INSTRUMENT MECHANIC (CHEMICAL PLANT)

COMPETENCY BASED CURRICULUM
(Duration: 2 Yrs.)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 5

SECTOR – CHEMICAL

सत्यमेव जयते

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

Directorate General of Training

Skill India
कौशल भारत-कुशल भारत

INSTRUMENT MECHANIC (CHEMICAL PLANT)

(Revised in 2018)

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NSQF LEVEL - 5

Developed By

Ministry of Skill Development and Entrepreneurship
Directorate General of Training
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
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Kolkata – 700 091

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CONTENTS

1. BACKGROUND

1.1 Apprenticeship Training Scheme under Apprentice Act 1961

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

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

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

1.2 Changes in Industrial Scenario

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

1.3 Reformation

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

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

2. TRAINING SYSTEM

2.1 GENERAL

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

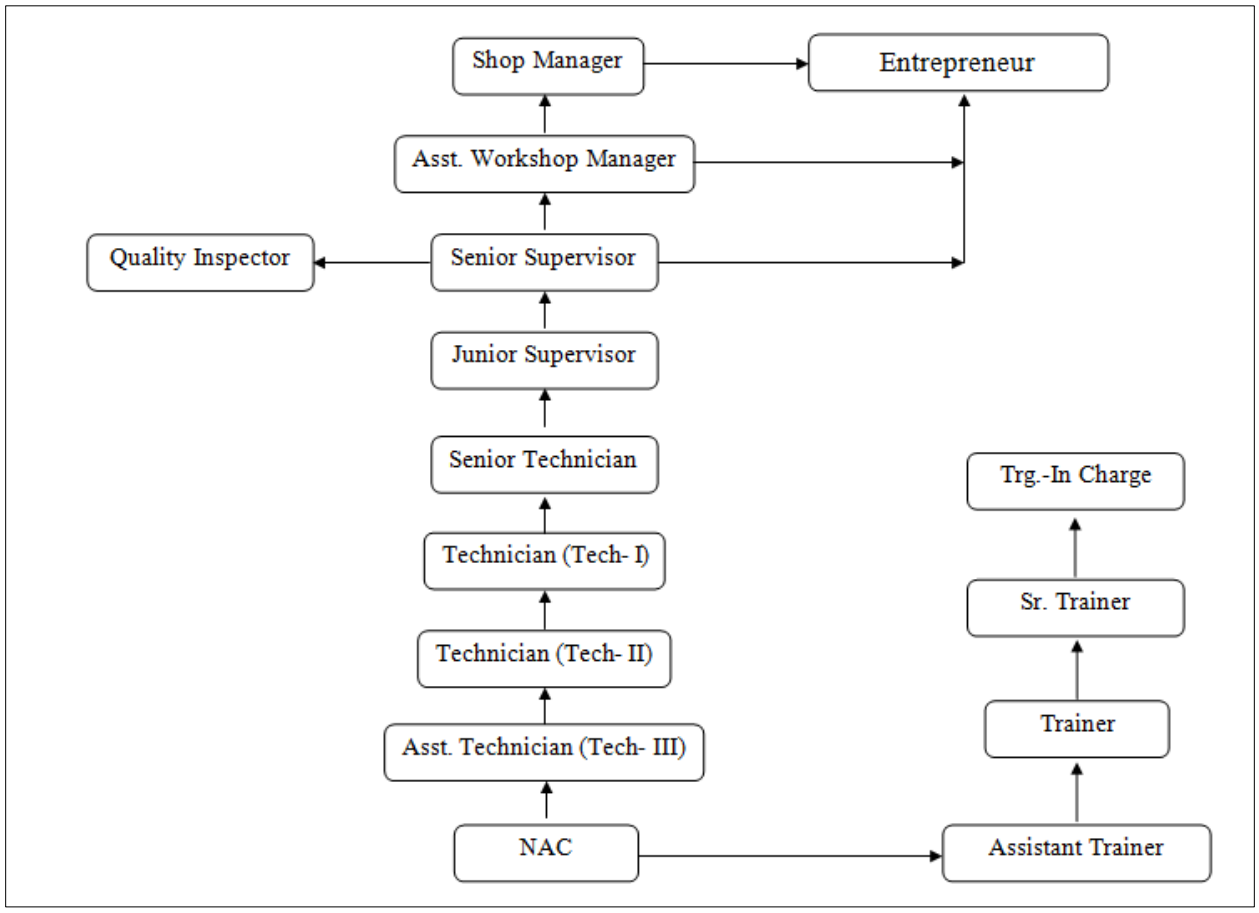
Instrument Mechanic (Chemical Plant) trade under ATS is one of the most popular courses delivered nationwide through different industries. The course is of two years (02 Blocks) duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional - skills and knowledge, while Core area - Workshop Calculation and science, Engineering Drawing and Employability Skills imparts requisite core skills & knowledge and life skills. After passing out the training programme, the trainee is being awarded National Apprenticeship Certificate (NAC) by NCVT having worldwide recognition.

Broadly candidates need to demonstrate that they are able to:

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

2.2 CAREER PROGRESSION PATHWAYS:

- Indicative pathways for vertical mobility.



2.3 COURSE STRUCTURE:

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

Total training duration details: -

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

A. Basic Training

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

Sl. No.	Course Element	Total Notional Training Hours	
		For 02 yrs. course	**For 01 yr. course**
1	Professional Skill (Trade Practical)	550	275
2	Professional Knowledge (Trade Theory)	240	120
3	Workshop Calculation & Science	40	20
4	Engineering Drawing	60	30
5	Employability Skills	110	55
	Total (including Internal Assessment)	**1000**	**500**

B. On-Job Training:-

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

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

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

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

C. Total training hours:-

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

2.4 ASSESSMENT & CERTIFICATION:

The trainee will be tested for his skill, knowledge and attitude during the period of course and at the end of the training programme as notified by Govt of India from time to time. The Employability skills will be tested in first two semesters only.

a) The **Internal assessment** during the period of training will be done by **Formative assessment method** by testing for assessment criteria listed against learning outcomes. The training institute have to maintain individual *trainee portfolio* as detailed in assessment guideline (section-2.4.2). The marks of internal assessment will be as per the template (Annexure – II).

b) The final assessment will be in the form of summative assessment method. The All India Trade Test for awarding NAC will be conducted by NCVT on completion of course as per guideline of Govt of India. The pattern and marking structure is being notified by govt of India from time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline (section-2.4.2) before giving marks for practical examination.

2.4.1 PASS REGULATION

The minimum pass percent for Practical is 60% & minimum pass percent for Theory subjects 40%. The candidate pass in each subject conducted under all India trade test.

2.4.2 ASSESSMENT GUIDELINE

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

Assessment will be evidence based comprising the following:

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

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

Performance Level	Evidence
(a) Weightage in the range of 60 -75% to be allotted during assessment	
For performance in this grade, the candidate with occasional guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of an acceptable standard of craftsmanship.	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment • Below 70% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A fairly good level of neatness and consistency in the finish • Occasional support in completing the project/job.
(b)Weightage in the range of above75% - 90% to be allotted during assessment	
For this grade, the candidate, with little guidance and showing due regard for safety procedures and practices, has produced work which demonstrates attainment of a reasonable standard of craftsmanship.	• Good skill levels in the use of hand tools, machine tools and workshop equipment • 70-80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A good level of neatness and consistency in the finish • Little support in completing the project/job
(c) Weightage in the range of above 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment • Above 80% tolerance dimension/accuracy achieved while undertaking different work with those demanded by the component/job/set standards. • A high level of neatness and consistency in the finish. • Minimal or no support in completing the project.

3. JOB ROLE

Brief description of job roles:

Mechanic Precision Instrument, General Mechanic, Precision Instrument General tests, repairs, overhauls and assembles various precision instruments and their parts for efficient performance. Examines instrument for defects. Dismantles components and cleans them in appropriate fluid such as petrol, kerosene etc. to find out extent of damage or wear and tear to parts. Removes minor defects of parts by grinding, filing, drilling, etc. and replaces worn out and damaged parts. Adjusts position of various parts using screwdriver, spanner etc. and assembles instrument to form complete unit. Makes simple electrical connections, solders contact points and performs other tasks as necessary. Tests performance either by visual observation or by conducting simple electrical and mechanical tests and ensures that repaired or assembled instrument conforms to prescribed efficiency. May make new components and assemble new instruments. May specialize in any particular type of instrument like mechanical, hydraulic, pneumatic, electrical, optical, orthopedic etc.

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.

Mechanic Precision Instrument, Mechanical Mechanic Precision Instrument, Mechanical makes, alters and adjusts mechanical instruments or mechanical parts of electrical and optical instruments by accurate milling, filing, grinding, lapping and other processes. Studies drawings or samples and examines precision instrument like balance, meters, pressure gauges etc. for defects. Dismantles instrument, cleans metal components in petrol, kerosene oil or otherwise and checks them to find out extent of damage and further serviceability. Makes new parts on lathe milling or other machines, if necessary. Sizes and fits metal parts by filing, scraping, grinding lapping etc. as necessary and ensures their desired accuracy by checking with precision measuring instruments shadow graph and other highly perfect devices. Assembles parts to form complete unit. Gets electrical components repaired by Electrician. Fits electrical and optical parts to instrument and adjusts them as required. Texts repaired or assembled instrument for clarity or vision sensitivity, correct meter and scale readings etc. as required and ensures stipulated performance within prescribed limits. Makes necessary adjustments and seals meters to avoid manipulations. May specialize in particular type of instruments like balance, pressure gauges, meters, the odolites, etc.

Mechanic, Precision Instrument, Electrical Mechanic Precision Instrument Electrical; Meter Repairer, Electrical repairs and sets electrical parts of precision instruments such as megger,

voltmeter, ammeter, condensers, galvanometers, etc., to high accuracy for recording correct readings by reviving, replacements and necessary adjustments. Studies drawings, circuit diagrams and other specifications and examines instrument visually to locate any apparent loose connection, short circuits etc. Dismantles instrument using insulated screw drivers, pliers, special spanners etc., and checks components, insulation wiring, fittings and other features with precision mechanical and electrical measuring instruments to locate wear and tear, short circuits and other defects. Cleans necessary or any fluid used in instrument and their various parts using special brushes. Checks gear shell, bearing jewels and other operating parts and repairs or replaces worn out and damaged ones. Assembles parts, replaces insulation and makes electrical wiring and connections according to diagram and prescribed specification. Examines assembled or repaired instrument by standard tests, makes necessary adjustments and ensures correct reading and desired performance within prescribed limits. Seals cut-outs, meters etc. to avoid manipulation. May wind coils, set new resistance and perform other electrical functions, if required.

Reservoir Caretaker Reservoir Caretaker controls equipment to regulate water flow and water level in reservoirs: Turns valves and pulls levers to regulate water flow through aqueduct and floodgates. Reads gauges and meters to control specified water flow, water levels, and water pressure in reservoir. Records data, such as water level, turbidity, temperature, and flow rate. Lubricates and performs minor repairs to equipment, using hand tools. Patrols area to detect property damage and to prevent trespassing. May tend heating apparatus to prevent freezing of valves and gates. May add chemicals to water to retard organic growth such as algae.

Wastewater-Treatment-Plant Operator Wastewater Treatment Plant Operator operates sewage treatment, sludge processing, and disposal equipment in wastewater (sewage) treatment plant to control flow and processing of sewage: Monitors control panels and adjusts valves and gates manually or by remote control to regulate flow of sewage. Observes variations in operating conditions and interprets meter and gauge readings and tests results to determine load requirements. Starts and stops pumps, engines, and generators to control flow of raw sewage through filtering, settling, aeration, and sludge digestion processes. Maintains log of operations and records meter and gauge readings. Gives directions to SEWAGEDISPOSAL WORKERS in performing routine operations and maintenance. May collect sewage sample, using dipper or bottle and conduct laboratory tests, using testing equipment, such as colorimeter. May operate and maintain power generating equipment to provide steam and electricity for plant.

Chemical Processing Plant Controllers, Other Chemical Processing Plant Controllers, Other include plant controllers who operate and monitor chemical plants and adjust and maintain, processing units and equipment which distil, filter, separate, heat or refine chemicals not elsewhere classified.

Instrument Mechanic (Chemical Plant)

Continuous Still Operator, Petroleum Continuous Still Operator, Petroleum; Stillman, Petroleum operates one or more continuous stills for distilling or refining crude oil to obtain fuel gas, gasoline, kerosene, diesel oil, lubricating oil, wax, bitumen, etc. Reads processing schedules, operating logs, test results of oil samples, and laboratory recommendations to determine changes in equipment controls required to produce specified quantity and quality of product; moves and sets controls, such as knobs, valves, switches, levers, and index arms on control panels to adjust, maintain, and co-ordinate process variables, such as flows, temperatures, pressures, vacuum, time, catalyst, and chemicals, by automatic regulation and remote control of processing units, such as heaters furnaces, compressors, exchangers, recharges, absorbers. Moves controls to regulate valves, pumps, compressors, and auxiliary equipment to direct flow of product, reads temperature and pressure gauges and flow meters, records readings, and compiles operating records; tests products for specific gravity and observes their colour to determine whether processing is being carried out properly; makes minor adjustments to equipment; shuts down still for cleaning and opens it up again; supervises workers who assist in operation of still. May fire oil or gas burning furnace through which oil is run to heat it to processing temperature. May specialize in a particular type of still, kind of oil processed, and be designated according to process involved or plant operated as ABSORPTION PLANT OPERATOR; PURIFICATION OPERATOR; STILLMAN; CRACKING UNIT; STILLMAN, POLYMERIZATION, etc.

Reference NCO-2015:

(i) 7311.0100 – Mechanic Precision Instrument, General
(ii) 7311.0101 – Technician Instrumentation
(iii) 7311.0400 – Mechanic Precision Instrument, Mechanical
(iv) 7412.0100 – Mechanic, Precision Instrument, Electrical
(v) 3132.0200 – Reservoir Caretaker
(vi) 3132.0400 – Wastewater-Treatment-Plant Operator
(vii) 3133.9900 – Chemical Processing Plant Controllers, Other
(viii) 3134.0100 – Continuous Still Operator, Petroleum

4. NSQF LEVEL COMPLIANCE

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

The NSQF level-5 descriptor is given below:

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

5. GENERAL INFORMATION

Name of the Trade	**INSTRUMENT MECHANIC (CHEMICAL PLANT)**
NCO - 2015	7311.0100, 7311.0101, 7311.0400, 7412.0100, 3132.0200 3132.0400, 3133.9900, 3134.0100
NSQF Level	Level – 5
Duration of Apprenticeship Training (Basic Training + On-Job Training)	Two years (02 Blocks each of one year duration).
Duration of Basic Training	a) Block –I : 3 months b) Block – II : 3 months **Total duration of Basic Training: 6 months**
Duration of On-Job Training	a) Block–I: 9 months b) Block–II : 9 months **Total duration of Practical Training: 18 months**
Entry Qualification	Passed 10th Class with Science and Mathematics under 10+2 system of Education or its equivalent
Selection of Apprentices	The apprentices will be selected as per Apprenticeship Act amended time to time.
Instructors Qualification for Basic Training	As per ITI instructors qualifications as amended time to time for the specific trade.
Infrastructure for basic training	As per related trade of ITI
Examination	The internal examination/ assessment will be held on completion of each block. Final examination for all subjects will be held at the end of course and same will be conducted by NCVT.
Rebate to Ex-ITI Trainees	01 year
CTS trades eligible for Instrument Mechanic (Chemical Plant) Apprenticeship	1. Instrument Mechanic (Chemical Plant) 2. Electronic mechanic 3. Electrician

Note:

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

6. LEARNING OUTCOME

6.1 GENERIC LEARNING OUTCOME

The following are minimum broad Common Occupational Skills/ Generic Learning Outcome after completion of the Instrument Mechanic (Chemical 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 –Archimedes' principle, viscosity, newton law of motion, fraction, mass, weight, density, velocity, ratio and proportion, percentage, Work, Power & Energy, Geometry & Mensuration, Trigonometry, friction, Heat & Temperature, , Centre of gravity, flow of fluids, Pressure]*

3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, geometrical figures, Machined components & different thread forms, Assembly drawing, Estimation of material, Electrical, electronic, valves and instrumentation symbol, flow sheets of chemical plants]*

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. Interpretation and demonstration: the plant and its different products, capacity of production etc. Plant activities including process and maintenance.
2. Preparing a Schematic Layout of the plant. (Material flow & information flow and instrument).
3. Installation and maintain personal & plant safety procedures and use of safety equipment, fire and fire fighting facilities/techniques, handing of hazardous chemicals and poisons substances.
4. Installation and maintenance of the Unit process and Unit operation.
5. Reading and demonstrate a (process & instrument) flow sheet of a process. Making a simple flow sheet of a unit
6. Installation and maintenance of the various elements like sensing element, transmitter, controller, final control valve of a control loop
7. Installation and maintenance of instruments mountings like Panel mountings, Wall mountings and Yoke Mountings. etc.
8. Care, and maintenance of pneumatics and electrical fittings, coupling and associated tools
9. Dismantling, Cleaning and Re-assembling of Air-Filters, Air Regulators. Giving or Removing Input, Output and Air supply connections of a pneumatic instrument. Routing, bending etc of pneumatic pipes.
10. Doing simple routine works like, Winding of clocks, Filling of Mercury, Cleaning and changing of Inks, Replacement of charts with drawing and returning of materials to and from stores
11. Select, install and Care isolate system for connection of Electrical components.
12. Soldering practice, metal to metal, wire to wire. Wires to plugs, wires to connectors, wires to strokes, wires to terminal blocks. Ferruling, crimping cable routing of wires.
13. Identification, testing and replacement of various components, elements, circuits in different electronic circuit boards.
14. Installation, maintenance of various power supply units and circuits.
15. Selection and usage of various electrical measuring instruments for different applications.

Block – II

16. Calibration and Installation of measuring instruments like RTD, thermocouple, Pressure gauges/transmitters, Level transmitter, flow transmitters pH-meter, conductivity etc.
17. Installation and maintenance of paper chart recorder, Paper less recorder.
18. operate and Maintenance of Control Loops and components (sensing element, transmitter, indicator/recorder, controller and final control element), relays
19. fixing and maintain Instrument and Panel Installation as per Blue Prints.
20. Practice on maintenance scheduled & maintenance activity including calibration (Logging) followed in the instrument shops.

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21. Interpretation with safe, protective storage procedure and inventory system followed for instruments and their components in the establishments
22. Operating, Installation and maintenance of analytical laboratory instrument.
23. Calibration of Smart transmitter for pressure, temperature, flow and level and its adjustment. Calibration of HART Devices.
24. Maintenance of PLC. Basic small programs on PLC – logic gates preparation. Small programs on timers and counters. Maintenance of SCADA and DCS operating controlling system.
25. Operate and work with DCS & SCADA based system complete with communication system on process trainer.
26. Operate and test of Heat Exchanger, Chiller, Steam Trap. Study of shell and tube heat exchanger Study of packed distillation column with DCS / PLC study of triple effect evaporator.
27. Operate and test of various foundation field bus based transmitters & positioners , its calibration& control using DCS
28. Operation and maintenance of smart transmitter like HART, Wireless HART, Foundation field bus etc.
29. Installation, maintenance and handling of various Analytical instruments such as IR – Spectro photo meter, UV –Spectro photo-meter, Spectro Lubro meter High Pressure Liquid Chromatographer, Auto Tritrator etc.

NOTE:

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

7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

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

including basic electrical and apply in day to day work.*[Different mathematical calculation & science –Archimedes' principle, viscosity, newton law of motion, fraction, mass, weight, density, velocity, ratio and proportion, percentage, Work, Power & Energy, Geometry & Mensuration, Trigonometry, friction, Heat & Temperature, , Centre of gravity, flow of fluids, Pressure]*	pressure, heat treatment, centre of gravity, friction.
	2.2 Measure dimensions as per drawing
	2.3 Use scale/ tapes to measure for fitting to specification.
	2.4 Comply given tolerance.
	2.5 Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
	2.6 Ensure dimensional accuracy of assembly by using different instruments/gauges.
	2.7 Explain basic electricity, insulation & earthing.
3. Interpret specifications, different *engineering* drawing and apply for different application in the field of work. [*Different engineering drawing- Geometrical construction, Dimensioning, Layout, Method of representation, Symbol, scales, geometrical figures, Machined components & different thread forms, Assembly drawing, Estimation of material, Electrical, electronic, valves and instrumentation symbol, flow sheets of chemical plants]*	3.1 Read & interpret the information on drawings and apply in executing practical work.
	3.2 Read & analyse the specification to ascertain the material requirement, tools, and machining /assembly /maintenance parameters.
	3.3 Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
4. Select and ascertain measuring instrument and measure dimension of components and record data.	4.1 Select appropriate measuring instruments such as micrometers, vernier calipers, dial gauge, bevel protector and height gauge (as per tool list).
	4.2 Ascertain the functionality & correctness of the instrument.
	4.3 Measure dimension of the components & record data to analyse the with given drawing / measurement.

5. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.	5.1 Explain the concept of productivity and quality tools and apply during execution of job.
	5.2 Understand the basic concept of labour welfare legislation and adhere to responsibilities and remain sensitive towards such laws.
	5.3 Knows benefits guaranteed under various acts
6. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.	6.1 Explain the concept of energy conservation, global warming, pollution and utilize the available recourses optimally & remain sensitive to avoid environment pollution.
	6.2 Dispose waste following standard procedure.
7. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.	7.1 Explain personnel finance and entrepreneurship.
	7.2 Explain role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.
	7.3 Prepare Project report to become an entrepreneur for submission to financial institutions.
8. Plan and organize the work related to the occupation.	8.1 Use documents, drawings and recognize hazards in the work site.
	8.2 Plan workplace/ assembly location with due consideration to operational stipulation
	8.3 Communicate effectively with others and plan project tasks
	8.4 Assign roles and responsibilities of the co-trainees for execution of the task effectively and monitor the same.
SPECIFIC OUTCOME	
Block-I& II (Section:10)	
*Assessment Criteria i.e. the standard of performance, for each specific learning outcome mentioned under **block – I & block – II**(section: 10) must ensure that the trainee achieves well developed skill with clear choice of procedure in familiar context. Assessment criteria should broadly cover the aspect of **Planning** (Identify, ascertain, estimate etc.); **Execution** (perform, illustration, demonstration etc. by applying 1) a range of cognitive and practical skills required*	

to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information 2) Knowledge of facts, principles, processes, and general concepts, in a field of work or study 3)Desired Mathematical Skills and some skill of collecting and organizing information, communication) and ***Checking/ Testing*** *to ensure functionality during the assessment of each outcome. The assessments parameters must also ascertain that the candidate is responsible for own work and learning and some responsibility for other's work and learning.*

BASIC TRAINING (Block – I)

Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	1. Demonstration about PPE'S, Safety Equipments, First aid box. 2. Occupational Safety & Health 3. Importance of housekeeping & good shop floor practices.	**INTRODUCTION:** Introduction about ITI Rules and Regulation. Importance of trade Introduction of Chemistry, branches of chemistry, importance of chemistry, Safety precautions to be taken in Chemistry Laboratory, different equipment and apparatus used in Laboratory **SAFETY:** Introduction & Importance of safety, General precautions about safety. PPE'S Used in chemical industries Safety slogan. First aid in industry & Workshop Soft Skills: its importance and Job area after completion of training.
2	4. Screw Drivers, Pliers, Spanners, their classification, materials and precautions while using them.	Hand Tools and measuring tools used in instrumentation. Screw drivers, pliers, Allen keys, hammers, spanners, pointer puller etc. Vernier caliper, micrometer, bevel protector, dial test indictor. Basic SYMBOLS USED IN Instrumentation.
3	**VOLUMETRIC ANALYSIS:** 5. Alkali metric Titration 6. Volumetric Analysis 7. Acidimetric Titration	Atom, molecule, Element, compound, mixture, Physical change, chemical change, Acids, bases, salts-their properties. Molecular weight, equivalent weight, atomic weight, Normality, molarity. Metals & Non-Metals
4	8. To study action of pure and salt water on metals and alloys. 9. To study action of acids and bases on metals and alloys.	Water- sources, hard and soft water, causes and removal of hardness, Water for industrial purposes. Introduction to Effluent Treatment Plant (ETP).
5	10. Determination of pH (by PH meter) Measurement of conductivity by conductivity meter, DO2 Measurement, TDS Measurement.	Definition of pH, pH scale, measurement of pH. Conductivity, DO2, TDS. **ELASTICITY**: Stress, strain, elastic limit, Types of modulus of elasticity, work done in a stretching wire.
6	11. Study of basic electrical symbols.	**Basic electricity**.

	12. Use of Multi-meter. 13. Read Colour Code of resistors & verification by measurement. 14. Verification of Ohm's Law.	Types of supply-D.C, A.C advantages and disadvantages and its measurement. Voltage, current. Use of Multi-meter. Resistance, resistivity and resistor. Types of resistor and colour code. Ohm's Law and problems on ohm's Law. D.C. series and parallel circuits. Basic of Kirchhoff laws. Earthling types and their use.
7	15. Soldering and desoldering practice. 16. Testing Inductor and capacitor using LCR meters. 17. Measurement of voltage and current of transformer primary and secondary.	Soldering and de-soldering. Inductor, Inductance, Self and mutual inductance, Inductive reactance. Transformers. Types and applications. Current and voltage transformer. Capacitance and capacitor. Capacitor in series and parallel.
8	18. Measurement of power using voltmeter and ammeter method. 19. Calibration of voltmeter, ammeter Watt meter and energy meter etc. 20. Measurement of voltage and frequency using CRO.	Operate and testing of PMMC, MI, Electrodynamometer, and induction type meters, megger. Range extension of voltmeter and ammeters. 2 watt and 3 watt meter power measurement in 3 phase. Use of CRO (voltage and frequency measurement).Use of clam on meters.
9	21. Verification of Diode characteristics & Transistor switch circuit	Diode, types and applications. Applications of LED, Photo diode, thyresistor.Transistor and its applications. Transistor small signal amplifier.
10	22. Study of Half wave & full wave Rectifier 23. Study of regulator IC 24. Study of SMPS & UPS	Rectifier – half wave and full wave. Capacitor and LC filter. Regulators-zener and IC regulator advantages and limitations of SMPS and UPS.
11	25. Determination of specific resistance using Wheat stone's meter bridge. 26. Determination of coefficient of expansion of Solid. 27. Determination of coefficient of expansion of liquid.	Modes of heat transfer, determination of thermal conductivity. Temperature & its measurement, expansion of solid, liquid and gases
12	28. Draw & Study of P & I Diagram for Distillation (ISA standard etc)	ISA symbols used in process instrumentation **Distillation**: Introduction, USE OF Instruments during distillation. Manufacturing process and flow sheet of Urea.
13	29. Draw & Study of P & I Diagram for Evaporation	**Evaporation**: Introduction, use of Instruments during evaporation.

	Internal Assessment/Examination 03days

NOTE: -

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

BASIC TRAINING (Block – II)
Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	30. Awareness and safety of various instruments in the lab and Identifying various parts and section.	**Introduction to Instrumentation:** Scope and necessity of instrumentation. Fundamentals of measurement systems. **Static Characteristics:** Accuracy, precision, sensitivity, resolution dead zone, repeatability, reproducibility, drift, Dead band, backlash, hysteresis. **Dynamic characteristics:** Speed response, fidelity, and lag. Error, deviation, true value, data. Types of errors- systematic, random & illegitimate error. Certainty/ uncertainty, validity of result. Measuring system Response. Classification of hazardous areas. Brief concept on intrinsic safety and flame protection.
2	31. Measurement of pressure using pressure gauge- bourdon tube and diaphragm. 32. Assembling and dismantling of bourdon tube. 33. Testing of pressure switch using lamp load.	**Pressure:** Definition of pressure. Types of pressure- Barometric (Atmospheric) Pressure, Gauge Pressure, Differential Pressure, Absolute Pressure, Vacuum pressure & their units. Types of pressure sensing elements- bourdon tube, diaphragms, capsules, and bellows. Each one type, shapes, material used for various applications, ranges advantages and limitations. Pressure switches types and applications.
3	34. Measurement of pressure using u tube manometer. 35. Calibration of pressure gauge using dead weight tester. 36. Calibration and testing of pressure transmitter.	U tube and well type manometer applications.& Barometers applications. Importance of calibration in Metrology. Dead weight tester and comparators. Pressure transmitter (load cell type) working and applications.
4	37. Temperature measurement using – bimetallic and liquid metal thermometer.	**Temperature measurement :** Definition, Units of Temperature. Temperature gauges – bimetallic, liquid filed

	38. RTD temperature characteristics. 39. RTD transmitter testing and calibration.	system thermometer working and application. RTD –types, working and application. 2 wire, 3 wire and 4 wire RTD limitation.
5	40. Thermocouple transmitter testing and calibration. 41. Measurement of temperature using optical pyrometer.	Thermocouple- types, working and application. Need of cold junction and lead compensation. Thermistor-types, applications. Optical and radiation pyrometer working and application.
6	42. Installation and testing of Venturiand Orifice flow meter. 43. Dismantling, assembling of Rotameter.	Basic properties of fluids, fluids in motion, getting fluids to flow, units of flow rate and quantity flow, factors affecting flow rate. Relation between flow rate and pressure, area, quantity. Head type flow meter types. Working and application of venturi and orifice flow meter. Rota meter working, application.
7	44. Calibration and testing of turbine flow meter. 45. Rotating vane flow meter dismantling, assembling and testing.	Turbine flow meter, magnetic flow meters, vertex flow meter, ultrasonic flow meter, Thermal mass flow meter, Coriolis Mass flow meter- working and applications. Rotating vane and notating disc type quantitative flow meter working and application.
8	46. Dismantling, assembling of sight glass gauge. 47. Level measurement using by sight glass and float type gauge. 48. Installation and testing of hydrostatic level gauge.	Introduction about Types of level measurement systems. Units of level measurement. Sight glass, float type working, and applications. Hydro-static open tank and close tank level measurement system advantages, limitations and application.
9	49. Testing and calibration of air purge level indicator. 50. Testing and calibration of ultrasonic level instrument.	Air purge, Capacitance and ultra-sonic level measurement working and application. Radar type level measurement working and application.
10	51. Dismantling, maintenance and assembling of heat exchanger (as available). 52. Dismantling and assembling of control valve.	Types of heat Exchanger, double pipes, Shell & Tube heat Exchanger. Types of steam Trap. Types of control Valves, Gate Valve, Globe Valve, and NRV. Type of actuators and use.

		Types of final control elements and applications. Selection of control valve like as per safety, type of applications, type of flow etc
11	53. Installation and testing of I/P and valve positioned. 54. Study the working PID process loop.	Working, Application of I to P and valve positioned. ON-OFF controller, P, PI, PD, PID controls limitations and application.
12	55. AND, OR and NOT logics (ladder logic) on PLC.	Introduction about types of PLC. Brief description of PLC blocks diagram and applications of PLC.
13	56. Use of universal calibrator. 57. Study the working of DCS and SCADA (industrial visit or in Industrial on job training)	Use and application of universal calibrator and HART calibrator. Introduction about types of DCS and SCADA. Brief description, blocks diagrams and applications.
	Internal Assessment/Examination 03days	

NOTE: -

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

9. SYLLABUS - CORE SKILLS

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

Block – I		
Sl. No.	**Workshop Calculation and Science (Duration: - 20 hrs.)**	**Engineering Drawing (Duration : - 30 hrs.)**
1.	**Unit**: Systems of unit- CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units **Material Science**: Properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and non-Ferrous metals	**Engineering Drawing**: Introduction and its importance **Drawing Instruments** : their Standard and uses - Drawing board, T-Square, Drafter (Drafting M/c), Set Squares, Protractor, Drawing Instrument Box (Compass, Dividers, Scale, Diagonal Scales etc.), Pencils of different Grades, Drawing pins / Clips. **Lines :** - Definition, types and applications in Drawing as per BIS SP:46-2003 - Classification of lines (Hidden, centre, construction, Extension, Dimension, Section) - Drawing lines of given length (Straight, curved) - Drawing of parallel lines, perpendicular line
2.	**Fractions** : Fractions, Decimal fraction, L.C.M., H.C.F. Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using Scientific Calculator. **Mass ,Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals.	**Drawing of Geometrical Figures**: Definition, nomenclature and practice of - Angle: Measurement and its types, method of bisecting. - Triangle -different types - Rectangle, Square, Rhombus, Parallelogram, polygons. - Circle and its elements. **Lettering and Numbering** as per BIS SP46-2003: - Single Stroke, Double Stroke, inclined, Upper case and Lower case
3.	**Ratio &Proportion** : Simple calculation on related problems. **Speed and Velocity**: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation.	**Practice of Lettering and Title Block** **Dimensioning practice**: - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance.

4.	**Percentage**: Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa **Work, Power and Energy**: work, unit of work, power, unit of power, Horse power of engines, mechanical efficiency, energy, use of energy, potential and kinetic energy, examples of potential energy and kinetic energy.	**Drawing of Solid figures** (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions. **Free Hand sketch of hand tools and measuring tools used in res**pective trades.
5.	**Mensuration :** Area and perimeter of square, rectangle, parallelogram, triangle, circle, semi circle, Volume of solids – cube, cuboid, cylinder and Sphere. Surface area of solids – cube, cuboid, cylinder and Sphere. **Heat & Temparature**: Heat and temperature, their units, difference between heat and temperature, boiling point, melting point, scale of temperature, relation between different scale of temperature, Thermometer, pyrometer, transmission of heat, conduction, convection, radiation.	**Free-hand sketches** of Hand Tools, Screw drivers, Pliers, Spanner, Tweezer. Free-hand sketches of Vernier Caliper, micrometer, Depth Gauge, Dial Test Indicator, Bevel protractor **ISI symbols** of Generator, Voltmeter, Ammeter, Watt- meter. Resister, inductor, Capacitor, Transformer, AC & DC motors.etc. Drawing of pressure control process line

Instrument Mechanic (Chemical Plant)

Block – II		
Sl. No.	**Workshop Calculation and Science (Duration: - 20 hrs.)**	**Engineering Drawing (Duration : - 30 hrs.)**
1.	Archimedes's principle, principle of floatation hydrometers. Centre of gravity and Equilibrium condition. Definition - viscosity, flash point, fire point, flash points of standard lubricating oils, octane number.	**Drawing sketches of different types of valves**, such as gate valve, globe valve, ball valve, Plug Valve, check valve etc. **Drawing of different types locking devices** such as double nut, castle nut, pin etc
2.	Pressure, temperature, Boyle's law, Charles's law, Equation of perfect gas. Calculations. Newton's laws of motion unit of force, find out resultant force parallelogram law of forces,	**Symbolic representation of different types of valves**- gate valve, globe valve, butterfly valve, ball valve, diaphragm valve, control valve, non-return valve, and needle valve. **Free hand sketches** of Belt conveyor, Screw conveyer, Bucket elevator
3.	Centre of Gravity, (C.G. Of square, rectangle, triangle, circle, semicircle, cone) & its calculations Condition of equilibrium, kind of equilibrium, some examples of equilibrium in daily life.	**Drawing of pressure, Level, flow and temperature control system.** **Free hand sketches** of crushers, ball mill, hammer mill and centrifuges
4.	**Flow of fluids-** Equation of continuity, Bernoulli's theorem. Advantages & Disadvantages of friction, Limiting friction, Laws of limiting friction, Coefficient of friction, angle of friction, Inclined plane, Force of friction.	**Free hand sketches** of steam jet ejector, steam trap **Diagram of distillation column** with all accessories Free hand sketches of process instrument- such as temperature indicator, level indicator, LIC, TIC, PI, PIC, FI, FIC
5.	Flow measurement by orifice meter, venturi meter, Rota meter, U-tube manometer. Latent heat, sensible heat, saturated steam, wet steam, superheated steam. Reynolds's number, at different velocities.	Flow sheet / Block diagram of 1.Sulphuric acid 2.Nitric acid 3.Ammonia 4. Urea 4. Ethanol

9.2 EMPLOYABILITY SKILLS

(DURATION: - 110 HRS.)

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

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

Block – II **Duration – 55 hrs.**	
4. Entrepreneurship Skills	Duration : 15 Hrs. Marks : 06
Concept of Entrepreneurship	Entrepreneur - Entrepreneurship - Enterprises:- Conceptual issue Entrepreneurship vs. management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.
Project Preparation & Marketing analysis	Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of PLC, Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.
Institutions Support	Preparation of Project. Role of Various Schemes and Institutes for self-employment i.e. DIC, SIDA, SISI, NSIC, SIDO, Idea for financing/ non financing support agencies to familiarizes with the Policies /Programmes & procedure & the available scheme.
Investment Procurement	Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.
5. Productivity	Duration : 10 Hrs. Marks : 05
Benefits	Personal / Workman - Incentive, Production linked Bonus, Improvement in living standard.
Affecting Factors	Skills, Working Aids, Automation, Environment, Motivation - How improves or slows down.
Comparison with developed countries	Comparative productivity in developed countries (viz. Germany, Japan and Australia) in selected industries e.g. Manufacturing, Steel, Mining, Construction etc. Living standards of those countries, wages.
Personal Finance Management	Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.
6. Occupational Safety, Health and Environment Education	Duration: 15 Hrs. Marks : 06
Safety & Health	Introduction to Occupational Safety and Health importance of

	safety and health at workplace.
Occupational Hazards	Basic Hazards, Chemical Hazards, Vibro acoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.
Accident & safety	Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.
First Aid	Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person.
Basic Provisions	Idea of basic provision legislation of India safety, health, welfare under legislative of India.
Ecosystem	Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.
Pollution	Pollution and pollutants including liquid, gaseous, solid and hazardous waste.
Energy Conservation	Conservation of Energy, re-use and recycle.
Global warming	Global warming, climate change and Ozone layer depletion.
Ground Water	Hydrological cycle, ground and surface water, Conservation and Harvesting of water.
Environment	Right attitude towards environment, Maintenance of in -house environment.
7. Labour Welfare Legislation	Duration: 05 Hrs. Marks : 03
Welfare Acts	Benefits guaranteed under various acts- Factories Act, Apprenticeship Act, Employees State Insurance Act (ESI), Payment Wages Act, Employees Provident Fund Act, The Workmen's compensation Act.
8. Quality Tools	Duration: 10 Hrs. Marks : 05
Quality Consciousness	Meaning of quality, Quality characteristic.
Quality Circles	Definition, Advantage of small group activity, objectives of quality Circle, Roles and function of Quality Circles in Organization, Operation of Quality circle. Approaches to

	starting Quality Circles, Steps for continuation Quality Circles.
Quality Management System	Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.
House Keeping	Purpose of House-keeping, Practice of good Housekeeping.
Quality Tools	Basic quality tools with a few examples.

10. DETAILS OF COMPETENCIES (ON-JOB TRAINING)

BROAD LEARNING TO BE COVERED IN INDUSTRY FOR TURNER TRADE:

1. Safety and best practices /Basic Industrial Culture (5S, KAIZEN, etc.)
2. Record keeping and documentation.
3. Assembling of different components as per requirement and check functionality.
4. Carryout maintenance of different machines including hydraulics & pneumatics system.

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

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

Block -I

1. Interpretation and demonstration the plant and its different products capacity of production etc. Plant activities including process and maintenance.
2. Preparing a Schematic Layout of the plant. (Material flow & information flow and instrument).
3. Installation and maintain personal & plant safety procedures and use of safety equipment, fire and fire fighting facilities/techniques, handing of hazardous chemicals and poisons substances.
4. Installation and maintenance of the Unit process and Unit operation.
5. Reading and demonstrate a (process & instrument) flow sheet of a process. Making a simple flow sheet of a unit
6. Installation and maintenance of the various elements like sensing element, transmitter, controller, final control valve of a control loop
7. Installation and maintenance of instruments mountings like Panel mountings, Wall mountings and Yoke Mountings. etc.
8. Care, and maintenance of pneumatics and electrical fittings, coupling and associated tools
9. Dismantling, Cleaning and Re-assembling of Air-Filters, Air Regulators. Giving or Removing Input, Output and Air supply connections of a pneumatic instrument. Routing, bending etc of pneumatic pipes.
10. Doing simple routine works like, Winding of clocks, Filling of Mercury, Cleaning and changing of Inks, Replacement of charts with drawing and returning of materials to and from stores
11. Select, install and Care isolate system for connection of Electrical components.
12. Soldering practice, metal to metal, wire to wire. Wires to plugs, wires to connectors, wires to strokes, wires to terminal blocks. Ferruling, crimping cable routing of wires.
13. Identification, testing and replacement of various components, elements, circuits in different electronic circuit boards.
14. Installation, maintenance of various power supply units and circuits.
15. Selection and usage of various electrical measuring instruments for different applications.

Block – II

16. Calibration and Installation of measuring instruments like RTD, thermocouple, Pressure gauges/transmitters, Level transmitter, flow transmitters pH-meter, conductivity etc.
17. Installation and maintenance of paper chart recorder, Paper less recorder.
18. operate and Maintenance of Control Loops and components (sensing element, transmitter, indicator/recorder, controller and final control element), relays
19. Fixing and maintain Instrument and Panel Installation as per Blue Prints.
20. Practice on maintenance scheduled & maintenance activity including calibration (Logging) followed in the instrument shops.
21. Interpretation with safe, protective storage procedure and inventory system followed for instruments and their components in the establishments
22. Operating, Installation and maintenance of analytical laboratory instrument.
23. Calibration of Smart transmitter for pressure, temperature, flow and level and its adjustment. Calibration of HART Devices.
24. Maintenance of PLC. Basic small programs on PLC – logic gates preparation. Small programs on timers and counters. Maintenance of SCADA and DCS operating controlling system.
25. Operate and work with DCS & SCADA based system complete with communication system on process trainer.
26. Operate and test of Heat Exchanger, Chiller, Steam Trap. Study of shell and tube heat exchanger Study of packed distillation column with DCS / PLC study of triple effect evaporator.
27. Operate and test of various foundation field bus based transmitters & positioners, its calibration& control using DCS
28. Operation and maintenance of smart transmitter like HART, Wireless HART, Foundation field bus etc.
29. Installation, maintenance and handling of various Analytical instruments such as IR – Spectro photo meter, UV –Spectro photo-meter, Spectro Lubro meter High Pressure Liquid Chromatographer, Auto Tritrator etc.

Note:

- Industry must ensure that above mentioned competencies are achieved by the trainees during their on job training.
- In addition to above competencies/ outcomes industry may impart additional training relevant to the specific industry.

ANNEXURE – I

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

Instrument Mechanic (Chemical Plant)			
LIST OF TOOLS AND EQUIPMENT for Basic Training (For 20 Apprentices)			
A. TRAINEES TOOL KIT			
Sl. no.	**Name of the Tool &Equipment**	**Specification**	**Quantity**
1.	Screw Driver Set	Bits of 5 and above With tester indication	20 nos.
2.	Watchmaker screw driver set	Set of 6 or above	20 nos.
3.	Pointer Puller	-	20 nos.
4.	Adjustable Spanner	100 mm,200mm or near size	20 nos. each
5.	Digital Multi-meter	Voltage (AC &DC) 0-700 V or above Current 0- 100 mA or above 0-10 A or above Resistance 0-1M or above Facility of continuity test, Diode test etc . Manual selection	20 nos.
6.	Soldering iron	25 W	20 nos.
7.	Desoldering Pump	-	20 nos.
B: INSTRUMENTS & GENERAL SHOP OUTFIT			
8.	Allen Key set (inches & MM)	Set of 10 or above	1 Each
9.	Ring Spanner Set	6 to 32 mm	2
10.	ball pain hammer	200 gm	4
11.	Hack Saw Frame		3
12.	Combination pliers	150 MM	4
13.	Long nose pliers	150 MM	4
14.	Stripper	100 mm or above	4
15.	Circlip plier		4
16.	Fire extinguisher (DCP Type)	Dry Chemical Powder	1
17.	Fire Extinguisher	(C02)	1
18.	Fire Extinguisher	Foam type	1
19.	Sand bucket		2

20.	Fire blanket		2.
21.	Glass Electrode PH meter	PH Range: 1-14 Resolution: 0.01 pH Temperature Range: 0.0°C to 100°C Digital LED Display Power Supply: 230VAC ±10%	2
22.	Conductivity Meter with conductivity cell	Display: 4-digit LED Range: Conductance = 0.1 mho to 1000 mmhos in 5 ranges, Resistance = 0.1 ohm to 2 M ohm in 5 ranges Accuracy: conductance = +/- 0.5% or range +/- 1digit Resistance = +/- 0.5% of range+/- 1 digit Supply: 220/230 V Supplied with conductivity cell, dust cover, instructional manual	2
23.	D02 Meter & TDS meter	**DO2 Meter:** The unit will consist of M.S. / SS tanks, mini air pump, Variable Speed Motor and Agitator. The reactor is mounted on a Suitable base plate. Input: Do Sensor/ Cell Temperature Compensation: Automatic/manual, Set Point Functions: Low and High Selectable, Protection: Overload and Reset Facility, Power Supply: 85/264 V AC, 50 / 60 Hz Power: 5 VA Max., with Overload Protection with D.O Electrodes.	2 Nos

		TDS Meter: Digital TDS Meter is a highly stable, rugged, reliable, efficient and accurate instrument for measurement of TDS of aqueous solutions with Range: 0-20000 ppm, Accuracy: +-0.5% FSD +- 1 digit. The results are displayed on 3½ Digit LED Display.	
24.	DC volt meter	0-30 V, 0-100 V	3 Nos. (each)
25.	DC ammeters	0-30 mA, 0-100 mA, 0-500 mA	3 Nos. (each)
26.	AC voltmeter	0-300 V	4 Nos.
27.	AC ammeter	0-5 A, 0-10 A	4 Nos.
28.	Watt meter or better	5000 Watt	2 Nos.
29.	Energy meter (single phase)	230V, 10 A or above	2 Nos.
30.	DC regulated power supply	0- 30 V, 2 A or better	4 Nos.
31.	Digital LCR meter		2 Nos.
32.	Digital storage oscilloscope (DSO)	20 MHz or better	2 Nos.
33.	CRO	20 MHz or better	1 Nos.
34.	Function generator	0- 10 MHz or above, sine, square, triangle, saw tooth, pulse signal etc. generation	2 Nos.
35.	Co-efficient of expansion of solid operators	It will consist of a half-meter long chromium plated rod, Steam prepared in copper steam boiler, 2 Thermometers, 1 hot plate of 1kw.	2 Nos.
36.	Pressure mesurement trainer	1. Consisting one pressure process vessel minimum 20 liter capacity 2. Bourden tube pressure gauge (C and spiral type one each) (0-7 kg/cm^2) 3. diaphram type pressure gauge (0-7 kg/cm^2) 4. electronic pressure transmitter 5. (input 0- 7 Kg/cm2, output 4 to 20 mA)	1 units.

		6. pnumatic pressure trasmitter 7. (input 0-7 kg/cm2, output 3 to 15 psi) 8. Pressure switch(0-7 kg/cm2) 9. Absolute pressure gauge (7 kg/cm2) 10. FRL unit with input and output gauge All the instruments are with safety hand valve , flanged arrangement for easy assembling and dismantling, with all necessary accessories and meters for operating and measurement. Tank consisting two extra tapping for connecting any other measurements.	
37.	Various types of pressure gauges Burden type, Diaphragm type, Capsule type with 6inch dial	Dial size- 4 inch above Sensing element-SS or phosphor bronze Range- as required	2 Nos. each
38.	U tube manometer	Mercury filled, 600-0-600 mm or above	2 Nos.
39.	Well type manometer	Mercury filled, 0-30 inch or above	1 Nos.
40.	DP transmitter (electronic)	Supply voltage 24 V DC. Wetted part S.S. Output: 4 – 20 mA, HART compatible.	1 Nos.
41.	I to P and P to I converter trainer	I to P converter (input 4 to 20 mA, output 3 to 15 psi) P to I converter (input 0- 1 Kg/cm^2, output 4 to 20 mA) With pressure gauge0-2 Kg/cm^2, current meter and current source 0 to 20 mA, FRL unit working	2 Nos.

		setup.	
42.	Pressure comparator	capacity / Range – 0 -30kg/cm^2 or above	1 No.
43.	Dead weight tester	Capacity / Range – 0 – 30kg/cm^2 or above. It will consist of frictionless piston (ram) mounted on a rugged base, with Range of 0.5 – 30 kg/ cm2, Step Size of 0.1 kg/cm2, Accuracy of 0.2 to 0.1 %, to study the calibration of pressure gauge.	1 No.
44.	Electronic pressure calibrator	consisting pressure and current measurement, pressure hand/ motored pump to generate pressure, mA current and voltage sourcing, wide range of selectable measurement units for pressure, simultaneous pressure and current measurement	1 No.
45.	FLR (filter +Lubricator+ regulator)	Range- 0-5 Kg/cm^2 or above With input and output gauges	4 Nos.
46.	Mercury glass thermometer (consumable) various range and sizes	-	2 Nos. each
47.	Alcoholic glass thermometer (consumable) various range and sizes	-	2 Nos. each
48.	Bimetallic thermometer	0 to 100 ^{0}C, 0 – 200 ^{0}C	2 Nos. each
49.	Mercury in steel thermometer	0 – 200 ^{0}C or above.	1 No.
50.	Thermocouples (minimum 4 types)	J, K, E and N	1 No. each

Instrument Mechanic (Chemical Plant)

51.	RTD (minimum 2 types)		1 No. each
52.	RTD temperature transmitter/ indicator	Compatible PT, Ni, Cu etc. RTDs with digital display	2 Nos.
53.	Thermocouple temperature transmitter/ indicator	Compatible J,K,T,E,S, R, etc. thermocouples with digital display.	2 Nos.
54.	Optical Pyrometer	800-1000^{0}C or above Portable, battery operated. Digital /Analog display, 800°C to 1500 °C Measurement Range with accessories.	1 No.
55.	Thermocouple Type Pyrometer with Milli Voltmeter - with different types of Thermocouples	Water bath, heater, PID, temperature indicator, thyristor drive, gear motor with agitator, different thermocouples like J, K, pyrometer.	1 No.
56.	Radiation Pyrometer with Standard Accessories	250 to 900 ^{o}C Temp. range, DC Power Supply, scalable 4 – 20 mA Output.	1 No.
57.	Temperature calibrator	Measure popular RTD (Ni, PT, Cu etc.), THERMOCOUPLE(J,K,T,E,S, R, etc.), measures- resistance, volts, current of sensors and transmitters, act as source/ simulate to thermocouples, RTDs measuring instruments and transmitter.	1 No.
58.	Head type and quantitative Flow measurement and calibration setup with level measurement and calibration setup	[consisting Rotameter 1 No. Venturi tube (bronze) 1-inch size1 No. Orifice flow setup 1 No.	1 No.

		U tube manometer 1 No. Electronic DP transmitter/indictor 1 No. Rotating van flow meter 1 No. Process tank consisting following level measurement setup (with flanged setup and hand valve protection) Sight glass level indicator (open channel and close channel setup both) Float type level measurement Air purge level indicator Static pressure type level indicator (open channel and closed channel both) (pressure gauge type) with minimum one-inch pipe dia., one SS process tank (100 liters capacity or above) and one SS reservoir tank (150-liter capacity or above) pump should be above one HP, with all necessary accessories and meters for operating and measurement, all the meters are flanged arrangement for easy assembling and dismantling]	
59.	Electronic flow measurement and calibration setup and level measurement setup	consisting **Flow Measurement** Vertex flow meter Turbine flow meter Magnetic Flow meter Thermal Mass Flow meter. For	1 No.

		Gas Ultrasonic Flow meter Coriolis Flow meter **Level Measurement** Capacitance type level transmitter Noncontact type(ultrasonic) level transmitter Radar Type Level Transmitter with minimum one-inch pipe dia. one SS process tank (100 liters capacity or above) and one SS reservoir tank (150 liters capacity or above) pump should be above one HP, with all necessary accessories and meters for operating and measurement, all the meters are flanged arrangement for easy assembling and dismantling	
60.	Different types of Control valve cut view (double seated type) (with view of actuator parts, valve body-upper bonnet, bottom bonnet, trim parts, etc.)	Globe Valve, Gate Valve, Diaphragm Valve, Butterfly Valve	1 Nos.
61.	Control valve (equal percentage, linear, quick opening)set up	Pneumatic control valves of linear, equal % and quick opening type. S.S. water tank with 0.5 HP Mono block type pump, Rotameter, Air filter regulator and pressure regulator, Valve positioner, Air compressor, Closed loop water circulation system. Linear control valve of Pneumatic Type, 1/2" size, Input: 3-15 psig, Action: Air to open. Linear Equal % control valve of	1 No each

		Pneumatic type, 1/2" size, Input: 3-15 psig, Action: Air to close, Characteristic: Equal. Quick control valve of Pneumatic type, 1/2" size, Input: 3-15 psig, Action: Air to open, Characteristic: Quick. S.S.-304 Overhead tank with one valve at a time, S.S.-304 Receiving tank, with drain valve Tube with graduated scale at control valve inlet to pressure indication, Air regulator having range of 0-2.5 kg/cm^2, Pressure gauge having range of 0-2.5 kg/cm^2, The equipment is self-sufficient type including all necessary piping and valves and will not Require any more foundation.	
62.	Temperature control trainer	Complete unit consisting PID controller, HART transmitter, final control element and Heat Exchanger control type process with S.S. tanks, pumps and suitable pipe fitting and structure, computer inter face and software with all necessary accessories	1 No.
63.	Electronic Pressure control trainer	complete unit consisting PID controller, HART Transmitter, control valve, I/P converter, FRL unit and process tank/vessel, with gauges computer inter face and software, with all necessary accessories and piping systems	1 No.

64.	PLC (Micro PLC) Trainer	Micro PLC DI-8 or above DO-4 or above AI and AI – each 2 or above (at least digital 4 input & 4 Output,4 analog input & output) At least digital 8 input & 8 Output, 4 analog input & output with simulation software and hardware for understanding PLC programming and functioning.	1 No.
65.	DCS Training Kit	DI-16 or above DO-16 or above AI and AI – each 8 or above Programming software. True distributed control system having dedicated redundant function controller, power supply, communication modules, and integrated software modules, algorithms for complex process control. consist of small pilot plant with different control action using basic parameters like level, temperature, flow, pressure, ratio, feed forward, cascade. To study about DCS kit. To study various control parameters like pressure, temperature, flow & level.	1 No
66.	Plant with various type of parameter like temperature, pressure, level, flow, Controller, recorder and transmitter pipe fittings, pumps and valves etc	Level transmitter, Pressure transmitter, Temperature transmitter, Globe valve of ½" connection, Rotameter, I/P converter, Seamless Data Transfer Unit, Flow transmitter, Air compressor, The unit will consist of necessary piping, fittings, standard pneumatic lines and electrical connections provide wherever necessary. The setup will be mounted on suitable structure MS framework.	1 No

		Window compatible software package will have developed using SCADA software.	
67.	PLC & SCADA Training Kit	(at least digital 4 input & 4 Output,4 analog input & output) At least digital 8 input & 8 Output, 4 analog input & output with simulation software and hardware for understanding PLC programming and functioning. Also, With Industrial User friendly SCADA software having with two-way communication for control and data acquisition. Also, with Manual and automatic control with mode Selection facility and Live mimic diagrams & trends with Dynamic multi-color data display.	1 Nos.
68.	Pneumatic controllers for pressure, flow, temperature and level with associated equipment	Pneumatic PID Controller with Scale for Set Point & Process, Input/output 0.2 to 1.0 Kg/cm2 and Range 0 to 100 (% or Deg. C) Having with selectable Control Mode & Control Action. with Pneumatic DP transmitters (for pressure, flow & level system) and pneumatically operated diaphragm operated globe type control valves each for parameter to control all four systems with require close loop system, mounted on suitable frame structure.	1 Nos.
69.	**Electric Work Bench: Type B** 1. Voltmeters (0-230 V AC) 2. Voltmeters (0-230 V DC) 3. Ammeters (0- 5 A AC & DC). 4. Wattmeter Dynamometer (0-3000 W) 5. Power Factor Meter. 6.Vibrating Frequency Meter (0-60 HZ)	With necessary electrical components such as AC/DC voltmeters, AC/DC Ammeters, power factor meter, watt meter, energy meter, frequency meter and ohmmeter to calibrate analog and digital meters using the bench.	1 Nos.
70.	**Instrumentation Work Bench: Type**	1.Dual Power Supply - 0 to 30	1 Nos.

	A 1.Dual Power Supply - 0 to 30 Volts, 5 Amp 2. Digital Multimeter (3 ½ Digit) 3. Air Filter & Regulator 4. Compressed Air Supply 5. Digital Pressure Indicator for pressure measurement 6. I TO P convertor 7. Utility socket with 230 V AC 8. Oscilloscope 9. Function Generator	Volts, 5 Amp 2. Digital Multimeter (3 ½ Digit) 3. Air Filter & Regulator 4. Compressed Air Supply 5. Digital Pressure Indicator for pressure measurement 6. I TO P convertor 7. Utility socket with 230 V AC 8. Oscilloscope 9. Function Generator	
71.	Pressure and Flow Control loop (With PLC Controller)	Made up of S.S. sump tank, pump, pressure vessel, pressure transmitter, air compressor, rotameter, DP transmitter, orifice plate assembly, PLC modules, HMI modules control valves with Actuators, I/P converters, air regulators, current meters, pressure gauges, mounted on suitable frame structure.	1 Nos.
72.	Packed distillation column with DCS / PLC system.	With DCS / PLC system made up of S.S. of 1000 mm (H) 75 mm (D) with sight glasses, feed tank, cold water tank, steam generator, rotameters, temperature Scanner, Shell & Tube type heat exchanger, pumps, Reflux drum, solenoid valve, product collection tank, suitable pipes and fittings, seamless data transfer unit, SCADA, computer, HMI, ether net. Mounted on Suitable Frame Structure.	1 Nos.
C : GENERAL FURNITURE			
73.	Class Room Chairs (armless) / Dual desk may also be allowed		20 nos.
74.	Class Room Tables / Dual desk may also be allowed	3ft X 2ft	20 nos.
75.	Chair for Trainer (armed) movable		01 no.
76.	Table for Trainer with Drawer and cupboard	4 ½ ft X 2 ½ ft	01 no.

77.	LCD / LED Projector		01 no.
78.	Multimedia Computer System with all accessories with UPS	Latest configuration PC With LCD / LED display	01 set
79.	Computer Table		01 no.
80.	White Board	6ft X 4 ft	01 no.
81.	LCD Projector Screen		01 no.
82.	Wall charts, Transparencies and DVDs related to the trade		As required

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: INSTRUMENT MECHANIC (CHEMICAL PLANT)
LIST OF TOOLS& EQUIPMENTS FOR -20APPRENTICES

1) **Space Norms** : 120 Sq. m. (For Engineering Drawing)

2) Infrastructure:

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

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

ANNEXURE-II

FORMAT FOR INTERNAL ASSESSMENT

Name & Address of the Assessor :													**Year of Enrollment :**		
Name & Address of ITI (Govt./Pvt.) :													**Date of Assessment :**		
Name & Address of the Industry :													**Assessment location: Industry / ITI**		
Trade Name :		**Semester:**											**Duration of the Trade/course:**		
Learning Outcome:															
Sl. No	**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														