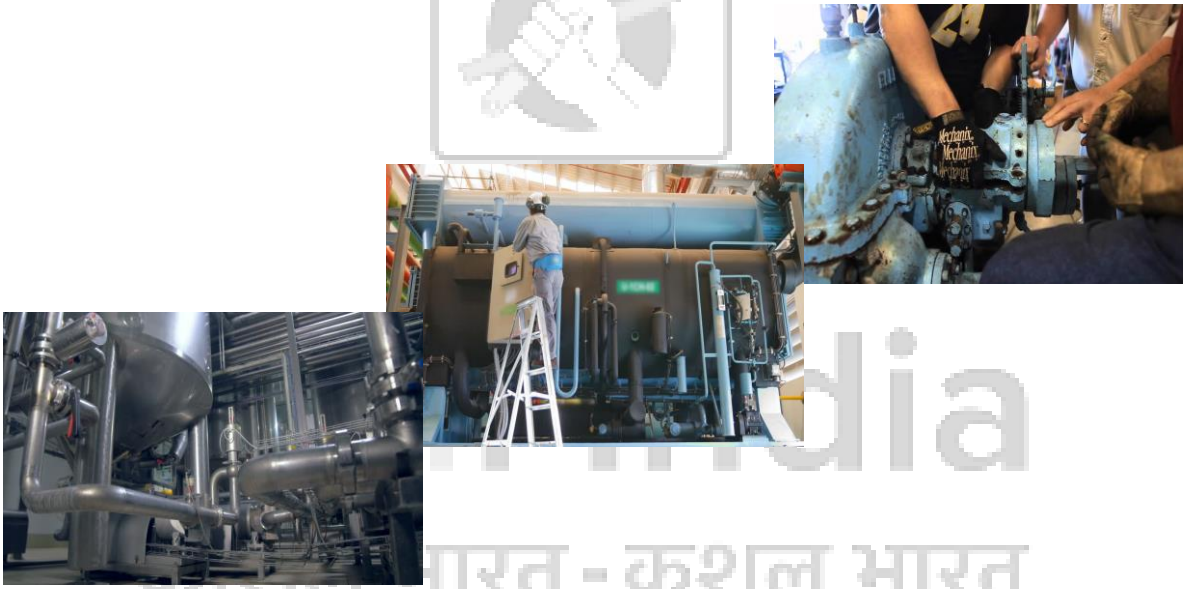
MAINTENANCE MECHANIC (CHEMICAL PLANT)

COMPETENCY BASED CURRICULUM

(Duration: 2 Yrs.)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL- 5



SECTOR – CHEMICAL

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

MAINTENANCE MECHANIC (CHEMICAL PLANT)

(Revised in 2018)

APPRENTICESHIP TRAINING SCHEME (ATS)

NSQF LEVEL - 5

Developed By

Ministry of Skill Development and Entrepreneurship
Directorate General of Training
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Special acknowledgement is extended by DGT to the following expert members who had contributed immensely in this curriculum.

Co-ordinator for the course: Sh. ……..

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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.

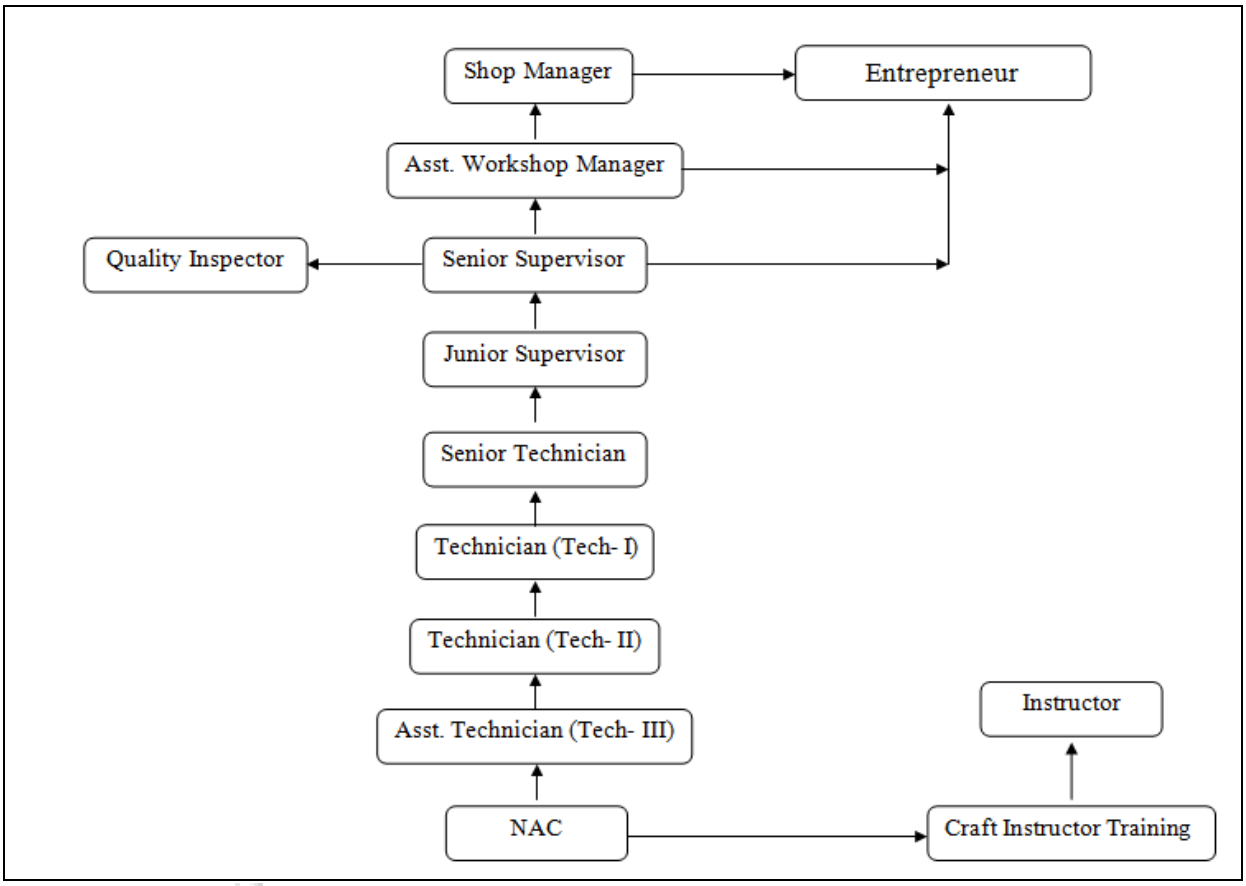
"Maintenance Mechanic (Chemical Plant)" trade under ATS is one of the most popular courses delivered nationwide through different industries. The course is of two years (02 Blocks) duration. It mainly consists of Domain area and Core area. In the Domain area Trade Theory & Practical impart professional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

- Maintenance mechanic in chemical plant covers all professional knowledge & skill to maintain the plant equipments & machineries in good, safe & effective running conditions .Also helps the plant operations to run smoothly. This course helps the apprentice to achieve job opportunity & self employment.
- Enhancement of training for preparing skilled man power as per need of chemical industries.
- To minimize skill gap between trainee and industry
- As per industrial development now a day in India, more skilled man power is required to improve the skill technique.
- Familiarization with industrial exposure.
- Up-gradation of employability ratio.

2.2 CAREER PROGRESSION PATHWAYS:

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



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. 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 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 of "Maintenance Mechanic (Chemical Plant)" is

Mechanic Maintenance (Chemical Plant); repairs and overhauls chemical plant, machinery and equipment periodically and on break downs to maintain them in efficient operating condition. Studies methods of processing of raw material to finished products. Examines plant and equipment to locate faults and removes minor defects on spot. Reports major defects and break downs to Chemical Engineer and dismantles defective unit as directed with necessary precaution, using hand tools, adopter, twists etc. as necessary. Replaces or repairs defective parts and components by re-metalling, filling, drilling, grinding, scraping, soldering, brazing, etc. as required and reassembles unit according to specifications with prescribed precautions particularly for explosive, gas acid and other chemical plants, ensuring correct alignment clearance, valve operations, adjustments, flow of material operational functions and other necessary details. Tests assembled unit for proper performance, makes further adjustments, if necessary and gets assembled if examined by appropriate authority before handing over to production. Checks, adjusts and lubricates equipment periodically or gets it done and performs other tasks to maintain plan in proper working order. May maintain records of parts examined, repairs done, replacements made and plant performance. May erect and install equipment under the guidance of Chemical Engineer.

Reference NCO: 7233.1100 – Mechanic Maintenance (Chemical Plant)

4. NSQF LEVEL COMPLIANCE

NSQF level for "Maintenance 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 Maintenance 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	**Maintenance Mechanic (Chemical Plant)**
NCO - 2015	**7233.1100 – Mechanic Maintenance (Chemical Plant)**
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 Apprenticeship	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 Maintenance Mechanic (Chemical Plant) Apprenticeship	Maintenance Mechanic (Chemical Plant)

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 "Maintenance 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 -Work, Power & Energy, Geometry & Mensuration, Heat & Temperature, Levers & Simple machine, Centre of gravity, speed and velocity Pressure, flow of fluids, viscosity, Reynolds number,]*
3. Interpret specifications, different engineering drawing and apply for different application in the field of work. *[Different engineering drawing-Geometrical construction, Dimensioning, Method of representation, Symbol, scales, Machined components & different thread forms, Assembly drawing, Sectional views, freehand sketches of valves , free hand flow sheets of manufacturing of Sulphuric acid, nitric acid, urea, Ammonia, ethanol, free hand sketches of distillation column, size reduction equipments, pressure, level, flow ,temperature control system.]*
4. Acid & base titration, boiling point ,melting point, P^H measureurment ,static friction, pipe fittings and gasket cutting ,operation & overhauling of pumps and valves,
5. Select and ascertain measuring instrument and measure dimension of components and record data.
6. Explain the concept in productivity, quality tools, and labour welfare legislation and apply such in day to day work to improve productivity & quality.
7. Explain energy conservation, global warming and pollution and contribute in day to day work by optimally using available resources.
8. Explain personnel finance, entrepreneurship and manage/organize related task in day to day work for personal & societal growth.
9. Plan and organize the work related to the occupation.

6.2 SPECIFIC LEARNING OUTCOME

Block – I

1. Role & duties of Maintenance Mechanic (Chemical Plant) in chemical process Industry.

2. Safety precautions observed while working as Maintenance Mechanic (Chemical plant) in chemical process plant.
3. Prepare different types of documentation as per industrial need by different methods of recording information.
4. Familiarization of different section of chemical plant, raw materials used, Product capacity of production, flow sheet, writing report, etc.
5. Familiarization of Safety, Health & Environment (SHE) in chemical Plant, PPEs ,fire extinguishers, good housekeeping ,fire hazards & toxic hazards on site & offsite emergencies. Familiarization of plant utilities, pipe colour coding.
6. Plan and organize the work to make job as per specification applying different types of basic fitting operations and check for dimensional accuracy. [Basic fitting operation – marking, hack-sawing, punching, chiselling, filing, drilling, countersinking, counter boring, reaming, taping, pipe threading etc., accuracy: ± 0.25mm]
7. Make a step fit of components for assembling as per required tolerance. [Step fit, required tolerance: ±0.04 mm]
8. Plan, identify & perform different operation – Experiments related to safety & general .awareness in chemical industries. (Diff. operations – select & operate proper fire extinguisher as per demand, identify chemicals hazards, PPE's, read & obtain relevant data).
9. Identify and install / connect instruments / devices to measure pressure, temp., flow & level, record readings. (Instruments / devices - bourden tube, capsule type gauge, mercury in glass, bimetallic thermometer, RTD, Orifice meter, venturimeter, rotameter, sight glass type, air purge type & capacitance type level indicator.
10. Installations of flow meters, pumps and valves , compressors ,fans ,blowers ,heat exchange equipments , mass transfer equipments, heat & mass transfer equipments, agitation and mixing equipments , waste management ,water treatment equipments, chemical reactor, drying equipments and air pollution control measures equipments and their maintenance work.
11. Understand term vacuum and it's utilization in chemical industries. Overhauling and troubleshooting of vacuum pump and checking for proper functioning.
12. Identify different types of valve, their specific application. Carry out overhauling procedure for different types of valves.
13. Plan, dismantle, trouble shoot, clean & reassemble different machine & components for transportation of liquid and check their functionality, uses of different types of pumps.
14. Repair & maintenance work of equipments and machineries of chemical process plant.

Block – II

15. Familiarization with sample quality control tests (Quality control).

16. Routine chemical plant jobs such as start up and shut down of plants, taking readings in log sheet , replacement of gland seal /mechanical seals/gasket/coupling ,chains, keys. Cleaning of tubes of heat exchangers, etc.
17. Understand & explain different types of maintenance, their importance and frequently record keeping. Types of maintenance – online, predictive, preventive, breakdown and effective maintenance.
18. Routine maintenance, preventive maintenance, overhauling and installation of cooling towers, humidification & refrigeration unit, absorption towers, adsorption equipments, crystallizers, industrial filtration equipments, sedimentation and coagulation equipments, size reduction and size separation equipments.
19. Power transmission device – belt, pulleys and their design, material & mountings. Checking functionality.
20. Machinery handling and their installation as per standard procedure, it's planning & implementation.
21. Identify major parts and function of pressure vessel, various pipe fittings, valves, parameters and other attachments. Operating and working of pressure vessel, its care and safety precautions taken while working on pressure vessel.
22. Knowledge about utilization of steam and its classification. Plan, dismantle, trouble shoot, clean scale formation & reassemble. Electrode & Oil fired boiler.
23. Identify term size reduction and operate size reduction machine (jaw crusher, hammer mill, ball mill). Carry out size analysis with proper screening equipments & their maintenance.
24. Identify term mixing & agitation and its importance. Knowledge about construction details, operating & working and its maintenance. Types of mixer & agitators.
25. Identify importance of conveyor to convey materials in chemical industries. Specification of conveyor and elevators. Knowledge about construction details, operating & working, its maintenance, Trouble & trouble shooting. Types of conveyors and elevators.

26. Repair & maintenance work of equipments and machineries of chemical process plant. (The practical for this component may be demonstrated by video)

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

7. LEARNING OUTCOME WITH ASSESSMENT CRITERIA

GENERIC LEARNING OUTCOME	
LEARNING OUTCOMES	**ASSESSMENT CRITERIA**
1. Recognize & comply safe working practices, environment regulation and housekeeping.	1. 1. Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	1. 2. Recognize and report all unsafe situations according to site policy.
	1. 3. Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	1. 4. Identify, handle and store / dispose off dangerous/unsalvageable goods and substances according to site policy and procedures following safety regulations and requirements.
	1. 5. Identify and observe site policies and procedures in regard to illness or accident.
	1. 6. Identify safety alarms accurately.
	1. 7. Report supervisor/ Competent of authority in the event of accident or sickness of any staff and record accident details correctly according to site accident/injury procedures.
	1. 8. Identify and observe site evacuation procedures according to site policy.
	1. 9. Identify Personal Productive Equipment (PPE) and use the same as per related working environment.
	1. 10. Identify basic first aid and use them under different circumstances.
	1. 11. Identify different fire extinguisher and use the same as per requirement.
	1. 12. Identify environmental pollution & contribute to avoidance of same.
	1. 13. Take opportunities to use energy and materials in an environmentally friendly manner
	1. 14. Avoid waste and dispose waste as per procedure
	1. 15. Recognize different components of 5S and apply the same in the working environment.
2. Understand, explain different mathematical calculation & science in the field of study including basic	2.1 Explain concept of basic science related to the field such as Material science, Mass, weight, density, speed, velocity, heat & temperature, force, motion, pressure, heat treatment, centre of gravity, friction.

electrical and apply in day to day work.*[Different mathematical calculation & science -Work, Power & Energy, Algebra, Geometry & Mensuration, Heat & Temperature, Levers & Simple machine, Centre of gravity, flow of fluid , Pressure, Viscosity ,Reynolds's number]*	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 & earthling.
	2.8 Different types of flow, viscosity, Reynolds's number
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, Machined components & different thread forms, Assembly drawing, Sectional views,]*	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.
	3.4 Symbolic representation of valves, free hand sketches of size reduction equipments, distillation column ,flow sheets of Sulphuric acid, Nitric acid, .Ammonia, Urea, Ethanol, etc.
4. Select and ascertain measuring instrument and measure dimension of components and record data.	4.1 Select appropriate measuring instruments such as micrometers, vernier callipers, 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 with given drawing/measurement.
5. Chemical sample analysis	5.1 Acid-base titration, distillation, BP, MP, P^H measurement. Sample analysis.
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, and 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	
*Assessment Criteria i.e. the standard of performance, for each specific learning outcome mentioned under **block – I & block – II**(section: 10) must ensure that the trainee achieves well developed skill with clear choice of procedure in familiar context. Assessment criteria should broadly cover the aspect of **Planning** (Identify, ascertain, estimate etc.); **Execution** (perform, illustration, demonstration etc. by applying 1) a range of cognitive and practical skills required to accomplish tasks and solve problems by selecting and applying basic methods, tools, materials and information 2) Knowledge of facts, principles, processes, and general concepts, in a field of work or study 3)Desired Mathematical Skills and some skill of collecting and organizing information, communication) and **Checking/ Testing** to ensure functionality during the assessment of each outcome. The assessments parameters must also ascertain that the candidate is responsible for own work and learning and some responsibility for other's work and learning.*	

8. SYLLABUS

BASIC TRAINING (Block – I)

Duration: (03) Three Months

Week No.	Professional Skills (Trade Practical)	Professional Knowledge (Trade Theory)
1	Introduction of glass wares used in chemical laboratory. Acid base titration, first aid method and basic training	Introduction of chemistry, branches of chemistry, importance of chemistry, safety precautions to be taken in Chemistry Laboratory, different equipment and apparatus used in Laboratory **Importance of housekeeping & good shop floor practices.** Introduction to 5S concept & its application. **Occupational Safety & Health**: Health, Safety and Environment guidelines, legislations & regulations as applicable.
2	Acid base titration & Preparation of soap	Atom, molecule, Element, compound, mixture, Physical change, chemical change, Acids, bases, salts &their properties. Molecular weight, equivalent weight, atomic weight, Normality, molarity, etc.
3	Simple distillation & fractional distillation	Sources of water, hard and soft water, causes and removal of hardness.
4	Boiling point, melting point, P^H measurement	Purification processes, organic reactions, Boiling point, Melting point, Distillation
5	Law of parallelogram of forces. Coefficient of static friction	Introduction to Physics, Scalar and Vector quantities, their representation, resultant. Triangle and parallelogram laws of forces.
6	M.A, V.R & Efficiency by inclined plane. ‘ g’ by simple pendulum	Simple machine Inclined plane, Lever, Screw jack, pulley Motion – uniform, circular & rotational motion.
7	Coefficient Of cubical expansion Coefficient Of linear expansion Thermal conductivity of metal	Modes of heat transfer, determination of thermal conductivity. Temperature & its measurement, expansion of solid, liquid and gases.
8	Verification of ohm’s law Specific resistance of wire by Wheatstone bridge	Electricity- Ohm's law, series & parallel connections, specific resistance.
9	ECE of copper J by electrical method	Electrolysis Faraday’s First & Second law of electrolysis Calorimetry, mechanical equivalent of heat, 'J' by electrical method

10	Measuring & marking practice on MS flat with using universal scribing block. Hacksawing practice on MS flat. Filing flat surface and Checking flatness and squareness using engineer's try square. Drilling and reaming Countersinking & counter boring practice,	**Basic Fittings:-** **Hand Tools**:- Description, construction and uses of different hand tools such as hacksaw, files, hammer & chisels. **Measuring Tools**:- Description, construction, calculation and uses of different linear measuring instruments – Vanier caliper, vainer depth gauge, height gauge, micrometer outside, bevel protector. Direct & indirect measurement tool such as, steel rule, caliper, engineering try square. **Marking Tools** :- Description, construction, type and uses of different marking tools such as punches, scriber, scribing block, combination set, **Job Holding Device**: - Description, construction, type and uses of different job holding devices such as vice, V'- Block with 'C' clamp. Drilling, Reaming, Counter sinking, Counter boring.
11	Pipe fitting and gasket cutting	Different types of pipe joints, Gasket materials for particular applications-cork sheet, oil-proof paper etc
12	Dismantle, clean & reassemble of different types of valve. Dismantle, clean & reassemble of different types of pumps. Operation of centrifugal pump, reciprocating pump and gear pumps.	Construction, working and uses of various types of valves. Construction, working and uses of various types of pumps
13	Dismantle, clean & reassemble of different types of pumps.	Types of maintenance in industry – preventive, predictive, breakdown, daily, online, effective.
	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	Occupational Safety & Health (OSH). Importance of housekeeping & good shop floor practices. Introduction to safety equipment and their uses in chemical plant. Personal protective Equipments (PPEs). Use of Fire extinguishers Study of chart of MSDS Of chemicals which is mostly used in chemical industry.	Role of Maintenance Mechanic (Chemical Plant) in chemical plant. Introduction about chemical industrial work. Introduction to Unit Operations and Unit processes, their meanings. Features of unit Operations. Soft Skills: its importance and Job area after completion of training Introduction of First aid. Operation of electrical mains. Introduction of PPEs. Introduction to 5S concept & its application. Response to emergencies eg; power failure, fire, and system failure. **MSDS of Chemicals**:- Material safety data sheet (MSDS)of acids, bases , hydrocarbon & solvents
2	Application of various fitting tools for maintenance. Application of various Fastener and locking device such as Nut bolt, wisher, pins etc. Making of key & keyways in shafts, using cross cut chisel.	**Fitting and Maintenance :-** Introduction about various fitting tools for maintenance., such as spanner, Allen key, pipe wrench, screw driver, hammer, chisel, punch, steel rule, pliers, caliper, circlip pliers, file, spirit level, etc. **Fastener and Locking Devices :-** Types & uses fastener & locking device. **Key & Keyways: -** Various, types of keys, allowable clearance and tapers, proportion of keys based on dia. of shaft. Repairing of Key ways.
3	Online maintenance & Record maintaining of workshop equipments. Overhauling of all machineries and gear boxes in workshop Breakdown maintenance work on workshop machineries & equipments Lubrication practice on workshop/ machineries & equipments	**Lining:-** lead lining, rubber lining, FRP lining, glass lining. **Lagging :-** Importance of lagging (Insulation), types of lagging material and its application **Maintenance :-** Definition &types of maintenance, Advantage of preventive maintenance and disadvantage of breakdown maintenance. Making of check list. Work Permit System

		(WPS). **Lubrication**: - Definition, Quality of good lubricant, grade of lubricants, different method of lubricating system, selection of good lubricant.
4	Practical on fitting and removing of bearing with bearing puller. Practical on maintenance of gear boxes Making of gasket on given flange. Practical on maintenance of bearing & gearbox.	**Bearing**:-Classification of bearing, i.e. bush bearing, solid bearing journal bearing, ball bearing-single row, double row, self-aligned ball bearing, angular contact ball bearing. thrust bearing, roller bearing-taper, cylindrical roller bearing, construction &application of all bearings, care& Handling of bearing. **Gear boxes:** Types and uses of gear such as spur gear, helical gear, bevel gear, meter gear, worm Gear etc. Selection of gear. MoC of gear. Types of gear boxes. **Gasket & Packing :** Uses, material of gasket &packing's. Types of gaskets &packing's. Gland packing
5	Practice on installation of mechanical seal & testing Dismantling, cleaning, repairing, and reassembling of different types of valves. Dismantling, cleaning, repairing, and reassembling of centrifugal pump, reciprocating pump, gear pumps, vacuum pump.	**Mechanical seal: Types** of mechanical seal care and handling of mechanical seal, material of seal, application of mechanical seal. Oil seals and its specification. **Valve**:-Definition and Types of valve. Principle, Construction details, & working of different types of valves and their maintenance, trouble& trouble shooting. **Pumping Device For Liquid:** -Definition, use, types of pump (Centrifugal pump & positive displacement pump) and their maintenance, trouble & trouble shooting. **Vacuum System: -** Definition of vacuum. vacuum generation in vacuum pumps & jet ejector.
6	Dismantling, cleaning & repairing and reassembling of fan & blower Dismantling, cleaning & repairing and reassembling of centrifugal compressors & positive displacement compressors. Rearrange coupling of pumps. Operation & maintenance of reciprocating compressors.	**Compressor Blower & Fan :-** Definition, use, types Its maintenance, trouble& trouble shooting of all types of compressors **Power transmission elements :** **Coupling :-** types of couplings i.e. flange coupling, muff coupling, types of coupling, universal coupling, bush pin type coupling and their applications

		Belt:-The object of belts, their size & specification, material of belt, selection of belt, load and tension. Advantages and disadvantages of belt
7	Standard practice on alignment of pump shaft with motor shaft using two dial gauge. Installation and erection of machine as per standard procedure. Practical on working of lifting appliances.	**Alignment:-**Requirement of alignment. Causes and effect of misalignment. Different method of testing alignment, i.e. Alignment by straight edge, alignment by dial gauge (radially &axially), and alignment by laser system (3 axes system) . **Installation of Machinery:** Receiving, checking, foundation, installation, leveling, alignment, **Lifting & handling**:-Various types of lifting and lowering devices such as chain block, crane, screw jack, hydraulic jack, material handling devices , fork lift, hand trolley.
8	Maintenance practical on pressure vessel	**Pressure Vessels/ Reactor**:-Types of pressure vessels, care and maintenance of pressure vessels.
9	Installation of flow meters (orifice meter, venturi meter, pitot tube and rotameter)	Orifice taps, construction of orifice meter, venurimeter, pitot tube and rotameter, precaution to be taken during their installation.
10.	To operate shell and tube heat exchanger and maintenance work while operating if any To operate vertical tube evaporator and maintenance work while operating if any	**Heat Transfer:** Mechanism of heat transfer in solid, liquid and gases and their application in industries, thermal conductivity. Heat transfer equipments. **Evaporation:** Definition, classification of evaporators, Capacity, steam economy of evaporators
11	Operation & maintenance of distillation column, mixer settler, spray extraction column Flooding velocity experiment using a packed glass column	**Distillation**: Definition, distillation process, method & types of distillation. Distillation column. Types of column (packed & plate) construction details, operating & working, Its maintenance, trouble& trouble shooting. Theory of extraction and leaching and absorption.
12	Operation and maintenance of i) Plate and frame /washing –non-washing filter press ii) Rotary drum vacuum filter,	**Filtration :-** Definition, Filtration media, filtration equipment (plate & frame / washing –non washing filter press, rotary drum vacuum

	iii) Top/ bottom driven centrifuge Operation and maintenance of i) Jaw crusher, ii) Ball mill, iii) Hammer mill, iv) Vibrating screen.	filter, centrifuge, leaf filter, nustch filter, ANFD, sparkler filter) operating & working, its maintenance, Trouble& Trouble shooting **Size Reduction :** Definition, Advantages of size reduction, Crushing& Grinding, Classification, Equipments (black jaw crusher, hammer mill, ball mill), operating & working, its maintenance, Trouble& trouble shooting **Screening:** Mesh number, classification of screening equipments.
13	Operation and maintenance of tray drier.	Drying: introduction, vapour pressure curve for water, relative humidity, rate of drying, tray drier, rotary drier.
	Assessment/Examination 03 days	

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

9. SYLLABUS - CORE SKILLS

9.1 WORKSHOP CALCULATION SCIENCE & ENGINEERING DRAWING

Block – I		
Sl. No.	**Workshop Calculation and Science (Duration: - 20 hrs.)**	**Engineering Drawing (Duration: - 30 hrs.)**
1.	**Unit**: Systems of unit- FPS, CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units **Material Science** : Properties -Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and non-Ferrous metals	**Engineering Drawing: Introduction and its importance** - 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.
2.	**Fractions**: Fractions, Decimal fraction, Addition, Subtraction, Multiplication and Division of Fractions and Decimals, conversion of Fraction to Decimal and vice versa. Simple problems using 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	**Drawing of Solid figures** (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and

	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	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, cuboids, cylinder and Sphere. Surface area of solids – cube, cuboids, 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, Tweezers. Free-hand sketches of Vernier Calliper, 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

Block – II		
Sl. No.	**Workshop Calculation and Science (Duration: - 20 hrs.)**	**Engineering Drawing (Duration: - 30 hrs.)**
1.	**Calculation:** Archimedes's principle, principle of floatation hydrometers. Centre of gravity and Equilibrium condition. **Science:** 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.	**Calculation:** Pressure, temperature, Boyle's law, Charles's law, Equation of perfect gas. Calculations. **Science** :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.	**Calculation**: Centre of Gravity, (C.G. Of square, rectangle, triangle, circle, semicircle, cone) & its calculations **Science:** 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 **Science** : 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, etc. .
5.	**Flow of fluids:** Flow measurement by orifice meter, venturimeter, Rotameter, U-tube manometer. Reynolds's number, at different velocities. **Science :** Latent heat, sensible heat, saturated steam, wet steam, superheated steam.	Flow sheet / Block diagram of 1.Sulphuric acid 2.Nitric acid 3.Ammonia 4. Urea 5. 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, Vibroacoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.
Accident & safety	Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.

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

10. DETAILS OF COMPETENCIES (ON-JOB TRAINING)

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

Block – I

1. Safety and best practices (5S, KAIZEN, etc.)
2. Store procedure, Record keeping, inventory management and documentation.
3. Identification and testing of equipments and machineries of chemical plant.
4. Repair &Maintenance work of equipments and machineries of chemical plant.

List of installation /operations/maintenance /overhauling /trouble shooting of equipments and machineries in Petro Chemicals, heavy chemicals, fire chemicals, paper and pulp, Cement, pharmaceutical ,Fertilizer and allied chemical industries.	
Sl. No	**List of maintenance skills to be covered in chemical process plant.**
5.	Introduction in safety precautions as applicable to the trade
6.	**Orientation :** The plant and its product, raw materials, capacity of production, its hazards. Different sections of the plant including process, maintenance and their activities. Study of the process and operations carried out in the establishments with the help of simple flow sheet under the guidance of plant-in-charge / supervisory familiarization with the equipment, used in the establishment by actually going round the plant. Writing brief report (Diary) of day to day work.
7.	**Safety :Safety management (General awareness)**
8.	Familiarization with utilities and service lines such as steam, cooling water, chilled water, brine, vacuum, compressed air, refrigeration, air conditioning units etc. Familiarization with colour code system of pipe lines used in chemical industries
9.	**Maintenance Shop** : Fitting if simple parts of machines and equipments such as keys, gland, mechanical seal etc. Threading pipes, drilling, reaming and taping blocks. Expanding tubes in the tube sheet of heat exchanger. Scraping and bedding of bearing, valves lapping. Pipe fabrication and replacement as per the Blue Print. Cutting of threads on pipes and rods by dies. Gas and arc welding on pipes, (welding process) if available. PP/HDPE/FRP welding, if available, lead lining and rubber lining, if available.
10.	Routine maintenance, preventive maintenance, overhauling and installation, depending on their availability in the industry of the following equipment / material. (i) Installation of Flow meters, pipe fitting and joints (ii) Pumps, compressors, blowers, fans, steam ejectors. (iii) Heat exchangers, boilers, furnaces, kilns. (iv) Distillation columns / plants /crude oil Refinery process (v) Evaporators and their accessories, Barometric condensers and refrigeration units. (vi) Solvent (liquid –liquid) Extraction units and leaching (solid –liquid) extraction

	units (vii) Agitation ,mixing and blending equipments (viii) Waste Management (ix) Water Treatment Plant (x) Storage Facility, Chemical Reactors (xi) Air Pollution Control Measures equipments (APCM) such as electrostatic precipitator /cyclone separator/ venturi scrubber, bag filter ,etc. (xii) Various drying equipment & their maintenance

Block – II

List of installation /operations/maintenance /overhauling /trouble shooting of equipments and machineries in Petro Chemicals, heavy chemicals, fire chemicals, paper and pulp, Cement, pharmaceutical , Fertilizer and allied chemical industries	
Sl. No	**List of maintenance skills to be covered in chemical process plant.**
11.	**Quality Control** Familiarization with sample quality control tests.
12.	**Routine Plant Jobs** (i) Fitting of flanges of equipment or in pipeline. (ii) Fitting of pressure and vacuum gauges, thermometers etc. winding of recorders (iii) Removal of chart and inking of pens of recorders. (iv) Replacement of packing seal/gasket seal in pipe flanges. (v) Changing of belts coupling, Chain etc. (vi) Valves lapping. (vii) Cleaning of evaporator tubes, heat exchangers etc. (viii) Mitigation of emergencies in the plant i.e. leakage / fix / process chemicals –toxic hazards
13.	Routine maintenance, preventive maintenance, overhauling and installation, depending on their availability in the industry of the following equipment / material. (i) Cooling towers, humidification & refrigeration units. (ii) Absorption towers, adsorption equipments (iii) Dryers and crystallizes. (iv) Industrial Filtration equipments , sedimentation and coagulation (v) Size separation and size reduction equipments. (vi) Material handling and conveying equipments (vii) Power transmission – line shaft, clutches reduction gear, coupling etc. (viii) Thermal insulation, bearings, gear box , lubrication work ,Solar power plant,

Note:

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

ANNEXURE – I

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

LIST OF TOOLS AND EQUIPMENT FOR THE TRADE OF MAINTENANCE MECHANIC (CHEMICAL PLANT)			
Sl. no.	**Name of the Consumable Items Chemistry lab**	**Specification**	**Quantity (No/Nos.)**
1.	Pipette Measuring	10 ml Borosilicate	6
2.	Burret stand		6
3.	Burette Clamp		6
4.	Clamp Holder		6
5.	Beaker Borosilicate	250 ml	6
6.	Burette Boro flow	25 ml Borosilicate Glass	6
7.	Volumetric Flask	500 ml	6
8.	Watch Glass	9 cm	6
9.	Spatula	8”	2
10.	Funnel	9 cm	6
11.	Conical Flask	250 ml Borosilicate Glass	6
12.	Rubber Teat	for 10 ml pipette	6
13.	Bottle for solution	1000 ml	6
Tools & Equipment			
14.	Divider Spirng Type -	150 mm	6
15.	Punch Center	Diameter -10 mm and Length - 100 mm	6
16.	Punch Prick	100 mm	6
17.	Letter and Number Punch	5mm	1
18.	Scriber- Straight	150 mm	6
19.	Hacksaw Frame - Fixed	300 mm	6
20.	File - Flat - Bastard	250 mm	6
21.	File - Flat - Second Cut	250 mm	6
22.	File - Flat - Smooth	250 mm	6
23.	Chisel - Cold - Cross Cut	9 mm X 150 mm	6
24.	Chisel - Cold - Flat	20 mm X 150 mm	6
25.	Chisel - Diamond Point -	9 mm x 150 mm	5
26.	Hammer - Ball Pein	250 grams	6
27.	Hammer - Ball Pein	500 grams	6
28.	Screw Driver	9 X 300 mm	4
29.	Drill Twist Set - Straight Shank	3 mm to 13 mm by 0.5 mm	1
30.	Drill Twist Set - Straight Shank	9.8 mm	1
31.	Hand Reamer Parallel	10 mm	2

32.	Tap set	12 mm	2
33.	Allen Keys Set	Hexagonal - 1 - 12 mm, set of 12 Keys	1
34.	V Block	75 x 75 x 50 mm with Clamp (Hardened & Ground)	1
35.	Bench Vice -	125 mm	6
36.	Safety goggle (white)		6
37.	Pliers – combination,	8”/20 cm	4
38.	Phillips head screw driver set	1-4 sizes	1
39.	Double ended Open spanners.	set of 6x7,8x9, 10x11,12x13,14x15,16x 17, 18x19,20x22,21x23,24x 27, 25x28,30x32	1 set
40.	Double ended Ring spanners	set of 6x7,8x9,10x11, 12x13,14x15,16x17, 18x19,20x22,2 1x23,24x27,25x28,30x3 2.	1set
41.	Circlip Plier,	8''(internal)	1
42.	Circlip Plier	8''(External)	1
43.	Spanner	Adjustable - 200 mm	1
44.	Pipe Wrench	450 mm	1
45.	Steel Rule	Unit 300 mm, Graduated both in Metric and English	6
46.	Try Square	150 mm	6
47.	Caliper - Inside Spring	150 mm	6
48.	Caliper - Outside Spring	150 mm	6
49.	Snip Cutter for Gasket cutting		1
TOOLS INSTRUMENTS AND GENERAL SHOP OUTFITS			
50.	Safety shoes (Regular size)		17
51.	Safety hand gloves Rubber (Regular size)		17
52.	Safety hand gloves leather (Regular size)		17
53.	Ear plug		17
54.	Helmet		17
55.	Fire Extingusher (C02)		1
56.	Fire Extinguisher (Dry Chemical Powder)		1
57.	Sand bucket		2
58.	Fire blanket		2
59.	First Aid Box		1
GENERAL MACHINERY INSTALLATIONS:-			

60.	Vernier Caliper	0 - 200 mm with least count 0.02mm	1
61.	Vernier Height Gauge	0 - 300 mm with least count = 0.02 mm	1
62.	Vernier Bevel Protractor	300 mm Blade with Acute Angle Attachment	1
63.	Vernier Depth Gauge	300 mm (L. C.- 0.02 mm)	1
64.	Flow meter test rig flow measurement through, Orific meter, rotameter, venturi meter in 1" pipeline with sump tank, measuring tank and pump with bypass valve		1 unit
65.	Universal Dial Test Indicator - Plunger Type	Range 0 - 10 mm, Graduation 0.01 mm & 0.001mm Reading 0 - 10 with Revolution Counter complete with Clamping Devices and Magnetic Stand	2
66.	Micrometer - Outside	0 - 25 mm	1
67.	Combination Set	300 mm	2
68.	Surface Plate - Granite	600 x 600 mm with Stand and Cover	1
69.	pH Meter Digital		2
70.	Bunsen Burners		8
71.	Tripods Stand		8
72.	Asbestos wire gauge	8"	8
73.	Gauge Wire without asbestos	8"	8
74.	Gauge Feeler / Thickness	0.05 mm to 1 mm by 0.05	1
75.	Oil Cane	½ pt	2
76.	Spirit Level ,	300 mm	1
77.	Single row deep groove Ball Bearing,	no.6309	1
78.	Cylindrical Roller Bearing,	NU307	1
79.	Taper Roller Bearing,	30208	1
80.	Needle Roller Bearing,	RNA4908	1
81.	Spherical Roller Bearing,	22211 EKC3	1
82.	Hydraulic Bearing puller		1
83.	Grease Gun (medium size)		1
84.	3 leg Bearing puller ,	6"	1
85.	Bearing fitting kit including standard sleeve		1
86.	Gear Box Reduction Type (Cut Section)		1

87.	Gear Box Planetary Bevel Gear Type (Cut		1
88.	Gate Valve, (Rising and non rising type) 2"		2 each
89.	Globe valve (Z-body, Y-body , Angle valve),		2 each
90.	Needle valve diameter	25 mm (SS) 15 mm	2
91.	Safety Valve (Spring loaded Type), MoC	15mm	2
92.	Horizontal and vertical swing check valve		2 each
93.	Horizontal and vertical lift check valve		2 each
94.	Ball valve	2" diameter (SS)	2
95.	Butter fly valve	4" diameter (MS)	2
96.	Solenoid valve N/C type	15 mm diameter (SS)	2
97.	Diaphragm valve,	2" diameter (CI body with rubber diaphragm)	2
98.	Various (AO/AC) type of Control valve. (Cut		1
99.	Cut section of volute type Centrifugal pump		1
100.	Diaphragm Pump (Air Operated)		1
101.	Reciprocating pump (Cut Model)		1
102.	Cut section of Internal gear pump		1
103.	Cut section of External gear pump		1
104.	Cut section of screw pump		1
105.	Cut section sliding vane pump		1
106.	Lobe Pump (Without Motor)		1
107.	Metering Pump (Without Motor)		1
108.	Mechanical seal (multiple spring)		1
109.	Mechanical seal (Bellows seal)		1
110.	Mechanical seal (single spring)		1
111.	Hydraulic jack		1
112.	Multistage compressor fitted with inter-cooler and after coolers		1
113.	Centrifugal blower		1
114.	Screw Compressor (cut model)		1
115.	1-1 /1-2 Shell and tube heat exchanger		1
116.	Plate and frame/washing and non-washing type filter press with slurry tank and gear pump (S/D-25 mm, 50 meter Head , 2HP) and gear pump		1
117.	Top/ bottom driven centrifuge		1
118.	Ball mill with 2 HP motor		1
119.	Vibrating screen (Sieve Shaker) of different mesh nos.	8” diameter with 12 sieves	1 unit
120.	Tray Drier with weighting arrangement		1

121.	Flow meters – Rota meter, Venturimeter, Orifice meter, Pitot tube		One each
122.	Ultrasonic Thickness Tester		1
123.	Standard vertical tube (rising film)		1
124.	Plant for maintenance of various types of pipe fittings, flanges, gasket, mechanical seal, bearing and coupling, with vibration test facilities of pumps ,valves, agitated vessel, reduction gear box, etc.		1

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: MAINTENANCE MECHANIC (CHEMICAL PLANT)

LIST OF TOOLS& EQUIPMENTS FOR -20APPRENTICES

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

2) Infrastructure:

A : TRAINEES TOOL KIT:-			
Sl. No.	**Name of the items**	**Specification**	**Quantity**
1.	Draughtsman drawing instrument box		20+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	(700mm x500 mm) IS: 1444	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 (Magnetic)	Size : 8feet x 4feet	01
7	Trainer's Table		01
8	Trainer's Chair		01

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

ANNEXURE-II

FORMAT FOR INTERNAL ASSESSMENT

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

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