CURRICULUM

FOR THE TRADE OF

MAINTENANCE MECHANIC

(CHEMICAL PLANT)

UNDER

APPRENTICESHIP TRAINING SCHEME

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

CONTENTS

1. ACKNOWLEDGEMENT

The DGT sincerely express appreciation for the contribution of the Industry, State Directorate, Trade Experts and all others who contributed in revising the curriculum. Special acknowledgement to the following industries/organizations who have contributed valuable inputs in revising the curricula through their expert members:

1. DVET,Maharashtra state
2. D.E.T., Gujarat State
3. Rashtriya Chemicals &Fertilizers Limited, Chembur, Mumbai
4. Bharat Petroleum Corporation Ltd., Mahul Refinery, Mumbai
5. Gujarat State Fertilizer Company Limited, Vadodara Gujarat
6. GSP Crop Science Pvt. Ltd. Nandesari, Vadodara
7. Nitrite Ltd., Nandesari, Vadodara
8. INEOS Styrolution India Ltd., Nandesari, Vadodara
9. Rubamin Ltd., Nandesari, Vadodara
10. Farmson Analgesic, Nandesari, Vadodara
11. Technology Exchange, Ahmedabad
12. Nish Automation, Ahmedabad
13. Masibus Automation, Ahmedabad

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

Co-coordinators for the course: Shri Sunil Wakde ,ADT, ATI, Mumbai and

Shri L K Mukherjee, DDT, CSTARI, Kolkata

Sl. No.	Name & Designation Sri /Mr./Ms.	Organization	Remarks
1.	SA Pandav, RDD, Vadodara & Surat	DET, Gujarat	Expert
2.	Sri P.R. Patil, Training Officer	Govt. ITI, Nagothane	Expert
3.	Sri Sunil Wakde , Assistant Director	ATI,Mumbai	Expert
4.	Sri A. N. Mancharkar, Craft Instructor	Govt. ITI, Ambernath	Expert
5.	Sri D.R. Markande,	Govt. BTRI, Vileparle	Expert
6.	Sri Girish Labhane,	RCF, Mumbai	Expert
7.	Rajendra Mandora, Manager	Nish Automation,	Expert
8.	Rupesh Shah, Sr. Manager	Masibus Automation	Expert
9.	Shri J P Gadhavi I/C Asst.Appr. Advisor	ITC Tarsali, Vadodara	Expert

10.	DK Sharma, MD	Technology Exchange, Ahmedabad	Expert
11.	Kamlesh Prajapati, Director	Technology Exchange, Ahmedabad	Expert
12.	Shri Sudhir Joshi, Dy. Manager (Trg. & HRD)	GSFC Ltd., Vadodara	Expert
13.	Shri Paresh Faldu, Sr. Manager (QC & QA)	GSP Crop Science. Pvt. Ltd., Nandesari, Vadodara	Expert
14.	Shri Navin Chauhan, Sr. Manager (Production)	Deepak Nitrite Ltd., Nandesari, Vadodara	Expert
15.	Shri Sunil Patel, Dy. Manager (QA)	INEOS Styrolution India Ltd., Nandesari, Vadodara	Expert
16.	Shri Chirag J. Patel, Maintenance Manager	Rubamin Ltd., Nandesari, Vadodara	Expert
17.	Shri Falgun Patel, Production Manager	Farmson Analgesic, Nandesari, Vadodara	Expert
18.	Smt. S. B. Sarvaiya, Principal	ITI Savli, Di-Vadodara	Expert
19.	Shri D. R. Sanchala, I/C Asst. Appre. Advisor	ITI Dashrath, Di-Vadodara	Expert
20.	Shri Nilesh H Patel I/C Asst.Appr. Advisor	ITI Tarsali, Vadodara	Expert
21.	Sri J. H. Suryawanshi, Training Officer	Govt. ITI, Mahad	Expert

2. BACKGROUND

2.1 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.

2.2 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.

2.3 **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. RATIONALE

[Need for Apprenticeship in "**Maintenance Mechanic (Chemical Plant)"** trade]

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.

3. JOB ROLES: REFERENCE NCO

Brief description of Job roles:

1) Preventive, Periodical, Breakdown, online Routine, daily maintenance of chemical plant equipments and machineries.
2) Awareness of Industrial safety
3) Proper communication skill
4) Record maintaining.
5) High skill level in the use of hand tools, machine tools & work permit system.
6) High level of neatness & consistency in the finish.
7) Proper maintenance scheduling.
8) Minimal or no support in completing the activities.
9) Good housekeeping.
10) Failure Analysis of the machine

Reference NCO:- 8159.79

4. GENERAL INFORMATION

1. **Name of the Trade** **: Maintenance Mechanic (Chemical Plant)**

2. **N.C.O. Code No.** : 8159.79

3. **Duration of Apprenticeship Training (Basic Training + Practical Training):** 2 Years

3.1 **For Freshers: - Duration of Basic Training**: -

a) Block –I : 3 months

b) Block – II : 3 months

Total duration of Basic Training: 6 months

Duration of Practical Training (On -job Training): -

a) Block–I: 9 months

b) Block–II : 9 months

Total duration of Practical Training: 18 months

3.2 **For ITI Passed: - Duration of Basic Training**: - NIL

Duration of Practical Training (On -job Training): 12 months

4. **Entry Qualification** : Passed 10^{th} class examination under 10+2 system of education with Science & Mathematics or its equivalent.

5. **Selection of Apprentices:** The apprentices will be selected as per Apprentices Act amended time to time.

6. **Rebate to ITI Passed out Trainees: one year** for the trade of MMCP

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.

5. COURSE STRUCTURE

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**

Components of Training	Duration of Training in Months →																							
↓	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Basic Training Block - I																								
Practical Training Block - I																								
Basic Training Block - II																								
Practical Training Block - II																								

6. SYLLABUS

7.1 BASIC TRAINING
(BLOCK – I & II)
DURATION: 06 MONTHS

GENERAL INFORMATION

Name of the Trade : **Maintenance Mechanic (Chemical Plant)**

1) **Hours of Instruction** : 1000 Hrs. (500 hrs. in each block)
2) **Batch size** : 20
3) **Power Norms** : 13 Kw
4) **Space Norms** : 104 Sq.m.
5) **Examination** : The internal assessment will be held on completion of each Block.
6) **Instructor Qualification** :

i) Degree/Diploma in Mechanical / Chemical Engg. from recognized university/Board with one/two year post qualification experience respectively in the relevant field.

OR

ii) NTC/NAC in the trade of MMCP with three year post qualification experience in the relevant field.

Preference will be given to a candidate with Craft Instructor Certificate (CIC)

7) **Tools, Equipments & Machinery required** : - As per Annexure – I

7.1.1 DETAIL SYLLABUS OF CORE SKILL

A. Block– I

Basic Training

Topic No.	a) Engineering Drawing	Duration (in hrs)	b) Workshop Science & Calculation		Duration (in hrs)
		30	**Calculation (10)**	**Science (10)**	**20**
1	**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. **(2 Hrs)** **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 Hrs)**		**Unit**: Systems of unit- CGS, MKS/SI unit, unit of length, Mass and time, Conversion of units **(2 Hrs)**	**Material Science** : Properties - Physical & Mechanical, Types –Ferrous & Non-Ferrous, difference between Ferrous and non-Ferrous metals **(2Hrs)**	
2	**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. **(4 Hrs)** **Lettering and Numbering** as per BIS SP46-2003: - Single Stroke, Double Stroke, inclined, Upper case and Lower case **(4 Hrs)**		**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. **(2Hrs**)	**Mass ,Weight and Density** : Mass, Unit of Mass, Weight, difference between mass and weight, Density, unit of density, specific gravity of metals. **(2Hrs)**	
3	**Practice of Lettering and Title Block (2 Hrs)** **Dimensioning practice**: - Position of dimensioning (unidirectional, aligned, oblique as per BIS SP:46-2003) - Symbols preceding the value of dimension and dimensional tolerance. **(2 Hrs)**		**Ratio & Proportion** : Simple calculation on related problems. **(2Hrs)**	**Speed and Velocity**: Rest and motion, speed, velocity, difference between speed and velocity, acceleration, retardation. **(2Hrs)**	

4	**Drawing of Solid figures** (Cube, Cuboids, Cone, Prism, Pyramid, Frustum of Cone and Pyramid.) with dimensions. **(4 Hrs)** **Free Hand sketch of hand tools and measuring tools used in**. Burette, pipette, conical flask, beakers, secreting funnels. Condenser (leibig) **(4 Hrs)**		**Percentage** : Introduction, Simple calculation. Changing percentage to decimal and fraction and vice-versa **(2Hrs)**	**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. **(2Hrs)**	
5	**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 **(4 Hrs)** **ISI symbols** of Generator, Voltmeter, Ammeter, Watt- meter. Resister, inductor, Capacitor, Transformer, AC & DC motors.etc. Drawing of pressure control process line**(2 Hrs)**		**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. **(2 Hrs)**	**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. **(2 Hrs)**	

B. Block- II
Basic Training

Topic No.	a) Engineering Drawing	Duration (in hours)	b) Workshop Science & Calculation		Duration (in hours)
			Calculation	**Science**	
1	**Drawing sketches of different types of valves**, such as gate valve, globe valve, ball valve, check valve etc. **(4 Hrs)** **Drawing of different types locking devices** such as double nut, castle nut, pin etc.**(2 Hrs)** **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. **(1 Hrs)** **Free hand sketches** of Belt conveyor, Screw conveyer, Distillation Column **(2 Hrs)**	**30**	Archimedes's principle, principle of floatation hydrometers. Centre of gravity and Equilibrium condition. **(2Hrs)**	Definition - viscosity, flash point, fire point, flash points of standard lubricating oils, octane number. **(2Hrs)**	**20**
2	**Drawing of pressure, Level , flow and temperature control system.** **(1 Hrs)** **Free hand sketches** of crushers, ball mill, hammer mill and centrifuges **(2 Hrs)**		Pressure, temperature, Boyle's law, Charles's law, Equation of perfect gas. Calculations.. **(2 Hrs)**	Newton's laws of motion unit of force, find out resultant force parallelogram law of forces, **(2Hrs)**	
3	**Free hand sketches** of steam jet ejector, steam trap **(1 Hrs)** **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 **(4 Hrs)**		Centre of Gravity, (C.G. Of square, rectangle, triangle, circle, semicircle, cone) & its calculations **(2 Hrs)**	Condition of equilibrium, kind of equilibrium, some examples of equilibrium in daily life,. **(2 Hrs)**	
4	**Flow sheet / Block diagram of** 1.Nitric acid 2.Ammonia 3. Urea **(3 Hrs)**		**Flow of fluids-** Equation of continuity, Bernoulli's theorem **(2 Hrs)**	Advantages & Disadvantages of friction, Limiting friction, Laws of limiting friction, Coefficient of friction, angle of friction, Inclined plane, Force of friction **(2 Hrs)**	
5	**Projections:** - Concept of axes plane and quadrant. - Orthographic projections - Method of first angle and third angle projections (definition and difference) - Symbol of 1st angle and 3rd angle projection as per IS specification Drawing of Orthographic projection. (**10Hrs)**		Flow measurement by orifice meter, venturi meter, Rota meter, U-tube manometer. **(2 Hrs)**	Latent heat, sensible heat, saturated steam, wet steam, superheated steam. Reynolds's number, at different velocities. **(2 Hrs)**	

7.1.2 DETAIL SYLLABUS OF PROFESSIONAL SKILLS & PROFESSIONAL KNOWLEDGE

A. Block –I

Basic Training

Week No.	Professional Skills (275Hrs)	Professional Knowledge(120 Hrs)
1	1.Introduction of glass wares used in chemical Laboratory 2.Solution Preparation	Introduction of Chemistry, branches of chemistry, importance of chemistry, Safety precautions to be taken in Chemistry Laboratory, different equipment and apparatus used in Laboratory
2	1.Acid Base Titration 2.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.
3	1.Simple Distillation 2. Fractional Distillation	Sources of water, hard and soft water, causes and removal of hardness.
4	1.Boiling Point 2.Melting Point 3.PH Measurement	Purification processes, organic reactions, Boiling point, Melting point, Distillation
5	1.Law of parallelogram of forces 2.Coefficient Of Static Friction	Introduction to Physics, Scalar and Vector quantities, their representation, resultant. Triangle and parallelogram laws of forces.
6	1. M.A,V.R,& Efficiency by inclined plane 2. ‘ g’ by simple pendulum	Simple machine Inclined plane, Lever, Screw jack, pulley Motion –uniform ,circular & rotational motion
7	1. Coefficient Of cubical expansion 2. Coefficient Of linear expansion 3. Thermal conductivity of metal	Modes of heat transfer, determination of thermal conductivity. Temperature & its measurement, expansion of solid, liquid and gases
8	1. Verification of ohm’s law 2. Specific resistance of wire by Wheatstone bridge	Electricity- Ohm's law, series & parallel connections, specific resistance
9	1. ECE of Copper 2. 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 - 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 - Venire Caliper, Venire Depth gauge, Height gauge, Micrometer outside, Bevel protector. Direct & indirect measurement tool such as, steel rule, caliper, engg. 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 - Gasket cutting	Different types of pipe joints, flanges ,Gasket materials for particular applications-cork sheet, oil-proof paper etc
12	Dismantle, clean & Reassemble of different types of valve Operation and maintenance of Centrifugal pump, All positive displacement pump such as Reciprocating pump and Gear Pump .	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 Pump	Types of maintenance in industry – preventive ,predictive ,breakdown ,daily ,online
	Internal Assessment 03days	

B. Block –II
Basic Training

Week No.	Professional Skills (275 Hrs)	Professional Knowledge (120 Hrs)
1.	Occupational Safety & Health. Importance of housekeeping & good shop floor practices. Introduction to safety equipment and their uses in chemical plant. Personal protective Equipments (PPE). Use of Fire extinguishers Study of chart of MSDS Of chemicals which is mostly used in chemical industry.	Role of Maintenance mechanic 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 of Acid, Base , 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 & key ways in shafts, using cross cut chisel.	**Fitting and Maintenance :-** Introduction about various fitting tools for maint. , 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 & Key Way :-** 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. **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 & gear box.	**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 Box:** 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 Gate Valve ,Globe valve ,Needle valve ,ball valve, NRV, PSV, diaphragm valve, Butterfly valve ,control valve Dismantling, cleaning, repairing, and reassembling of Centrifugal pump, Reciprocating pump, vacuum pump.	**Mechanical seal: Types** of mechanical seal care and handling of mechanical seal, Material of seal, application of mechanical seal. Oil seal its specification. **Valve**:-Definition and Types of valve. Principle, Construction details, & working of Gate Valve, Globe valve, Needle valve. Its maintenance, trouble& trouble shooting. **Pumping Device For Liquid :** -Definition, use, types of pump(Centrifugal pump & positive displacement pump), Its maintenance, trouble& trouble shooting. **Vacuum System:** - Defination of vacuum. Vacuum generation in vacuum pump & 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 pump. Operation & maintenance of reciprocating compressor.	**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, tyre 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 maint. of pressure vessels.
9.	Installation of 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 equipment . **Evaporation:** Definition, classification of evaporators, Capacity, steam economy of evaporators

11.	Operation & maintenance of Distillation column. Operation & maintenance of mixer settler Operation & maintenance 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 filter press ii) Top/ Bottom driven centrifuge Operation and maintenance of i) Jaw crusher, ii) Ball mill, iii) Hammer mill, iv) Vibrating screen.	**Filtration :-** Definition, Filtration media, filtration equipment (plate &filter, rotary vacuum filter, centrifuge, Buckner filter, nutch 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 equipment's.
13	Operation and maintenance of tray drier.	Drying: introduction, vapour pressure curve for water, relative humidity, rate of drying, tray drier, rotary drier.

7.1.3 EMPLOYABILITY SKILLS

GENERAL INFORMATION

1)	**Name of the subject**	**:**	**EMPLOYABILITY SKILLS**
2)	**Applicability**	**:**	ATS- Mandatory for fresher only
3)	**Hours of Instruction**	**:**	**110 Hrs. (55 hrs. in each block)**
4)	**Examination**	**:**	The examination will be held at the end of two years Training by NCVT.
5)	**Instructor Qualification**	**:**	

i) MBA/BBA with two years experience or graduate in sociology/social welfare/Economics with two years experience and trained in Employability skill from DGET Institute.

And

Must have studied in English/Communication Skill and Basic Computer at 12th /diploma level

OR

ii) Existing Social Study Instructor duly trained in Employability Skill from DGET Institute.

7.1.3.1 SYLLABUS OF EMPLOYABILITY SKILLS

A. Block – I
Basic Training

Topic No.	Topic	Duration (in hours)
	English Literacy	**15**
1	**Pronunciation :** Accentuation (mode of pronunciation) on simple words, Diction (use of word and speech)	
2	**Functional Grammar** Transformation of sentences, Voice change, Change of tense, Spellings.	
3	**Reading** Reading and understanding simple sentences about self, work and environment	
4	**Writing** Construction of simple sentences Writing simple English	
5	**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.	
	I.T. Literacy	**15**
1	**Basics of Computer** Introduction, Computer and its applications, Hardware and peripherals, Switching on-Starting and shutting down of computer.	
2	**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.	
3	**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	
4	**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.	

	Communication Skill	25
1	**Introduction to Communication Skills** Communication and its importance Principles of Effective communication Types of communication - verbal, non verbal, written, email, talking on phone. Non verbal communication -characteristics, components-Para-language Body - language Barriers to communication and dealing with barriers. Handling nervousness/ discomfort. Case study/Exercise	
2	**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.	
3	**Motivational Training** Characteristics Essential to Achieving Success The Power of Positive Attitude Self awareness Importance of Commitment Ethics and Values Ways to Motivate Oneself Personal Goal setting and Employability Planning. Case study/Exercise	
4	**Facing Interviews** Manners, Etiquettes, Dress code for an interview Do's & Don'ts for an interview	
5	**Behavioral Skills** Organizational Behavior Problem Solving Confidence Building Attitude Decision making Case study/Exercise	

B. Block– II
Basic Training

Topic No.	Topic	Duration (in hours)
	Entrepreneurship skill	**10**
1	**Concept of Entrepreneurship** **Entrepreneurship**- Entrepreneurship - Enterprises:-Conceptual issue Entrepreneurship vs. Management, Entrepreneurial motivation. Performance & Record, Role & Function of entrepreneurs in relation to the enterprise & relation to the economy, Source of business ideas, Entrepreneurial opportunities, The process of setting up a business.	
2	**Project Preparation & Marketing analysis** Qualities of a good Entrepreneur, SWOT and Risk Analysis. Concept & application of Product Life Cycle (PLC), Sales & distribution Management. Different Between Small Scale & Large Scale Business, Market Survey, Method of marketing, Publicity and advertisement, Marketing Mix.	
3	**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.	
4	**Investment Procurement** Project formation, Feasibility, Legal formalities i.e., Shop Act, Estimation & Costing, Investment procedure - Loan procurement - Banking Processes.	
	Productivity	**10**
1	**Productivity** Definition, Necessity, Meaning of GDP.	
2	**Affecting Factors** Skills, Working Aids, Automation, Environment, Motivation How improves or slows down.	
3	**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.	
4	**Personal Finance Management** Banking processes, Handling ATM, KYC registration, safe cash handling, Personal risk and Insurance.	
	Occupational Safety, Health & Environment Education	**10**
1	**Safety & Health** Introduction to Occupational Safety and Health importance of safety and health at workplace.	
2	**Occupational Hazards** Basic Hazards, Chemical Hazards, Vibro-acoustic Hazards, Mechanical Hazards, Electrical Hazards, Thermal Hazards. Occupational health, Occupational hygienic, Occupational Diseases/ Disorders & its prevention.	

3	**Accident & safety** Basic principles for protective equipment. Accident Prevention techniques - control of accidents and safety measures.	
4	**First Aid** Care of injured & Sick at the workplaces, First-Aid & Transportation of sick person	
5	**Basic Provisions** Idea of basic provision legislation of India. of safety, health, welfare under legislation of India.	
6	**Ecosystem** Introduction to Environment. Relationship between Society and Environment, Ecosystem and Factors causing imbalance.	
7	**Pollution** Pollution and pollutants including liquid, gaseous, solid and hazardous waste.	
8	**Energy Conservation** Conservation of Energy, re-use and recycle.	
9	**Global warming** Global warming, climate change and Ozone layer depletion.	
10	**Ground Water** Hydrological cycle, ground and surface water, Conservation and Harvesting of water	
11	**Environment** Right attitude towards environment, Maintenance of in -house environment	
	Labour Welfare Legislation	**5**
1	**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.	
	Quality Tools	**5**
1	**Quality Consciousness :** Meaning of quality, Quality Characteristic	
2	**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.	
3	**Quality Management System :** Idea of ISO 9000 and BIS systems and its importance in maintaining qualities.	
4	**House Keeping :** Purpose of Housekeeping, Practice of good Housekeeping.	
5	**Quality Tools** Basic quality tools with a few examples	
	Leadership and Team Building skills.	**5**
	Leadership Discipline and Morale Team Work Case Study/ Exercise	
	Meet the Mentor **Role - play as a Supervisor**	**5**
	Organizing and Planning.	**5**
	Time Management Group Dynamics Case Study/ Exercise	

7.2 PRACTICAL TRAINING (ON-JOB TRAINING)
(BLOCK – I & II)
DURATION: 18 MONTHS (9 months in each block)

GENERAL INFORMATION

1) Name of the Trade : **Maintenance Mechanic (Chemical Plant)**

2)Batch size a) Apprentice selection as per Apprenticeship Guidelines

b) Maximum 20 candidates in a group

3)Examination i) The internal assessment will be held on completion of each block

ii) NCVT exam will be conducted at the end of 2nd year.

\4)Instructor Qualification :

i) Degree/Diploma in Mech/ Chem Engg. from recognized university/Board With one/two year post qualification experience in the relevant field.

OR

ii) NTC/NAC in the trade of MMCP with three year post qualification experience in the relevant field.
Preference will be given to a candidate with Craft Instructor Certificate (CIC)

1) **Tools, Equipments & Machinery required** : - As per Annexure – II

7.2.1 BROAD SKILL COMPONENT TO BE COVERED DURING ON-JOB TRAINING

A. 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**

DURATION: 09 MONTHS (39 WEEKS)	
List of operations in Petro Chemicals, heavy chemicals, fire chemicals, paper and pulp, Cement, pharmaceutical ,Fertilizer and allied chemical industries	
Sl. No	**List of operations/skills to be covered during Industrial Training**
1.	Introduction in safety precautions as applicable to the trade
2.	**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.
3.	**Safety** **Safety management (General awareness)**
4.	- 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.
5.	**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/FRV welding, if available. Lead lining and rubber lining, if available.
6.	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) APCM (Air pollution control Measures) ESP /cyclone separator/ Venturi scrubber, Bag filter (xii) Various Drying Equipment & its Maintenance

B. BLOCK – II

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**

DURATION: 09 MONTHS (39 WEEKS)	
List of operations in Petro Chemicals, heavy chemicals, fire chemicals, paper and pulp, Cement, pharmaceutical ,Fertilizer and allied chemical industries	
Sl. No	**List of operations/skills to be covered during Industrial Training**
1.	**Quality Control** Familiarization with sample quality control tests.
2.	**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
3.	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. (iv) Crystallizes. (v) Industrial Filtration equipments (vi) Sedimentation and coagulation (vii) Size separation and size reduction equipments. (viii) Crushing and grinding equipments (ix) Material handling and conveying equipments (x) Power transmission – line shaft, clutches reduction gear, coupling etc. xi) Thermal insulation, bearings, gear box , lubrication work xii) Solar power plant, if available

8. ASSESSMENT STANDARD

8.1 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 to be given while assessing for team work, avoidance/reduction of scrape/wastage and disposal of scarp/wastage as per procedure, behavioral attitude and regularity in training.

The following marking pattern to be adopted while assessing:

a) Weightage in the range of 60-75% to be allotted during assessment under following performance level:

For 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.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- many tolerances while undertaking different work are in line with those demanded by the component/job.
- 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 under following performance level:

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.

In this work there is evidence of:

- good skill levels in the use of hand tools, machine tools and workshop equipment
- the majority of tolerances while undertaking different work are in line with those demanded by the component/job.
- 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 under following performance level:

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.

In this work there is evidence of:

- high skill levels in the use of hand tools, machine tools and workshop equipment
- tolerances while undertaking different work being substantially in line with those demanded by the component/job.
- a high level of neatness and consistency in the finish.
- minimal or no support in completing the project

8.2 FINAL ASSESSMENT- ALL INDIA TRADE TEST FOR APPRENTICE

SUBJECTS	Marks	Sessional Marks	Full Marks	Pass Marks	Duration of Exam.
Practical	300	100	400	240	**08 hrs.**
Trade Theory	100	20	120	48	3 hrs.
Workshop Cal. & Sc.	50	10	60	24	3 hrs.
Engineering Drawing	50	20	70	28	4 hrs.
Employability Skill	50	--	50	17	2 hrs.
Grand Total	**550**	**150**	**700**	**-**	

Note: - The candidate pass in each subject conducted under All India Trade Test.

9. FURTHER LEARNING PATHWAYS

On successful completion of the course,

- The trainees will be employed in reputed Industries / Organizations.
- On successful completion of the course trainees can opt for Diploma course (lateral entry). {Applicable for candidates only who undergone ATS after CTS}
- They can also undergo CITS course in the relevant trade to become instructor in the ITI's

Employment opportunities:

On successful completion of this course, the candidates shall be gainfully employed in the following industries:

1. Chemical Process industries / Production & Manufacturing industries
2. Petroleum refineries and petrochemical industries
3. Fertilizer industry and allied industries.
4. Defence organisations such as ordinance factories
5. In public sector industries like IOCL, BPCL, HPCL, RCF, BARC, HWB,BHEL, etc and private industries in India & abroad.
6. Self employment

ANNEXURE – I

10.TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE: - MMCP

LIST OF TOOLS & EQUIPMENTS FOR '20' APPRENTICES

A : TRAINEES TOOL KIT:-

CONSUMABLE ITEMS

Sl. No.	Name of the items	Quantity (indicative)
1	Pippet Measuring 10 ml Borosilicate	6
2	Burret stand	6
3	Burret Clamp	6
4	Clamp Holder	6
5	Beaker Borosilicate 250 ml	6
6	Burrete Boroflow 25 ml Borosilicate Glass	6
7	Volumetric Flask 500 ml	6
8	Watch Glass 9 cm	6
9	Spetulla 8"	2
10	Funnel 9 cm	6
11	Conical Flask 250 ml Borosilicate Glass	6
12	Rubber Teat for 10 ml pippete	6
13	Bottle for solution 1000 ml	6

B : TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (indicative)
1.	Divider Spirng Type - 150 mm	6
2.	Punch Center - Diameter - 10 mm and Length - 100 mm	6
3.	Punch Prick - 100 mm	6
4.	Letter and Number Punch - 5mm	1
5.	Scriber- Straight- 150 mm	6
6.	Hacksaw Frame - Fixed - 300 mm	6
7.	File - Flat - Bastard - 250 mm	6

8.	File - Flat - Second Cut - 250 mm	6
9.	File - Flat - Smooth - 250 mm	6
10.	Chisel - Cold - Cross Cut - 9 mm X 150 mm	6
11.	Chisel - Cold - Flat - 20 mm X 150 mm	6
12.	Chisel - Diamond Point - 9 mm x 150 mm	5
13.	Hammer - Ball Pein - 250 grams	6
14.	Hammer - Ball Pein - 500 grams	6
15.	Screw Driver - 9 X 300 mm	4
16.	Drill Twist Set - Straight Shank - 3 mm to 13 mm by 0.5 mm	1
17.	Drill Twist Set - Straight Shank - 9.8 mm	1
18.	Hand Reamer Parallel - 10 mm	2
19.	Tap set -12 mm	2
20.	Allen Ket Set - Hexagonal - 1 - 12 mm, set of 12 Keys	1
21.	V Block - 75 x 75 x 50 mm with Clamp (Hardened & Ground)	1
22.	Bench Vice - 125 mm	6
23.	Safety google (white)	6
24.	Pliers – combination 8”/20 cm	4
25.	Phillips head screw driver set 1-4 sizes	1
26.	Double ended Open spanners set of 6x7,8x9,10x11,12x13,14x15,16x17,18x19,20x22,21x23,24x27,25x28,30x32.	1
27.	Double ended Ring spanners set of 6x7,8x9,10x11,12x13,14x15,16x17,18x19,20x22,21x23,24x27,25x28,30x32.	1
28.	Circlip Plier 8"(internal)	1
29.	Circlip Plier 8"(External)	1
30.	Spanner - Adjustable - 200 mm	1
31.	Pipe Wrench - 450 mm	1
32.	Steel Rule - 300 mm, Graduated both in Metric and English Unit	6
33.	Try Square - 150 mm	6

34.	Caliper - Inside Spring - 150 mm	6
35.	Caliper - Outside Spring - 150 mm	6
36.	Snip Cutter for Gasket cutting	1

C : TOOLS INSTRUMENTS AND GENERAL SHOP OUTFITS

Sl. No.	Name of the items	Quantity (indicative)
1.	Safety shooes (Regular size)	17
2	Safety handgloves Rubber (Regular size)	17
3	Safety handgloves leather (Regular size)	17
4	Ear plug	17
5	Helmet	17
6	Fire Extingusher (C02 ,)	1
7	Fire Extingusher (Dry Chemical pdr)	1
8	Sand bucket	2
9	Fire blanket	2
10	First Aid Box	1

D : GENERAL MACHINERY INSTALLATIONS:-

Sl. No.	Name & Description of Machines	Quantity (indicative)
1	Vernier Caliper - 0 - 200 mm with least count 0.02mm	1
2	Vernier Height Gauge - 0 - 300 mm with least count = 0.02 mm	1
3	Vernier Bevel Protractor - 300 mm Blade with Acute Angle Attachment	1
4	Vernier Depth Guage 300 mm(L..C. 0.02mm)	1
5	pilot plan for flow measurement through, Orific meter, rotameter,venture meter	1
6	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
7	Micrometer - Outside - 0 - 25 mm	1
8	Combination Set 300 mm	2
9	Surface Plate - Granite - 600 x 600 mm with Stand and Cover	1
10	pH Meter Digital	1
11	Bunsen Burners	8
12	Tripods Stand	8
13	Asbestos wire gauge 8”	8
14	Gauge Wire without asbestos 8”	8

15	Gauge Feeler / Thickness - 0.05 mm to 1 mm by 0.05 and	1
16	Cane oil ½ pt	1
17	Spirit Level - 300 mm	1
18	Single row deep groove Ball Bearing no.6309	1
19	Cyndrical Roller Bearing NU307	1
20	Taper Roller Bearing 30208	1
21	Needle Roller Bearing RNA4908	1
22	Spherical Roller Bearing 22211 EKC3	1
23	Hydraulic Bearing puller	1
24	Grease Gun	1
25	3 leg Bearing puller 6"	1
26	Bearing fitting kit including standard sleeve , mallet, Bearing induction heater	1
27	Gear Box Rduction Type(Cut Section)	1
28	Gear Box Planetory Bevel Gear Type(Cut Section)	1
29	Gate Valve 2"	1
30	Globe valve 2"	1
31	Needle valve 25 mm (SS)	1
32	Safety Valve (Spring Type) 2" (Brass)	1
33	Non return valve(swing check type) 2"	1
34	Non return valve(Lift Ball type) 2"	1
35	Ball valve 2" (SS)	1
36	Butter fly valve 2"	1
37	Solenoid valve	1
38	Diaphragm valve 2"	1
39	Various Type of Control valve. (Cut section)	1
40	Cut section of Centrifugal pump of back pullout type	1
41	Diaphragm Pump (Air Operated)	1
42	Reciprocating pump (Cut Model)	1
43	Cut section of Internal gear pump	1
44	Cut section of External gear pump	1
45	Cut section of screw pump	1
46	Cut section sliding vane pump	1
47	Lobe Pump(Without Motor)	1
48	Metering Pump(Without Motor)	1
49	Mechanical seal (multiple spring)	1
50	Mechanical seal (Bellows seal)	1
51	Mechanical seal (single spring)	1
52	Hydraulic jack	1
53	Multistage compressor fitted with inter-cooler and after coolers	1
54	Centrifugal blower	1
55	Screw Compressor (cut Model)	1
56	Shell and tube heat exchanger	1

57	Plate and frame filter press	1
58	Top driven centrifuge	1
60	Ball mill	1
61	Vibrating screen (Sieve Shaker)	1
62	Tray Drier	1
63	Flow meters –Rota meter, Venturimeter, Orifice meter, Pitot tube	One each
64	Ultrasonic Thickness Tester	1
65	Vertical Tube Evaporator	1
66	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

Note: In case of basic training setup by the industry the tools, equipment and machinery available in the industry may also be used for imparting basic training.

INFRASTRUCTURE FOR WORKSHOP CALCULATION & SCIENCE AND ENGINEERING DRAWING

TRADE: MMCP

LIST OF TOOLS& EQUIPMENTS FOR 20 APPRENTICES

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

2) Infrastructure:

A : TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (indicative)
1.	Draughtsman drawing instrument box	20
2.	Set square celluloid 45^0 (250 X 1.5 mm)	20
3.	Set square celluloid 30^0-60^0 (250 X 1.5 mm)	20
4.	Mini drafter	20
5.	Drawing board (700mm x500 mm) IS: 1444	20

B : FURNITURE REQUIRED

Sl. No.	Name of the items	Quantity (indicative)
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

ANNEXURE – II

INFRASTRUCTURE FOR ON-JOB TRAINING

TRADE: MAINTENANCE MECHANIC CHEMICAL PLANT

For Batch of 20 APPRENTICES

Actual training will depend on the existing facilities available in the establishments. However, the industry should ensure that the broad skills defined against On-Job Training part (i.e. 9 months + 9 months) are imparted. In case of any short fall the concern industry may impart the training in cluster mode/ any other industry/ at ITI.

ANNEXURE-III
11.GUIDELINES FOR INSTRUCTORS AND PAPER SETTERS

1. Due care to be taken for proper & inclusive delivery among the batch. Some of the following some method of delivery may be adopted:

A) LECTURE
B) LESSON
C) DEMONSTRATION
D) PRACTICE
E) GROUP DISCUSSION
F) DISCUSSION WITH PEER GROUP
G) PROJECT WORK
H) INDUSTRIAL VISIT

2. Maximum utilization of latest form of training viz., audio visual aids, integration of IT, etc. may be adopted.

3. The total hours to be devoted against each topic may be decided with due diligence to safety & with prioritizing transfer of required skills.