CURRICULUM

FOR THE TRADE OF

INSTRUMENT MECHANIC (CHEMICAL PLANT)

UNDER

APPRENTICESHIP TRAINING SCHEME

सत्यमेव जयते
Government of India

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

CONTENTS

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

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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.

3. RATIONALE

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

The demand for precise measurement and control of plant parameters are increasing day by day for modern industries that rely heavily on automation for economic viability and mass production. The availability of sophisticated instrument and variety of control devices has greatly improved not only the quality of the product but also contributed to the reduction of the cost. In the present times it is impossible to think of the industrial productions without instrument and control. The operation and safety of the plant relies on these instruments, so the Instrument Mechanic is very important as they constantly monitor and calibrate these instruments.

4. JOB ROLES: REFERENCE NCO

Brief description of Job roles:

1. Identification Of Equipment

2. Aware with construction of Equipment

3. Operating Of Equipment

4. Fault finding & Maintenance in running process.

5. Repairing Of Instruments

6. Calibration of instrument.

7. Erection of instruments.

8. Loop checking of process parameters.

9. Handle Advance process control system.

10. Recording, controlling and Transmitting Various Parameters

Reference NCO: 7311.30, 7311.65, 7241.10

5. GENERAL INFORMATION

1. **Name of the Trade : INSTRUMENT MECHANIC (CHEMICAL PLANT)**

2. **N.C.O. Code No.** : **7311.30, 7311.65, 7241.10**

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/Bsc Passed: - Duration of Basic Training**: - NIL

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

4. **Entry Qualification:**

1. 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/Bsc Passed out Trainees:** i) One year for the trade of IMCP

ii) One year for BSc. Passed with Physics and Chemistry

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.

6. 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																								

7. SYLLABUS

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

GENERAL INFORMATION

1) **Name of the Trade** : **Instrument Mechanic (Chemical Plant)**
2) **Hours of Instruction** : 1000 Hrs. (500 hrs. in each block)
3) **Batch size** : 20
4) **Power Norms** : 6 Kw
5) **Space Norms** : 120 Sq. m.

6) **Examination** : The internal assessment will be held on completion of each Block.
7) **Instructor Qualification** :

i) Degree/Diploma in Instrumentation/electronic instrumentation/ Process control Instrumentation Technology/ Engineering from recognized University with one year experience in relevant field. with one/two year post qualification experience respectively in the relevant field.

OR

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

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

8) **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 res**pective trades. **(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, Plug Valve, check valve etc. **(4 Hrs)** **Drawing of different types locking devices** such as double nut, castle nut, pin etc.**(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	**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. **(2 Hrs)** **Free hand sketches** of Belt conveyor, Screw conveyer, Bucket elevator **(4 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	**Drawing of pressure, Level , flow and temperature control system.** **(2 Hrs)** **Free hand sketches** of crushers, ball mill, hammer mill and centrifuges **(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	**Free hand sketches** of steam jet ejector, steam trap **(2 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)**		**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	Flow sheet / Block diagram of 1.Sulphuric acid 2.Nitric acid 3.Ammonia 4. Urea 4. Ethanol		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(120Hrs)
1.	Demonstration about PPE'S, Safety Equipments, First aid box. Occupational Safety & Health Importance of housekeeping & good shop floor practices.	**INTRODUCTION:** Introduction about ITI Rules and Regulation. Importance of trade Introduction of Chemistry, branches of chemistry, importance of chemistry, Safety precautions to be taken in Chemistry Laboratory, different equipment and apparatus used in Laboratory **SAFETY:** Introduction & Importance of safety, General precautions about safety. PPE'S Used in chemical industries Safety slogan. First aid in industry & Workshop Soft Skills: its importance and Job area after completion of training.
2.	Screw Drivers, Pliers, Spanners, their classification, materials and precautions while using them.	Hand Tools and measuring tools used in instrumentation. Screw drivers, pliers, Allen keys, hammers, spanners, pointer puller etc. Vernier caliper, micrometer, bevel protector, dial test indictor. Basic SYMBOLS USED IN Instrumentation.
3.	**VOLUMETRIC ANALYSIS:** Alkali metric Titration Volumetric Analysis Acidimetric Titration	Atom, molecule, Element, compound, mixture, Physical change, chemical change, Acids, bases, salts-their properties. Molecular weight, equivalent weight, atomic weight, Normality, molarity. Metals & Non-Metals

4.	To study action of pure and salt water on metals and alloys. To study action of acids and bases on metals and alloys.	Water- sources, hard and soft water, causes and removal of hardness, Water for industrial purposes. Introduction to Effluent Treatment Plant (ETP).
5	Determination of pH (by PH meter) Measurement of conductivity by conductivity meter,DO2 Measurement, TDS Measurement.	Definition of pH, pH scale, measurement of pH. Conductivity, DO2 ,TDS . **ELASTICITY**: Stress, strain, elastic limit, Types of modulus of elasticity, work done in a stretching wire.
6	Study of basic electrical symbols. Use of Multimeter. Read Colour Code of resistors & verification by measurement. Verification of Ohm's Law.	Basic electricity. Types of supply-D.C, A.C advantages and disadvantages and its measurement. Voltage, current. Use of Multi-meter. Resistance, resistivity and resistor. Types of resistor and colour code. Ohm's Law and problems on ohm's Law. D.C. series and parallel circuits.. Basic of Kirchhoff laws. Earthling types and their use.
7	Soldering and desoldering practice. Testing Inductor and capacitor using LCR meters. Measurement of voltage and current of transformer primary and secondary.	Soldering and de-soldering. Inductor, Inductance, Self and mutual inductance, Inductive reactance. Transformers. Types and applications. Current and voltage transformer. Capacitance and capacitor. Capacitor in series and parallel.
8	Measurement of power using voltmeter and ammeter method. Calibration of voltmeter, ammeter Watt meter and energy meter etc. Measurement of voltage and frequency using CRO.	Operate and testing of PMMC, MI, Electrodynamometer, and induction type meters, megger. Range extension of voltmeter and ammeters. 2 watt and 3 watt meter power measurement in 3 phase. Use of CRO (voltage and frequency measurement).Use of clam on meters.

9	Verification of Diode characteristics & Transistor switch circuit	Diode, types and applications. Applications of LED, Photo diode, thyresistor. Transistor and its applications. Transistor small signal amplifier.
10	Study of Half wave & full wave Rectifier Study of regulator IC Study of SMPS & UPS	Rectifier – half wave and full wave. Capacitor and LC filter. Regulators-zener and IC regulator. advantages and limitations of SMPS and UPS.
11	Determination of specific resistance using Wheatstone's meter bridge. Determination of coefficient of expansion of Solid. Determination of coefficient of expansion of liquid.	Modes of heat transfer, determination of thermal conductivity. Temperature & its measurement, expansion of solid, liquid and gases
12	Draw & Study of P & I Diagram for Distillation (ISA standard etc)	ISA symbols used in process instrumentation **Distillation**: Introduction, USE OF Instruments during distillation. Manufacturing process and flow sheet of Urea.
13	Draw & Study of P & I Diagram for Evaporation	**Evaporation**: Introduction, use of Instruments during evaporation.
	Internal Assessment 03days	

B. Block –II Basic Training

Week No.	Professional Skills (275Hrs)	Professional Knowledge(120 Hrs)
1.	Awareness and safety of various instruments in the lab and Identifying various parts and section.	**Introduction to Instrumentation:** Scope and necessity of instrumentation. Fundamentals of measurement systems. **Static Characteristics:** Accuracy, precision, sensitivity, resolution dead zone, repeatability, reproducibility, drift, Dead band, backlash, hysteresis. **Dynamic characteristics:** Speed response, fidelity, and lag. Error, deviation, true value, data. Types of errors- systematic, random & illegitimate error. Certainty/ uncertainty, validity of result. Measuring system Response. Classification of hazardous areas. Brief concept on intrinsic safety and flame protection.
2.	Measurement of pressure using pressure gauge-bourdon tube and diaphragm. Assembling and dismantling of bourdon tube. Testing of pressure switch using lamp load.	**Pressure:** Definition of pressure. Types of pressure-Barometric (Atmospheric) Pressure, Gauge Pressure, Differential Pressure, Absolute Pressure, Vacuum pressure & their units. Types of pressure sensing elements- bourdon tube, diaphragms, capsules, and bellows. Each one type, shapes, material used for various applications, ranges advantages and limitations. Pressure switches types and applications.
3.	Measurement of pressure using u tube manometer. Calibration of pressure gauge using dead weight tester. Calibration and testing of pressure transmitter.	U tube and well type manometer applications. & Barometers applications. Importance of calibration in Metrology. Dead weight tester and comparators. Pressure transmitter (load cell type) working and applications.
4.	Temperature measurement using – bimetallic and liquid metal thermometer. RTD temperature characteristics. RTD transmitter testing and calibration.	**Temperature measurement :** Definition, Units of Temperature. Temperature gauges – bimetallic, liquid filed system thermometer working and application. RTD –types, working and application. 2 wire, 3 wire and 4 wire RTD limitation.
5.	Thermocouple transmitter testing and calibration. Measurement of temperature using optical pyrometer.	Thermocouple- types, working and application. Need of cold junction and lead compensation. Thermistor-types, applications. Optical and radiation pyrometer working and application.

6	Installation and testing of Venturi and Orifice flow meter. Dismantling, assembling of Rotameter.	Basic properties of fluids, fluids in motion, getting fluids to flow, units of flow rate and quantity flow, factors affecting flow rate. Relation between flow rate and pressure, area, quantity. Head type flow meter types. Working and application of venturi and orifice flow meter. Rota meter working, application.
7	Calibration and testing of turbine flow meter. Rotating vane flow meter dismantling, assembling and testing.	Turbine flow meter, magnetic flow meters, vertex flow meter, ultrasonic flow meter, Thermal mass flow meter, Coriolis Mass flow meter- working and applications. Rotating vane and notating disc type quantitative flow meter working and application.
8	Dismantling, assembling of sight glass gauge. Level measurement using by sight glass and float type gauge. Installation and testing of hydrostatic level gauge.	Introduction about Types of level measurement systems. Units of level measurement. Sight glass, float type working, and applications. Hydro-static open tank and close tank level measurement system advantages, limitations and application.
9	Testing and calibration of air purge level indicator. Testing and calibration of ultrasonic level instrument.	Air purge, Capacitance and ultra-sonic level measurement working and application. radar type level measurement working and application.
10	Dismantling, maintenance and assembling of heat exchanger (as available). Dismantling and assembling of control valve.	Types of heat Exchanger, double pipes, Shell & Tube heat Exchanger. Types of steam Trap. Types of control Valves, Gate Valve, Globe Valve, and NRV. Type of actuators and use. Types of final control elements and applications. Selection of control valve like as per safety, type of applications, type of flow etc
11	Installation and testing of I/P and valve positioner. Study the working PID process loop.	Working , Application of I to P and valve positioner. ON-OFF controller, P, PI, PD, PID controls limitations and application.
12	AND, OR and NOT logics (ladder logic) on PLC.	Introduction about types of PLC. Brief description of PLC blocks diagram and applications of PLC.
13.	Use of universal calibrator.	Use and applications of universal calibrator and HART calibrator
	Internal Assessment 03 days	

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 /1500 Hrs)

GENERAL INFORMATION

1) **Name of the Trade** : **INSTRUMENT 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 Instrumentation/electronic instrumentation/ Process control Instrumentation Technology/ Engineering from recognized University with one year experience in relevant field with one/two year post qualification experience respectively in the relevant field.

OR

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

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

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

24.2.1 BROAD SKILL COMPONENT TO BE COVERED DURING ON- JOB TRAINING (OJT)

A. BLOCK – I

1. **Safety and best practices (5S, KAIZEN etc.)**
2. **Record keeping and documentation**
3. **Identification and testing of electronic components/devices**
4. **Repair & Maintenance work**

DURATION: 09 MONTHS (39 WEEKS) ***List of operations in Petro Chemicals, heavy chemicals, fire chemicals, paper and pulp, pharmaceutical ,Cement, Fertilizer and allied chemical industries***	
SL NO	List of Operations/Skills to be covered during Industrial Training
1.	The plant and its different products capacity of production etc. Plant activities including process and maintenance.
2.	Preparing a Schematic Layout of the plant. (Material flow & information flow and instrument)
3.	Study of personal & plant safety procedures and use of safety equipment, fire and fire fighting facilities/techniques, handing of hazardous chemicals and poisons substances
4.	Study of the Unit process and Unit operation in brief.
5.	Reading a (process & instrument) flow sheet of a process. Making a simple flow sheet of a unit
6.	Study of location of the various elements like sensing element, transmitter, controller, final control valve of a control loop
7.	Study of instruments mountings like Panel mountings, Wall mountings and Yoke Mountings. etc.
8.	Care, safety and proper use of pneumatics and electrical fittings, coupling and associated tools
9.	Dismantling, Cleaning and Re-assembling of Air-Filters, Air

	Regulators. Giving or Removing Input, Output and Air supply connections of a pneumatic instrument. Routing, bending etc of pneumatic pipes.
10.	Doing simple routine works like, Winding of clocks, Filling of Mercury, Cleaning and changing of Inks, Replacement of charts with drawing and returning of materials to and from stores
11.	Learning how to isolate system for connection of Electrical components.
12.	Soldering practice, metal to metal, wire to wire. Wires to plugs, wires to connectors, wires to strokes, wires to terminal blocks. Ferruling, crimping cable routing of wires.
13.	Identification, testing of various components, elements, circuits in different electronic circuit boards.
14.	Installation, maintenance of various power supply units and circuits.
15.	Selection and usage of various electrical measuring instruments for different applications.

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 electronic components/devices**
4. **Repair & Maintenance work**

DURATION: 09 MONTHS (39 WEEKS) ***List of operations in Petro Chemicals, heavy chemicals, fire chemicals, paper and pulp, pharmaceutical ,Cement, Fertilizer and allied chemical industries***	
SR NO	LIST OF OPERATIONS/SKILLS TO BE COVERED DURING INDUSTRIAL TRAINING
1.	Familiarization , Calibration and Installation of measuring instruments like RTD, thermocouple, Pressure gauges/transmitters, Level transmitter, flow transmitters pH-meter, conductivity etc.
2.	Installation and maintenance of paper chart recorder, Paper less recorder.
3.	Installation and Maintenance of Control Loops and components (sensing element, transmitter, indicator/recorder, controller and final control element), relays
4.	Instrument and Panel Installation as per Blue Prints.
5.	Familiarization with maintenance scheduled & maintenance activity including calibration (Logging) followed in. the instrument shops.
6.	Introduction and familiarization with safe, protective storage procedure and inventory system followed for instruments and their components in the establishments
7.	Familiarization with the analytical laboratory instrument.
8.	Calibration of Smart transmitter for pressure, temperature, flow and level and its adjustment. Calibration of HART Devices.
9.	Understanding the function of PLC and concept. Basic small programs on PLC – logic gates preparation. Small programs on timers and counters. Industrial visit for understanding SCADA and DCS operating controlling system.
10.	Study and use of DCS & SCADA complete with communication system on process trainer.
11.	Study of Heat Exchanger, Chiller, Steam Trap. Study of shell and tube heat exchanger Study of packed distillation column with DCS / PLC study of triple effect evaporator.

12.	Study various foundation field bus based transmitters & positioners , its calibration& control using DCS
13.	Study of smart transmitter like HART, Wireless HART, Foundation field bus etc.
14.	Study & handling of various Analytical instruments such as IR -Spectrophoto meter, UV - Spectrophoto meter, Spectro Lubro meter High Pressure Liquid Chromatographer, Auto Tritrator etc.

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

8.1 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. Production & Manufacturing industries.
2. Infrastructure, Defence organisations.
3. Instrumentation & Chemical Process industries.
4. In public sector industries like HPCL, BPCL, IOCL, ONGC, NTPC, RCF, etc and Private industries in India & abroad.
5. Self employment

ANNEXURE – I

10. TOOLS & EQUIPMENT FOR BASIC TRAINING

INFRASTRUCTURE FOR PROFESSIONAL SKILL & PROFESSIONAL KNOWLEDGE

TRADE: Instrument Mechanic (Chemical Plant)
LIST OF TOOLS & EQUIPMENTS FOR 20 APPRENTICES

A : TRAINEES TOOL KIT:-

Sl. No.	Name of the items	Quantity (indicative)
1.	Screw Driver Set	20
2.	Watchmaker screw driver set	20
3.	Pointer Puller	20
4.	Adjustable Spanner(1oo mm,200mm)	20
5.	Digital Multimeter	20
6.	Soldering iron(25 W)	20
7.	Desoldering Pump	20

B : TOOLS INSTRUMENTS AND GENERAL SHOP OUTFITS

Sl. No.	Name of the items	Quantity (indicative)
8.	Allen Key set (inches & MM)	1 Each
9.	Ring Spanner Set(6 to 32 mm)	2
10.	200 gm ball pain hammer	4
11.	Hack Saw Frame	3
12.	Combination pliers(150 MM)	4
13.	Long nose pliers(150 MM)	4
14.	Stripper	4
15.	Circlip plier	4
16.	Fire extinguisher (DCP Type)	1
17.	Glass Electrode PH meter	2
18.	Conductivity Meter with conductivity cell	2
19.	D02 Meter & TDS meter	2
20.	DC volt meter (0-30 V, 0-100 V)	3 Nos (each)

21.	DC ammeters (0-30 mA, 0-100 mA, 0-500 mA)	3 Nos (each)
22.	AC voltmeter (0-300 V)	4 Nos
23.	AC ammeter (0-5 A, 0-10 A)	4 Nos
24.	Watt meter (5000 Watt) or better	2 Nos
25.	Energy meter (single phase)(230V, 10 A or above)	2 Nos
26.	DC regulated power supply (0- 30 V, 2 A) or better	4 Nos.
27.	Digital LCR meter	2 Nos
28.	Digital storage oscilloscope (DSO) (20 MHz or better)	2 Nos
29.	CRO (20 MHz or better)	1 nos
30.	Function generator (0- 10 MHz or above, sine, square, triangle, saw tooth, pulse signal etc generation)	2 Nos.
31.	Co-efficient of expansion of solid operators	2 Nos
32.	Pressure mesurement trainer a. Consisting one pressure process vessel minimum 20 liter capacity b. Bourden tube pressure gauge (C and spiral type one each) (0-7 kg/cm^2) c. diaphram type pressure gauge (0-7 kg/cm^2) d. electronic pressure transmitter (input 0- 7 Kg/cm^2, output 4 to 20 mA) e. pnumatic pressure trasmitter (input 0-7 kg/cm^2, output 3 to 15 psi) f. Pressure switch(0-7 kg/cm^2) g. Absolute pressure gauge (7 kg/cm^2) h. FRL unit with input and output gauge All the instruments are with safety hand valve , flanged arrangement for easy assembling and dismantling, with all necessary accessories and meters for operating and measurement. Tank consisting two extra tapping for connecting any other measurements.	1 units.
33.	Various types of pressure gauges Burden type, Diaphragm type, Capsule type with 6inch dial	2 Nos. each
34.	U tube manometer (mercury filled, 600-0-600 mm)	2 Nos.
35.	Well type manometer (mercury filled , 0-30 inch)	1 Nos.
36.	DP transmitter (electronic) (input : as convenient, output 4 to 20 mA)	1 Nos.
37.	I to P and P to I converter trainer I to P converter (input 4 to 20 mA, output 3 to 15 psi) P to I converter (input 0- 1 Kg/cm^2, output 4 to 20 mA)	2 Nos.

	With pressure gauge0- 2 Kg/cm^2, current meter and current source 0 to 20 mA, FRL unit	
38.	Pressure comparator	1 No.
39.	Dead weight tester capacity / Range – 0 – 100kg) cm^2 or above	1 No.
40.	Electronic pressure calibrator (consisting pressure and current measurement, pressure hand/ motored pump to generate pressure, mA current and voltage sourcing, wide range of selectable measurement units for pressure, simultaneous pressure and current measurement)	1 No.
41.	FLR (filter +Lubricator+ regulator) Unit with input and output gauges, fluid :Air	4 Nos.
42.	Mercury glass thermometer (consumable) various range and sizes	2 Nos. each
43.	Alcoholic glass thermometer (consumable) various range and sizes	2 Nos. each
44.	Bimetallic thermometer (0 to 100 ^{0}C, 0 – 200 ^{0}C)	2 Nos. each
45.	Mercury in steel thermometer	1 No.
46.	Thermocouples (minimum 4 types)	1 No. each
47.	RTD (minimum 2 types)	1 No. each
48.	RTD temperature transmitter/ indicator (compatible PT, Ni, Cu etc RTDs with digital display)	2 Nos.
49.	Thermocouple temperature transmitter/ indicator (compatible J,K,T,E,S, R, etc thermocouples with digital display)	2 Nos.
50.	Optical Pyrometer (digital display, hand held type, filters)	1 No.
51.	Temperature calibrator [measure popular RTD (Ni, PT, Cu etc), THERMOCOUPLE(J,K,T,E,S, R, etc) , measures- resistance, volts, current of sensors and transmitters, act as source/ simulate to thermocouples, RTDs measuring instruments and transmitter.]	1 No.
52.	Head type and quantitative Flow measurement and calibration setup with level measurement and calibration setup [consisting a. Rotameter 1 No. b. Venturi tube (bronze) 1 inch size 1 No. c. Orifice flow setup 1 No. d. U tube manometer 1 No. e. Electronic DP transmitter/indictor 1 No. f. Rotating van flow meter 1 No.	1 No.

	g. Process tank consisting following level measurement setup (with flanged setup and hand valve protection) i. Sight glass level indicator (open channel and close channel setup both) ii. Float type level measurement iii. Air purge level indicator iv. Static pressure type level indicator (open channel and closed channel both) (pressure gauge type) with minimum one inch pipe dia, one SS process tank(100 liters capacity or above) and one SS reservoir tank(150 liter capacity or above) pump should be above one HP , with all necessary accessories and meters for operating and measurement, all the meters are flanged arrangement for easy assembling and dismantling]	
53.	Electronic flow measurement and calibration setup and level measurement setup consisting **Flow Measurement** a. Vertex flow meter b. Turbine flow meter c. Magnetic Flow meter d. Thermal Mass Flow meter e. Ultrasonic Flow meter **Level Measurement** i. Capacitance type level transmitter ii. Non contact type(ultrasonic) level transmitter iii. Radar Type Level Transmitter with minimum one inch pipe dia, one SS process tank(100 liters capacity or above) and one SS reservoir tank(150 liters capacity or above) pump should be above one HP , with all necessary accessories and meters for operating and measurement , all the meters are flanged arrangement for easy assembling and dismantling]	1 No.
54.	Different types of Control valve cut view(double seated type) (with view of actuator parts , valve body-upper bonnet, bottom bonnet, trim parts, etc)	1 Nos.
55.	Control valve (equal percentage, linear, quick opening)set up	1 No each
56.	Temperature control trainer (complete unit consisting PID controller, HART transmitter, final control element and furnace (0-600 C or above) type process, computer inter face and software with all necessary accessories)	1 No.
57.	Electronic Pressure control trainer (complete unit consisting	1 No.

	PID controller, HART Transmitter, control valve, I/P converter , FRL unit and process tank/vessel ,with gauges computer inter face and software, with all necessary accessories and piping systems)	
58.	HART Calibrator	1 No
59.	PLC (Micro PLC) Trainer	1 No.
60.	DCS Training Kit	1 no.
61.	Plant with various type of parameter like temperature, pressure, level, flow, Controller, recorder and transmitter pipe fittings, pumps and valves etc	1

C: FURNITURE:-

Sl. No.	Name & Description of Machines	Quantity (indicative)
1.	Class Room Chairs (armless) / Dual desk may also be allowed	20 nos.
2	Class Room Tables (3ft X 2ft) / Dual desk may also be allowed	20 nos.
3	Chair for Trainer (armed) movable	01 no.
4	Table for Trainer (4 ½ ft X 2 ½ ft) with Drawer and cupboard	01 no.
5	LCD / LED Projector	01 no.
6	Multimedia Computer System with all accessories with UPS	01 set
7	Computer Table	01 no.
8	White Board (6ft X 4 ft.)	01 no.
9	LCD Projector Screen	01 no.
10	Wall charts, Transparencies and DVDs related to the trade	As required

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: Instrument Mechanic (Chemical Plant)

LIST OF TOOLS & EQUIPMENTS FOR IMCP 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

TOOLS & EQUIPMENT FOR ON-JOB TRAINING

TRADE: Instrument 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

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.