling and calibration of transmitters, indicators, gauges, regulators and switches used for pressure, temperature, flow, level and other measurement.</p> <p>Configuration of smart transmitters using HART and other configurators.</p>	<p>uncertainty, dead band, dead zone, classification of error.</p> <p><b>Elements of measurement systems</b> and their functions. Sensors and transducers- classification and characteristics.</p> <p><b>Common sensors and transducers-</b> Working principle, characteristic and application of resistive, inductive, capacitive, thermal, optical and other sensors and transducers viz. strain gauge, LVDT, Piezo-electrical, capacitive and Hall effect.</p> <p>Test and calibration of these sensors.</p> <p><b>Encoders-</b> types, working and applications.</p> <p><b>Pressure and differential pressure measurement-</b> Definition, types and units, requirements of measurement. Manometers: principles, types and working. Working principle and constructional details of elastic and electrical pressure and DP sensors, Pressure gauges: constructional details, calibration and maintenance. Pressure switches: constructional details and maintenance. Dead weight testers and other pressure calibrators. Pressure/DP transmitters: types, working, calibration and maintenance. Smart P/DP transmitters : working principles, configuration and maintenance. HART and other protocols. Pressure recorders.</p> <p><b>Temperature measurement</b> - Definition, types, units and requirements of measurement. Principles, types and working of mechanical, electrical, radiation and other temperature sensors, its constructional details, calibration and maintenance, relative advantages and limitations. Temperature switches: constructional details and maintenance. Temperature calibrators. Temperature transmitters: types, working, calibration and maintenance. Smart temperature transmitters: working principles, configuration and maintenance.</p> <p><b>Flow measurement</b> - definition, types, units and requirements of measurement.</p>
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## Instrument Mechanic (Steel Plant)

		<p>Classification of methods.</p> <p>Restriction method: principles, mathematical derivation of relationship between flow and differential pressure.</p> <p>Constructional details, types and installation of orifice plate, venturi tube, flow nozzle, anubar and others.</p> <p>Variable area method: principles, types, constructional details, calibration and maintenance.</p>
11-12	<p>Operate a controller in different modes, setting of its PID values (controller tuning).</p> <p>Configuration of different blocks of a PID digital controllers.</p> <p>Connecting I/Os with a digital controllers (on- off &amp; PID) and making it operation.</p> <p>Calibration and testing of a control valve, I/P converter and valve positioners.</p> <p>Determination of process characteristics of a process on simulator / instrumentation tutors.</p>	<p><b>Process Control</b></p> <p>Introduction to process control, elements of a process control system, block diagram. Variables involved viz. process variables, manipulated variable and disturbances. Basic types of control- manual and automatic, close loop and open loop, feedback and feed-forward.</p> <p><b>Controller-</b> basic building blocks of analog and digital controllers, P, D &amp; I control modes and their characteristics. Tuning of a controller</p> <p><b>Final control elements:</b> I/P converters: types, working principle, construction, calibration and maintenance.</p> <p>Control valves &amp; actuators: types, working principle, construction, characteristic, calibration and maintenance.</p> <p>Valve positioner: types, working principle, construction, calibration and maintenance.</p> <p><b>Process Characteristic</b></p> <p>Advanced control strategies: Cascade and ratio control system,</p> <p><b>Reading and interpretation of P&amp;I diagrams-</b> flow sheet symbols, reading and interpretation of P&amp;I diagrams.</p>
13.	<b>Revision &amp; Internal Assessment</b>	

**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	Professional Knowledge
1-2	<p>Testing DC motors, identifying terminals, connecting, running and reversing direction of rotation of DC motors.</p> <p>Studying characteristics and drawing characteristic curves of DC motors of all types.</p> <p>Identification of types of transformers and its parts.</p> <p>Verification of transformation ratio, loading secondary, finding relation between primary and secondary currents, voltages and no. of turns</p> <p>Measurement of iron and copper losses, determination of regulation, efficiency etc., polarity marking of single-phase and three-phase transformers.</p> <p>Testing of single and three phase transformers, cleaning and maintenance, oil testing.</p> <p>Study of Instrument transformers - CT, PT and Tong-tester.</p>	<p><b>DC motor-</b> working principle, torque, speed, back emf, their relations. Types of DC motors-series, shunt, compound and separately excited their characteristics.</p> <p><b>Transformers-</b> working principle, transformation ratio, no-load and on-load phasors, classification, types of core, EMF equation, equivalent resistance, reactance and impedance; equivalent circuits.</p> <p>Open and short-circuit tests, regulation, losses and efficiency of transformers.</p> <p>Auto-transformers, Instrument transformers - CT, PT, Tong-tester and their applications.</p> <p>Related safety aspects.</p>
3	<p>Dismantling, inspection of parts, cleaning and testing of windings, lubricating bearings and assembling of 3-phase SC and SR motors</p> <p>Polarity marking (phase-sequence test) of a 3-phase induction motor and connection in star and delta.</p> <p>Testing induction motor by megger, and Motor Checker.</p> <p>Starting the motor using different</p>	<p><b>Induction motors-</b> Rotating magnetic field, and working of 3-phase induction motors, production of torque.</p> <p>Construction of SC and SR motors, slip, rotor emf, current, frequency, pf, Cu loss, Slip torque characteristics.</p> <p>Starters of induction motors and its necessity, types-DOL, soft-starters and rotor resistance starters of wound-rotor induction motors</p> <p>Single-phase induction motors - theory of</p>

## Instrument Mechanic (Steel Plant)

	<p>starters, running and reversing the motor, measuring the starting and no-load currents, measuring speeds at different loads, calculating speed etc.</p> <p>Dismantling, studying and re-assembling the electromagnetic AC contactors of different voltages, types, makes and categories.</p> <p>Settings of different types of motor protection relays.</p> <p>Doing panel wiring by using contactors relays etc. for automatic star-delta, autotransformer, rotor-resistance, and forward-reverse D.O.L. starters.</p> <p>Studying, overhauling of fan motors, connecting, running and reversing of single-phase motors.</p> <p>Identification of terminals of alternator, connecting, starting, running, loading and plotting characteristic curves.</p> <p>Starting synchronous motors by different methods.</p>	<p>rotation and self-starting, types, reversal and speed control.</p> <p>Related safety aspects.</p> <p><b>Synchronous machines Alternator-</b> parts, types of poles- salient pole and smooth-cylindrical type, rotating-field and rotating armature type etc.</p> <p>Synchronous motors: operation, types, characteristics, application.</p> <p>Related safety aspects.</p>
4	<p>Electronic Component identification and testing.</p> <p>Reading and interpretation of colour codes of components.</p> <p>Use of digital multimeters.</p> <p>Connecting function generator with oscilloscope, study of wave forms, measurement of voltage and frequency.</p> <p>Diode characteristic, Zener diode characteristics, testing, and identification,</p> <p><b>Making half wave and full wave</b></p>	<p><b>Basic Analog Electronics</b> – Introduction to Electronics and its application, difference between analog and digital electronics.</p> <p>Atomic theory, energy band diagram, classification of matter based on energy band diagram.</p> <p><b>Active and passive circuit elements:</b></p> <p><b>Resistors and their rating</b> - fixed and variable, carbon and wire wound, metal film and metal oxide, colour coding, power rating, accuracy and effect of temperature, uses of resistors.</p> <p><b>Fuses and their rating-</b> Slow blow and fast blow, semiconductor fuse.</p>

## Instrument Mechanic (Steel Plant)

	<p><b>rectifiers</b> using training kits, study of different wave shapes and their values on oscilloscope</p> <p>Soldering and desoldering practice.</p>	<p><b>Inductors and their rating</b> - types: ferrite core, air core, tapped and variable inductors. Factors affecting inductance and use of inductors.</p> <p><b>Capacitors and their rating:</b> Mica, ceramic, paper, electrolytic, tantalum, silvered mica, variable capacitors, colour coding and uses.</p> <p><b>Voltage and current sources-</b> Ideal and practical, AC and DC signal and its source.</p> <p><b>Semiconductor theory:</b> intrinsic and extrinsic, P and N type, development of P-N junction, drift and diffusion currents, barrier potential, biasing arrangement. Effect of temperature.</p> <p><b>Diodes:</b> working, classification, characteristics, coding, specification, identification and testing. Half wave and full wave rectifiers, PIV.</p> <p><b>Zener diodes:</b> characteristics, types and application., Voltage regulator using zener</p> <p><b>LED, varactor and photo diodes-</b> working principle and applications.</p>
5	<p><b>Transistors: identification and testing</b> finding of transistors in different modes using training kits, calculation of gains. Biasing circuits.</p>	<p><b>Transistors:</b> working, classification, VI characteristics (static and dynamic), CE, CB, CC configuration and their difference, current, voltage gains and their relationship. Biasing and heat sink. Packaging, coding, specification, identification and applications in detail.</p>
6	<p><b>Assembly and testing of amplifier circuits on PCB:</b> Single stage CE,CB,CC amplifiers, RC, Transformer and direct couple amplifiers. Study of input and output wave forms on oscilloscope. Calculation of gain and bandwidth. Drawing the frequency response curve.</p> <p>Assembly of oscillator circuits using transistor and measuring the output frequency and waveform.</p>	<p><b>Amplifiers:</b> working principle, classification and circuits. Small signal single stage AF/RF amplifiers: different circuits, load line, voltage, current and power gain, waveforms, frequency response.</p> <p><b>Power amplifier-</b> voltage and power amplifier, classification Class A, B,C and AB amplifier circuits.</p>
7	<p><b>OPAMPS</b> pins identification,</p>	<p><b>Linear ICs and OP-AMPs:</b> working,</p>

## Instrument Mechanic (Steel Plant)

	<p>assembly of inverting and non-inverting amplifiers, calculation of voltage gain, assembly of comparator, adder, subtractors, differentiator, integrator, V/I and I/V circuit and its testing.</p> <p>Study of Differential and Instrumentation amplifier.</p> <p><b>Construction of multivibrators using 555 timers</b>, Calculation of frequency</p>	<p>characteristic, pin diagram, applications as inverting and non-inverting amplifier, calculation of gain, comparator, unity gain buffer and scale changer, adder, subtractor, differentiator, integrator, V/I and I/V converter.</p> <p>Differential and Instrumentation amplifier.</p> <p><b>Switching and timer circuits:</b> classification of multi-vibrators, astable, monostable and bi-stable. Internal block diagram, operating of 555 timers and its applications.</p> <p><b>Opto-electronics-</b> elementary idea of LED, LCD, photo diodes, photo transistors, solar cells and their applications.</p>
8	<p>Verification of truth tables of different gates</p> <p>Realization of different Boolean expression with logic gates.</p> <p>Realization of adders and subtractors.</p> <p>Construct and verify truth tables of flip flops.</p> <p>Construct synchronous and asynchronous counters and study its functions.</p> <p>Construct controlled shift register and study their functions.</p> <p>Practice on reading and interpretation of IC data sheets.</p>	<p><b>Digital Electronics</b></p> <p><b>Number systems:</b> binary, octal, hex, 1's and 2's complements, conversion from one system to other, Boolean algebra: De Morgan theorem and its applications.</p> <p><b>Basic logic gates:</b> Symbolic representation and truth tables for logic gates: Buffer, NOT, OR, AND, NAND, NOR, XOR, XNOR. Different logic families and their characteristics, Electrical equivalent of gates, Negative and positive logic gates.</p> <p><b>Combinational logic circuits:</b> Half and full adder and subtractors. Encoders, decoders, multiplexer, de-multiplexers, parity generators and checker.</p> <p><b>Sequential logic circuits:</b> Difference between sequential and combinational circuits, triggering of sequential circuits. Flip-flops: RS, JK, D, T type, preset and clear signals, timing diagrams. Counters, Registers and its applications.</p> <p><b>Memory devices:</b> types, memory cells: RAM, ROM, PROM. EPROM, EEPROM, CD-ROM, memory addressing and IC chips, Static and dynamic RAM, latest developments.</p> <p><b>Data converters:</b> Digital to analog converters,</p>

## Instrument Mechanic (Steel Plant)

		<p>simple circuits, and applications. Analog to digital converters.</p> <p><b>Multivibrators:</b> Types, characteristics and circuits, Schmidt trigger.</p> <p><b>Microcontroller:</b> basic principle, architecture, types, programming concepts, interfacing.</p>
9	<p>Familiarization with different I/O modules of PLC.</p> <p>Development of simple programmes involving bit level instructions, timers and counters, simple data manipulation instructions.</p> <p>Feeding and running the programmes in PLC, I/O forcing.</p> <p>Documentation and editing of programmes</p> <p>Simple fault finding and trouble-shooting related to PLC.</p> <p>Demonstration of SCADA system, Study of communication system used in networking of PLC: DH, Controlnet, MODBUS, PROFIBUS</p> <p><b>DCS</b></p> <p>Familiarization with hardware of DCS</p> <p>Process operation practice on DCS (On DCS used in the plant.</p>	<p><b>Introduction to PLC &amp; DCS</b></p> <p>Introduction to PLC, its hard ware details, Function and working of different cards</p> <p>Program techniques of PLC, inputs, outputs, timer and counter instructions, data manipulation.</p> <p>Development of simple programs.</p> <p><b>DCS:</b> basic concepts, architecture, advantages.</p>
10	<p>Observation of different types of power electronic components .</p> <p>Drawing the V-I characteristic of a thyristor</p> <p>Study of different firing circuits of thyristors (RC, UJT, Ramp and Cosine firing circuits)</p> <p>Study of 1 ph and 3 ph converter - half wave, full wave, half controlled etc.</p> <p>Study of inverter circuit and waveforms</p>	<p><b>Power electronic devices:</b> Thyristor, its construction, characteristics and family.</p> <p>Turn "ON" &amp; turn "OFF" behavior of thyristors.</p> <p>Firing and commutation circuits,, role of snubber circuit. Rating &amp; protection of thyristors, Power diodes and power transistors, power MOSFET, IGBT, GTO, IGCT and their applications.</p> <p><b>Thyristor circuits:</b> Converter, AC voltage Regulator, Chopper, Inverter, IGBT circuit, PWM and their use.</p> <p><b>DC drives:</b> concept of speed control of DC</p>

## Instrument Mechanic (Steel Plant)

	<p>Checking of power MOSFET, thyristors, IGBT, GTO, IGCT. Testing of thyristor. Dismantling, assembly, test and calibration checking of indicators and recorders. Demonstrations of gas analyzers and CV analyzers. Demonstrations of liquid analyzers – pH &amp; conductivity. Demonstrations of humidity and moisture gauges.</p>	<p>motor. Block diagram of close loop unidirectional DC drive, four quadrant operation of DC drive, Related safety aspects. <b>Indicators and recorders-</b> working of industrial indicators and recorder, its types, working principle, calibration and maintenance. <b>Gas analyzers:</b> requirement of gas analyzers, components of a gas analyzer system, sampling system. <b>Conductivity and pH analyzers:</b> requirements, working principle.</p>
11	<p>Programming of DCS, its maintenance and troubleshooting. Programming of PLC, setting communication link, debugging, forcing, maintenance and troubleshooting. Development of simple projects using SCADA software.</p>	<p><b>Digital Controllers</b> Principle of digital control, difference between analog and digital control, advantage and limitation. Steel plant instrumentation and control system advanced. a. Fuel and furnaces used in steel plant, water, oxygen, nitrogen and other utilities network.</p>
12	<p>Familiarization with different types of electronic, pneumatic and hydraulic calibrators. Calibration of all types of instruments and preparing its calibration report. Impulse line laying and connection with transmitters and control valves. Instrument interconnection using cable, JB's and terminals. Practice on different types of terminations. Trouble shooting and rectification of instrumentation system.</p>	<p>Calibration- need of calibration, types of calibration, calibration standards- working, reference and international standards. Calibration record, Error and uncertainty Working of electronic and pneumatic calibrators. <b>Instrument sub-systems-</b> Panels, relays, terminals, fuse terminals, junction boxes, MCBs, cable gland, pipe and its colour code, air filter regulators. Instrument cabling, Earthing and grounding of instruments and its importance. Elimination of ground loops. <b>P&amp;I diagram</b> – flow sheet symbols, reading and interpretation of P&amp;I diagrams.</p>
13	<b>Assessment / Examination (03 days)</b>	

**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.

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING:

A. BLOCK- I

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
		<b>30</b>		<b>20</b>
1	<p><b>Engineering Drawing:</b> Introduction and its importance</p> <p>-Viewing of engineering drawing sheets. Method of Folding of printed Drawing Sheet as per BIS SP:46-2003 Drawing Instruments : their Standard and uses</p> <p>- 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.</p>		<p><b>Unit:</b> Systems of unit-FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units.</p>	
2	<p><b>Lines :</b></p> <p>- Definition, types and applications in Drawing as per BIS SP:46-2003</p> <p>- Classification of lines (Hidden, centre, construction, Extension, Dimension, Section)</p> <p>- Drawing lines of given length (Straight, curved)</p> <p>- Drawing of parallel lines, perpendicular line</p> <p>- Methods of Division of line segment</p>		<p><b>Fractions &amp; Simplification:</b> Fractions, Decimal fraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems Simplification using BODMAS.</p>	

## Instrument Mechanic (Steel Plant)

3	<b>Drawing of Geometrical Figures:</b> Definition, nomenclature and practice of - - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram. - Circle and its elements.		<b>Square Root :</b> Square and Square Root, method of finding out square roots, Simple problem using calculator	
4	<b>Lettering and Numbering</b> as per BIS SP46-2003: - Single Stroke, Double Stroke, inclined, Upper case and Lower case.		<b>Ratio &amp; Proportion:</b> Simple calculation on related problems.	
5	<b>Free Hand sketch:</b> Hand tools and measuring instruments used in electronics mechanics Trades		<b>Percentage:</b> Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa.	
6	<b>Free hand drawing :</b> - Lines, polygons, ellipse, etc. - Geometrical figures and blocks with dimension. -Transferring measurement from the given object to the free hand sketches.		<b>Material Science :</b> 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.	

## Instrument Mechanic (Steel Plant)

### B. Block- II

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation	Duration (in hours)
		<b>30</b>		<b>20</b>
<b>1</b>	<b>Symbolic Representation</b> (as per BIS SP:46-2003) of : - Fastener (Rivets, Bolts and Nuts) - Bars and profile sections - Weld, brazed and soldered joints. - Piping joints and fittings		<b>Mass ,Weight and Density</b> : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals	
<b>2</b>	Construction of Scales and diagonal scale P&I drawing symbols ISA 5.1 cable schedule		<b>Work, Power and Energy:</b> 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.	
<b>3</b>	Electrical and electronics element and components LED, IRLED, photo diode, photo transistor, opto-coupler symbols symbols of Logic gates		<b>Algebra:</b> Addition, Subtraction, Multiplicatio, Division, Algebraic formula, Linear equations (with two variables).	
<b>4</b>	Half adder, full adder, multiplexer and de-multiplexer		<b>Mensuration:</b> 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.	
<b>5</b>	UJT, FET, MOSFET, DIAC, TRIC, SCR, IGBT symbols and circuits of FET Amplifier, SCR using UJT triggering, snubber circuit, light dimmer circuit using TRIAC, UJT based free running oscillator.			

**Instrument Mechanic (Steel Plant)**

			<b>Trigonometry:</b> Trigonometrical ratios, measurement of angles. Trigonometric tables. Finding height and distance by trigonometry.	
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**9.2 EMPLOYABILITY SKILLS**

**(DURATION: - 110 HRS.)**

<b>Block – I</b> <b>(Duration – 110 hrs.)</b>	
<b>1. English Literacy</b> Duration : 20 Hrs. <span style="float: right;">Marks : 09</span>	
<b>Pronunciation</b>	Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)
<b>Functional Grammar</b>	Transformation of sentences, Voice change, Change of tense, Spellings.
<b>Reading</b>	Reading and understanding simple sentences about self, work and environment
<b>Writing</b>	Construction of simple sentences Writing simple English
<b>Speaking / Spoken English</b>	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.
<b>2. I.T. Literacy</b> Duration : 20 Hrs. <span style="float: right;">Marks : 09</span>	
<b>Basics of Computer</b>	Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.
<b>Computer Operating System</b>	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.
<b>Word processing and Worksheet</b>	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.
<b>Computer</b>	Basic of computer Networks (using real life examples), Definitions of Local Area Network (LAN), Wide Area Network (WAN), Internet,

## Instrument Mechanic (Steel Plant)

<b>Networking and Internet</b>	<p>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.</p>
<b>3. Communication Skills</b> Duration : 15 Hrs. <span style="float: right;">Marks : 07</span>	
<b>Introduction to Communication Skills</b>	<p>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.</p>
<b>Listening Skills</b>	<p>Listening-hearing and listening, effective listening, barriers to effective listening guidelines for effective listening.            Triple- A Listening - Attitude, Attention &amp; Adjustment.            Active Listening Skills.</p>
<b>Motivational Training</b>	<p>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.</p>
<b>Facing Interviews</b>	<p>Manners, Etiquettes, Dress code for an interview            Do's &amp; Don'ts for an interview.</p>
<b>Behavioral Skills</b>	<p>Problem Solving            Confidence Building            Attitude</p>
<b>Block – II</b> <b>Duration – 55 hrs.</b>	
<b>4. Entrepreneurship Skills</b> Duration : 15 Hrs. <span style="float: right;">Marks : 06</span>	
<b>Concept of</b>	Entrepreneur - Entrepreneurship - Enterprises:-Conceptual issue

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<b>Entrepreneurship</b>	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.
<b>Project Preparation &amp; Marketing analysis</b>	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.
<b>Institutions Support</b>	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.
<b>Investment Procurement</b>	Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.
<b>5. Productivity</b>	
Duration : 10 Hrs. <span style="float: right;">Marks : 05</span>	
<b>Benefits</b>	Personal / Workman - Incentive, Production linked Bonus, Improvement in living standard.
<b>Affecting Factors</b>	Skills, Working Aids, Automation, Environment, Motivation - How improves or slows down.
<b>Comparison with developed countries</b>	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.
<b>Personal Finance Management</b>	Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.
<b>6. Occupational Safety, Health and Environment Education</b>	
Duration : 15 Hrs. <span style="float: right;">Marks : 06</span>	
<b>Safety &amp; Health</b>	Introduction to Occupational Safety and Health importance of safety and health at workplace.
<b>Occupational Hazards</b>	Basic Hazards, Chemical Hazards, Vibroacoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.
<b>Accident &amp; safety</b>	Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.

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<b>First Aid</b>	Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person.
<b>Basic Provisions</b>	Idea of basic provision legislation of India. safety, health, welfare under legislative of India.
<b>Ecosystem</b>	Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.
<b>Pollution</b>	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
<b>Energy Conservation</b>	Conservation of Energy, re-use and recycle.
<b>Global warming</b>	Global warming, climate change and Ozone layer depletion.
<b>Ground Water</b>	Hydrological cycle, ground and surface water, Conservation and Harvesting of water.
<b>Environment</b>	Right attitude towards environment, Maintenance of in -house environment.
<b>7. Labour Welfare Legislation</b>	
Duration : 05 Hrs. <span style="float: right;">Marks : 03</span>	
<b>Welfare Acts</b>	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.
<b>8. Quality Tools</b>	
Duration : 10 Hrs. <span style="float: right;">Marks : 05</span>	
<b>Quality Consciousness</b>	Meaning of quality, Quality characteristic.
<b>Quality Circles</b>	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.
<b>Quality Management System</b>	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
<b>House Keeping</b>	Purpose of House-keeping, Practice of good Housekeeping.
<b>Quality Tools</b>	Basic quality tools with a few examples.

## **10. DETAILS OF COMPETENCIES (ON-JOB TRAINING)**

BROAD LEARNING TO BE COVERED IN INDUSTRY FOR INSTRUMENT MECHANIC (STEEL PLANT)  
TRADE:

1. Safety and best practices /Basic Industrial Culture (5S, KAIZEN, etc.)
2. Record keeping and documentation
3. Fitting components using different metal fitting procedure and perform testing of the assembly.
4. Assembling of different components as per requirement and check functionality.
5. Carryout maintenance of different systems .
6. *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. Identify and test the different types of cables, wires. Skin and crimp the cable and conductors using proper tools in electronic and instrumentation industry. Make different joints of wires.
2. Identify, test of various types of DC machines .Dismantle and assemble of a DC machine. Identify terminals, connections, run and reverse the direction of rotation of DC motors.
3. Identify, connect and test of various types of transformers (single phase, 3 phase, CT, PT etc) and its parts. Measure various parameters (voltage, current, losses, regulation, efficiency etc) of transformer.
4. Identify and test of various induction motors (single and 3 phase) .connection in star delta. overhauling of fan motors. connect, run and reverse of single-phase motors.
5. Perform panel wiring by using contactors relays etc. for automatic star-delta, autotransformer, rotor-resistance and forward-reverse D.O.L. starters.
6. Test and run small programs on Microprocessor/Microcontroller.
7. Identify, test , and measure using different sensor and transducers like LVDT, strain gauge, Capacitive gauges, Thermocouples, RTDs, Thermistors etc.
8. Dismantle, assemble and calibration of transmitters, indicators, gauges, regulators and switches used for pressure, temperature, flow , level and other measurement. Operate and test the different types of pressure calibrators (dead weight and comparator), temperature calibrator.
9. Install and Configure of smart transmitters using HART and other configurations.
10. Calibration and testing of control valve, I/P converter and valve positioners.
11. Connect , Operate, tune and configure PID controller in different modes.
12. Determination of process characteristics of a process on simulator/ instrumentation tutors.
13. Identify different modules, parts and connections of PLC and DCS. Development and test of simple programmes involving bit level instructions, timers and counters, simple data manipulation instructions.

## ***Instrument Mechanic (Steel Plant)***

14. Parameterization of AC drives.

### **Block – II**

1. Identify various components and connection on single line diagram of interconnected industrial power supply system.
2. Parameterization of digital relay and numerical relay.
3. Install operate and test of process components such as filter, pumps, float switch, valves, actuators etc.
4. Operation of proportional and servo valves, functions of control and feedback components.
5. Connect and test simple pneumatic and hydraulic circuit.
6. Assemble, test and calibration checking of pneumatic PT/DT, indicator, recorder, controller and control valves.
7. Test and operation of chemical instruments like gas analyzers, liquid analyzers-pH and conductivity meters etc.
8. Setting communication link, debugging, forcing, maintenance and troubleshoot of PLC and DCS systems.
9. Calibration of various types of process instruments and preparation of calibration report using various methods and different types of electronic, pneumatic and hydraulic calibrators.
10. Impulse line laying and connection with transmitters and control valves. Instrument interconnection using cable, JBs and terminals. Practice on different types of terminations.
11. Calibration of ammeter, voltmeter, wattmeter and energy meters. Preparation and correction curves calibration records.
12. Polarity marking of CT. Measurement of voltage current, power and energy using CT and PT
13. Practice different type of knots & hitches used in material handling such as Reaving sets of pulley block, Splicing of manila rope, Inspection of wire rope, Use of mechanical & hydraulic systems (jack, rope puller, chain puller, chain block, winch ), Inspection of tools and tackles, Loading, unloading and shifting of common and uncommon shapes of material. Hand signal used in rigging.
14. Demonstrate on Emission and pollution control equipment, dust handling & disposal system, effluent treatment plants, emission monitoring equipment.

### **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.

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

INSTRUMENT MECHANIC			
LIST OF TOOLS AND EQUIPMENT for Basic Training (For 20 Apprentices)			
A. TRAINEES TOOL KIT ( For each additional unit trainees tool kit Sl. 1-09 is required additionally)			
Sl. no.	Name of the Tool & Equipments	Specification	Quantity
1.	Steel rule	150 mm	20 nos.
2.	Watch maker screw driver SET	set of 6	20 nos.
3.	Pliers flat nose	100mm	20 nos.
4.	Hammer ball pain	250gm with handle	20 nos.
5.	Twiser fine point	125mm	20 nos.
6.	Twiser ordinary	125 mm	20 nos.
7.	File hand smooth	200mm	20 nos.
8.	File half round	2nd cut 250mm	20 nos.
9.	File triangular	2nd cut 200mm	20 nos.
10.	File square	2nd cut 150mm	20 nos.
11.	Screw driver set	Set of 5 pieces	20 nos.
B: TOOL, MEASURING INSTRUMENTS & GENERAL SHOP OUTFIT FOR UNIT			
12.	Try square hardened blade	100mm	4nos.
13.	Spring divider	100mm	4nos.
14.	Neon (phase) tester 230 v		4nos.
15.	Swiss file,	set of 12 nos	2nos.
16.	Eye glass	3 " focus watch maker	4 nos.
17.	Goggles safety		4nos.
18.	Oil can		4nos.
19.	Surface plate	400x400mm	2nos.
20.	Universal scribing block	250mm pillar	2nos.
21.	Vee block with clamp pair		2nos.
22.	Angle plate	150x100	2nos.
23.	Punch letter set	2mm	1set
24.	Punch figures set	2mm	1set
25.	Hacksaw frame adjustable	200-300mm	4nos.
26.	Hand drill machine	6mm cap	2nos.

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27.	Chisel cold flat	12mm	2nos.
28.	Drill twist	S.S. 1mm-12mm	2sets.
29.	Taps & dyes B.A set		2sets.
30.	Taps & dies B.S.F set		2sets.
31.	Hammer ball pain	450 gm with handle	2nos.
32.	Spirit level metal	100mm	2nos.
33.	Electric soldiering iron	25 watt pencil tip	4nos.
34.	De-soldering pump		4nos.
35.	Temperature controlled soldering station	With soldering and desoldering setup.	2nos.
36.	Single hot plate	1000watts	2nos.
37.	File flat 2nd cut	250mm	4nos.
38.	File flat smooth	150 mm	4nos.
39.	File warding 2nd cut	100mm	4nos.
40.	File warding smooth	100mm	4nos.
41.	vice swiveled base jaw	100mm	2nos.
42.	Vice bench jaw	100mm	20 nos.
43.	Vice pipe	100 mm	4nos.
44.	Pointer extractors(puller)	150 mm	4nos.
45.	Screw pitch gauge B.A.& metric each		2nos.
46.	Reamer parallel	1 mm to 6 mm	2 sets.
47.	Punch centre	100x10mm	4nos.
48.	Tool makers clamps	65x12x25mm	4nos.
49.	Plier side cutting	150 mm	4nos.
50.	Sine bar	125 mm plate	2nos.
51.	Spanner adjustable	200 mm	4nos.
52.	Flaring tool set		4nos.
53.	Micrometer outside	0-25 mm	2nos.
54.	Micrometer outside	25-50mm	2nos.
55.	Vernier height gauge	300mm	2 nos.
56.	Combination set	300mm	1no.
57.	Vernier caliper	150 mm	4nos.
58.	Standard wire gauge	Standard type	2nos.
59.	Feeler gauge	leaf type,26 blades, eng & metric	1no.
60.	Radius gauge	leaf type1-15mm	1no.
61.	Dial test indicator	in mm with accessories	2nos.
62.	Spanner set	1 mm to 25mm	4nos.
63.	Taps set metric	As required	2nos.
64.	Micrometer inside	25 mm with extension upto 150mm	1no.
65.	Combination plier	heavy duty 150mm	4nos.
66.	Fire buckets		4nos.

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67.	Glazed with felt cloth & marking pen sets (blue, black, Red & green)		4nos. each
68.	Tube cutter		4nos.
69.	Tube bender		4nos.
70.	Pinching tool		4nos.
71.	Combinational plier	200mm	4nos.
72.	Allen key set(metric)		2nos.
73.	Allen key set (English)		2nos.
74.	Screw driver	200mm	2nos.
75.	Screw driver	400mm	2nos.
76.	Philips screw driver	200mm	2nos.
77.	Outside micrometer,	0-25mm, LED/LCD display	1no.
78.	Round nose plier	150mm	2nos.
79.	Machine vice	150mm	2nos.
80.	Magnifying glass	75mm	4nos.
<b>C: MECHANICAL PRECISION INSTRUMENTS</b>			
81.	Vernier micrometer	(0-25mm),outside	1no.
82.	Vernier micrometer	(25-50mm),outside	1no.
83.	Vernier caliper	(0-300mm)	1no.
84.	Plug gauge		1no.
85.	Ring gauge		1no.
86.	Snap gauge		1no.
87.	Dial test indicator, metric with all accessories		1no.
88.	Surface gauge		1no.
89.	Telescopic gauge		1no.
90.	Vernier bevel protector		1no.
91.	Dividers,	250mm	2nos.
92.	Gauge blocks		1no.
93.	Comparators		1no.
94.	Monochromatic light source		2nos.
95.	Optical flat		
96.	Wire type strain gauge (bonded & unbounded)		2nos.
97.	Bonded & unbounded type microphone		2nos.
98.	Vibration sensing elements.		2nos.
99.	Accelerometer		1no.
100.	Seismic instruments		1no.
101.	Load cells of various ranges		2nos.
102.	Measuring microscope & travelling microscope.		2nos.

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<b>D: ROTATIONAL OR VELOCITY INSTRUMENTS</b>			
103.	Speedometers.	(at least 4 diff popular make) with adopters of various sizes	1no. each
104.	Centrifugal type tachometer.		1no.
105.	Drag cup type tachometer.		1no.
106.	Electrical tachometer.		1no.
107.	Chronometric type tachometer.		1no.
108.	Digital type tachometer.		2nos.
109.	Stroboscope		1no.
<b>E: PRECISION INSTRUMENTS</b>			
110.	Digital panel meter	3.5 digit	2nos.
111.	Digital panel meters	4.5 digits	2nos.
112.	Digital line frequency indicator		2nos.
113.	D.C .regulated power supplies a) low tension series (single) b) low tension series (dual) c) high tension series d) multi output series e) fixed output series		1no. each
114.	Digital sign or square generator(1Mhz) with frequency counter(8 digit/10 Mhz)	generator(1Mhz) frequency counter(8 digit/10 Mhz)	1no.
115.	Digital function generator	0-10 MHz	2nos.
116.	Pulse generator	0-10 MHz	1no.
117.	Digital frequency counter		1no.
118.	Digital insulation tester		2nos.
119.	Digital multimeter		4 nos.
120.	Analog multimeter		2nos.
121.	Digital ph meter		1no.
122.	Digital L.C.R bridge		2nos.
123.	Digital IC tester		2nos.
124.	Digital storage oscilloscope	100 MHz	2nos.
125.	Decade voltage dividers		1no.
126.	Decade attenuators		1no.
127.	Decade resistance boxes		2nos.
128.	Decade capacitance boxes		2nos.
129.	Decade inductance boxes		2nos.
130.	Transistor curve tracer		1no.
131.	Transistor tester		2nos.
132.	Electronic timers		1no.
<b>F: GENERAL EQUIPMENT TRAINERS FOR INSTRUMENTATION</b>			
133.	Instrumentation amplifier trainer.		2nos.

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134.	Voltage controlled oscillator trainer.		1no.
135.	Frequency to voltage converter trainer		1no.
136.	Voltage to frequency converter trainer.		1no.
137.	8 channel analog multiplexer trainer.		1no.
138.	8 channel analog demultiplexer trainer.		1no.
139.	FET voltmeter trainer		1no.
140.	Measurement of RMS voltage trainer.		1no.
141.	Measurement of average voltage trainer.		1no.
142.	Wheatstone`s bridge trainer.		1no.
143.	Kelvin`s bridge trainer.		1no.
144.	Trainer on C.R.O.		2nos.
145.	Trainers on transistor of all types		1no.
146.	Trainers on microphone		1no.
147.	Trainers on network circuits i.e. Kirchhoff`s law etc.		2nos.
148.	Trainers on linear ICs - operational amplifiers and 555 timers		2nos.
149.	Discreet component trainer.		2nos.
150.	Trainers on power suppliers-Half wave rectifier, full wave rectifier, bridge rectifier and power supply, regulated power supply.		2nos.
151.	Trainers on basic digital electronics, i.e. logic gates, Boolean expression, adder, subtracter, flip-flop, counter, register, converter etc.		2nos.
152.	Trainers on transistor amplifier circuits at least one each for all types of amplifiers.		2nos.
153.	Trainers on oscillators and multivibrators, signal generators, integrators, triggers and other wave shaping ckts.		2nos.
154.	Trainers on firing circuits, converters and invertors		2nos.
155.	Trainers on stepper motor, SCR motor, serve motor, UJT trigger,		2nos.

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	circuit breaker, timer and alarm.		
156.	SCR driven/controlled power supply trainer		2nos.
157.	Instrumentation training kits for following sensors- Strain gauge, LVDT, RTD, TC, Thermistors, Capacitive transducers, inductive transducers, hall effect transducers, optical encoders, magnetic encoder		2nos.
<b>G: ELECTRICAL INSTRUMENTS</b>			
158.	DC moving coil voltmeters. (various ranges)		2nos. each
159.	DC moving coil ammeters. (various ranges)		2nos. each
160.	DC moving coil miliammeters (various ranges)		2nos. each
161.	Centre zero galvanometers		2nos.
162.	AC moving iron type voltmeter (various ranges)		2nos. each
163.	AC moving iron type ammeters (various ranges)		2nos. each
164.	Wattmeter dynamometer.		2nos.
165.	Voltmeter dynamometer type AC & DC.		2nos.
166.	Voltmeter induction type		1no.
167.	Power factor meter		2nos.
168.	Vibrating reed frequency meter		1no.
169.	KWh meter induction type 1 ph		2nos.
170.	Ampere hour meter		2nos.
171.	Ohm`s meter		2nos.
172.	Multimeter (analog)		2nos.
173.	Multimeter (digital)		2nos.
174.	Potentiometer / Thermocouple test set		1no.
175.	Earth Insulation Tester (Megger)		2nos.
176.	Autotransformer.		2nos.
<b>H: PRESSURE INSTRUMENTS</b>			
177.	“U” tube manometers		2nos.
178.	Well type manometer		2nos.
179.	Inclined limp manometers		2nos.
180.	Ring balance type manometer		1no.
181.	Bourdon tube type gauges of various ranges		2nos.

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182.	Capsule type pressure gauges		2nos.
183.	Aneroid barometers		1no.
184.	Dead weight tester		2nos.
185.	Pressure regulators with filter and input & output gauges		4nos.
186.	Differential pressure transmitter (pneumatic).		2nos.
187.	Differential pressure transmitter (electronic/ Smart) with configurator (HART)		2nos.
188.	Diaphragm type pressure gauges of various ranges		2nos.
189.	Pressure Transmitters-	Resistive and Capacitive type, 4-20 mA output, 24 V DC Power Supply	1no. each
190.	Smart Pressure Transmitters with configurators (HART)		2nos.
191.	Pneumatic indicating controller (PID)		1no.
192.	Electronic pressure controller (PID)		2nos.
193.	Pressure control training simulators consisting of (a) process (pressurised vessel) and (b) control equipment to establish closed loop automatic control system using pressure transmitter, indicator, PID controller, recorder and final control element. A small PLC/DCS can also be used as controller.		1no.
194.	DC Power supply unit	0-24 V DC	2nos.
195.	Pressure calibrator (Pneumatic/ electronic)		2nos.
196.	Pressure switches of various ranges		2nos.
197.	Other miscellaneous fittings, pipes, tubes, etc.		As required
198.	Low pressure measuring gauges such as thermal conductivity gauges, pirani gauges and mcLeod gauge		1no. each
199.	I to P converters		2nos.
200.	Vacuum tester with pump and gauge		1no.
201.	Vacuum gauge	100 mm dial, Bourdon	2nos.

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		tube type	
202.	Pneumatic regulator with filter and input & output gauges		2nos.
203.	Diaphragm type pressure gauge		2nos.
204.	Stop watch		2nos.
<b>I: FLOW METERS / INSTRUMENTS</b>			
205.	Simple tank type quantity meter		2nos.
206.	Reciprocating piston type flow meter		2nos.
207.	Impeller type flow meter		1no.
208.	Bellows and liquid seal drum type flow meter		1no.
209.	Deflecting and rotating vane flow meter		1no.
210.	Helical and turbine flow meter		1no.
211.	Pitot tube flow meter.		1no.
212.	Orifice type flow meter		1no.
213.	Venturi tube flow meter		1no.
214.	Tapered tube flow meter		1no.
215.	Rotameter with needle valve		2nos.
216.	Magnetic Flow meter		1no.
217.	Vortex flow meter		1no.
218.	Flow control training simulators consisting of (a) process (Water flowing in a pipe ) and (b) control instruments to establish automatic feedback water flow control loop using flow element, transmitter, indicator, controller, recorder and final control element. A small PLC/DCS can also be used as controller.		1no.
219.	Coriolis mass flow meter		1no.
220.	Ultrasonic flow meter		1no.
221.	Flow switches		1no.
<b>J: LEVEL and TEMPURATURE INSTRUMENT</b>			
222.	Hook type level indicator		1no.
223.	Sight glass level indicator		2nos.
224.	Float type level indicator with potentiometer		2nos.
225.	Air purge (bubbler) type level indicator		1no.
226.	Level transmitters (float with potentiometer)		1no.

## Instrument Mechanic (Steel Plant)

227.	Level control training simulators consisting of (a) process (a tank being filled in with water by a pump) and (b) control instruments to establish automatic feedback water level control loop using level transmitter, indicator, controller, recorder and final control element. A small PLC/DCS can also be used as controller.		1no.
228.	Level measurement equipment by electrical method i.e. conductivity, capacitance, ultrasonic, radar, hydrostatic pressure type and point level detectors/transmitter with configurator.		1no. each
229.	Level measurement equipments for solid – ultrasonic, Microwave, Capacitance probes and Diaphragm switches		1no.
230.	Level switches of different type		1no. each
231.	Immersion pyrometers with bath temp. indicators		1no.
232.	Thermocouple type indicator with millivolt potentiometer for testing pyrometer		1no.
233.	Temperature transmitter-	RTD & TC input, 4-20 mA output, 24 V DC power supply	2nos.
234.	Smart Temperature transmitter with configurators		2nos.
235.	Experimental setup for measuring and controlling of temperature, consisting of measuring, controlling, indicating, recording and final control elements, complete closed loop system.		1no.
236.	Thermistor training kit		1no.
237.	Digital calibrator with adjustable mV/mA source and indicator injector		2nos.
238.	Electric furnace, twin chambers (300*200*1200) with standard temperature indicator		2nos.
239.	Compensating lead with for various thermocouples		As required

### K: RECORDERS

## Instrument Mechanic (Steel Plant)

240.	Electronic recorders(single point & multi point) both circular & strip chart types , analog and digital type		1no. each
<b>L: CONTROLLERS</b>			
241.	PID controller trainer consisting of instrument panel, digital computer& interface system		1no.
242.	Real PID controller-training kit		1no.
243.	Process simulator based on distributed control system		1no.
244.	PLC trainer with simulated process		1no.
245.	Precision air filter regulator with input & output gauges		1no.
246.	Pneumatic PID controller trainers		1no.
247.	PID controller		1no.
<b>M: EQUIPMENTS ON HYDRAULICS AND PNEUMATICS</b>			
248.	Hydraulic trainer		1no.
249.	Hydraulic training kits		1no.
250.	Pneumatic trainer		1no.
251.	Pneumatic training kits		1no.
<b>N: ANALYTICAL INSTRUMENTS</b>			
252.	Conductivity meter (probe and transmitter with indicator) with water sampling system		1no.
253.	pH meter (probe and transmitter with indicator) with water sampling system		1no.
254.	Gas analyzers for O <sub>2</sub> , CO, CO <sub>2</sub> and H <sub>2</sub> along with sampling system and calibration gas		1no.
255.	CV analyzers with calibration gas		1no.
256.	Humidity detector		1no.
257.	Moisture detector		1no.
258.	Hydrometers (lab. & storage battery testing type)		1no.
259.	Hair hydrometer		1no.
260.	Wet & dry bulb thermometer		1no.
261.	Sling Psychrometer hydrometer		1no.
262.	Fire extinguishers		As required

The specifications of the items in the above list have been given in Metric Units. The items which are available in the market nearest of the specification as mentioned above, if not available as prescribed should be procured Measuring instruments such as steel rule which are graduated both English and Metric Units may be procured, if available.

## ***Instrument Mechanic (Steel Plant)***

### **INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING**

#### **TRADE: Instrument Mechanic (Steel Plant)**

#### **LIST OF TOOLS& EQUIPMENTS FOR -20APPRENTICES**

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

2) **Infrastructure:**

<b>A : TRAINEES TOOL KIT:-</b>			
<b>Sl. No.</b>	<b>Name of the items</b>	<b>Specification</b>	<b>Quantity</b>
1.	Draughtsman drawing instrument box		20+1 set
2.	Set square celluloid 45°	(250 X 1.5 mm)	20+1 set
3.	Set square celluloid 30°-60°	(250 X 1.5 mm)	20+1 set
4.	Mini drafter		20+1 set
5.	Drawing board IS: 1444	(700mm x500 mm)	20+1 set
<b>B : Furniture Required</b>			
<b>Sl. No.</b>	<b>Name of the items</b>	<b>Specification</b>	<b>Quantity</b>
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

<b>TOOLS &amp; EQUIPMENTS FOR EMPLOYABILITY SKILLS</b>		
<b>Sl. No.</b>	<b>Name of the Equipment</b>	<b>Quantity</b>
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.**

**Skill India**  
कौशल भारत - कुशल भारत

### 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	Maximum Marks (Total 100 Marks)		15	5	10	5	10	10	5	10	15	15	Total internal assessment Marks	Result (Y/N)
	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		
1														
2														