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

COMPETENCY BASED CURRICULUM

INSTRUMENT MECHANIC (CHEMICAL PLANT)

(Duration: Two Years)

Revised in July 2022

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

SECTOR – CHEMICALS AND PETROCHEMICALS

Directorate General of Training

INSTRUMENT MECHANIC (CHEMICAL PLANT)

(Engineering Trade)

(Revised in July 2022)

Version: 2.0

CRAFTSMEN TRAINING SCHEME (CTS)

NSQF LEVEL- 4

Developed By

Ministry of Skill Development and Entrepreneurship

Directorate General of Training

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1. COURSE INFORMATION

During the two-year duration of Instrument Mechanic (Chemical Plant) trade a candidate is trained on professional skill, professional knowledge, and Employability skill related to job role. In addition to this a candidate is entrusted to undertake project work and extracurricular activities to build up confidence. The broad components covered during the course are given below:

FIRST YEAR: In this year the trainee learns about safety and environment, use of fire extinguishers & PPEs to begin with. He gets the idea of trade tools & its standardization, familiarize with chemistry and physics lab and also engineering workshop. Perform various types of titration and separate elements from mixtures and prepare standard solutions. Measure PH, and conductivity of various substances. Perform and practiceof basics fittings job in engineering workshop using proper tools and equipment. Practice drilling, reaming, counter boring, counter sinking, riveting, seaming and also thread cutting. Perform basic gas and arc welding. Identify various physical properties of materials and verify different physical laws by operating various instruments.

The candidate will be able to Identify and test various types of electrical/electronic components. Identify, test and calibrate various electrical measuring instruments. Practice soldering & de-soldering of various electrical/electronic components in different circuits. Construct and test various rectifiers and voltage regulated power supply. Perform basic computer hardware like identify of various parts, connect cables, replace part and also dismantled and assemble of desktop computer.

SECOND YEAR: In this year the trainee will be able to Identify and select various types of field instruments as per the applications. Perform troubleshoot, calibrate, test and repair of pressure measuring, indicating and controlling field instruments and analyze the data. Plan and execute Erection and commission of field control loop system for pressure. Perform troubleshoot, calibrate, test and repair of temperature measuring, indicating, controlling and recording field instruments and analyze the data. Perform troubleshoot, calibrate, test and repair of flow measuring and indicating field instruments. Perform troubleshoot, calibrate, test and repair of level measuring, indicating and controlling field instruments and analyze the data.

The trainee will apply safe working practice, follow instructional manual and handle calibrator and hart communicator. Perform troubleshoot, calibrate and repair electronic/pneumatic converters and safety valves. Perform calibrate, test and repair the various types of recorder of different type process parameters. Perform calibrate and test various transmitter for various process parameter. Select suitable controller, perform process

control, troubleshoot and calibrate various controller in chemical plant. Plan and execute erection, commission, overhaul and repair of final control elements with accessories. Basic working and Identification of faults in process control based on PLC, SCADA and DCS. Operate packed distillation column and carry out maintenance of triple effect evaporator, heat exchanger and chiller. Plan and execute automatic process control block diagram and others field bus control systems.

2. TRAINING SYSTEM

2.1 GENERAL

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

Instrument Mechanic (Chemical Plant)trade under CTS is one of the popular courses delivered nationwide through network of ITIs. The course is of two years duration. It mainly consists of Domain area and Core area. The Domain area (Trade Theory & Practical) impartsprofessional skills and knowledge, while Core area(Employability Skills) imparts requisite core skill & knowledge and life skills.After passing out the training program, the trainee is awarded National Trade Certificate (NTC) by DGT which is recognizedworldwide.

Candidates need broadly to demonstrate that they are able to:

- Read & interpret technical parameters/documentation, plan and organize work processes, identify necessary materials and tools;
- Perform task with due consideration to safety rules, accident prevention regulations and environmental protection stipulations;
- Apply professional knowledge, core skills & employability skills while performing the job and repair & maintenance work.
- Check the job with circuit diagrams/components as per drawing for functioning, diagnose and rectify faults in the components/module.
- Document the technical parameters in tabulation sheet related to the task undertaken.

2.2 PROGRESSION PATHWAYS:

- Can join industry as Instrument Technician and will progress further as Senior Technician, Supervisor and can rise to the level of Manager.
- Can become Entrepreneur in the related field.
- Can appear in 10+2 examination through National Institute of Open Schooling (NIOS) for acquiring higher secondary certificate and can go further for General/ Technical education.

- Can join Apprenticeship programme in different types of industries leading to National Apprenticeship certificate (NAC).
- Can join Crafts Instructor Training Scheme (CITS) in the trade for becoming instructor in ITIs.
- Can join Advanced Diploma (Vocational) courses under DGT as applicable.

2.3 COURSE STRUCTURE:

Table below depicts the distribution of training hours across various course elements during a period of two-years: -

S No.	Course Element	Notional Training Hours	
		1st Year	2nd Year
1	Professional Skill (Trade Practical)	840	840
2	Professional Knowledge (Trade Theory)	240	300
3	Employability Skills	120	60
	Total	**1200**	**1200**

Every year 150 hours of mandatory OJT (On the Job Training) at nearby industry, wherever not available then group project is mandatory.

4	On the Job Training (OJT)/ Group Project	150	150

Trainees of one-year or two-year trade can also opt for optional courses of up to 240 hours in each year for 10th/ 12th class certificate along with ITI certification, or, add on short term courses.

2.4 ASSESSMENT & CERTIFICATION

The trainee will be tested for his skill, knowledge and attitude during the period of course through formative assessment and at the end of the training programme through summative assessment as notified by the DGTfrom time to time.

a) The **Continuous Assessment** (Internal) during the period of training will be done by **Formative Assessment Method** by testing for assessment criteria listed against learning outcomes. The training institute has to maintain individual *trainee portfolio* as detailed in assessment guideline. The marks of internal assessment will be as per the formative assessment template provided on www.bharatskills.gov.in

b) The final assessment will be in the form of summative assessment. The All India Trade Test for awarding NTC will be conducted by **Controller of examinations, DGT** as per the guidelines. The pattern and marking structure is being notified by DGTfrom time to time. **The learning outcome and assessment criteria will be basis for setting question papers for final assessment. The examiner during final examination will also check** individual trainee's profile as detailed in assessment guideline before giving marks for practical examination.

2.4.1 PASS REGULATION

For the purposes of determining the overall result, weightage of 100% is applied for six months and one-year duration courses and 50% weightage is applied to each examination for two years courses. The minimum pass percent for Trade Practical and Formative assessment is 60% & for all other subjects is 33%.

2.4.2 ASSESSMENT GUIDELINE

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

Assessment will be evidence-based comprising some of the following:

- Job carried out in labs/workshop
- Record book/ daily diary
- Answer sheet of assessment
- Viva-voce
- Progress chart
- Attendance and punctuality
- Assignment
- Project work
- Computer based multiple choice question examination
- Practical Examination

Evidences and records of internal (Formative) assessments are to be preserved until forthcoming examination for audit and verification by examining body. The following marking

pattern to be adopted for formative assessment:

Performance Level	Evidence
(a) Marks in the range of 60%-75% to be allotted during assessment	
For performance in this grade, the candidate should produce work which demonstrates attainment of an acceptable standard of craftsmanship with occasional guidance, and due regard for safety procedures and practices	• Demonstration of good skill in the use of hand tools, machine tools and workshop equipment. • 60-70% accuracy achieved while undertaking different work 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) Marks in the range of 75%-90% to be allotted during assessment	
For this grade, a candidate should produce work which demonstrates attainment of a reasonable standard of craftsmanship, with little guidance, and regard for safety procedures and practices	• Good skill levels in the use of hand tools, machine tools and workshop equipment. • 70-80% accuracyachieved while undertaking different work 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) Marks in the range of more than 90% to be allotted during assessment	
For performance in this grade, the candidate, with minimal or no support in organization and execution and with due regard for safety procedures and practices, has produced work which demonstrates attainment of a high standard of craftsmanship.	• High skill levels in the use of hand tools, machine tools and workshop equipment. • Above 80% accuracyachieved while undertaking different work 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.

3. JOB ROLE

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

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

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

Mechanic, Precision Instrument, Electrical; Meter Repairer, Electrical repairs and sets electrical parts of precision instruments such as megger, voltmeter, ammeter, condensers, galvanometers, etc., to high accuracy for recording correct readings by reviving, replacements

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

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

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

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

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

Reference NCO-2015:

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

Reference NOS:

(i) MIN/N9401
(ii) MIN/N 9402
(iii) MIN/N 9461
(iv) MIN/N 9462
(v) MIN/N 9463
(vi) MIN/N 9464
(vii) MIN/N 9465
(viii) MIN/N 9466
(ix) MIN/N 9467

(x) MIN/N 9468
(xi) MIN/N 9469
(xii) MIN/N 9470
(xiii) MIN/N 9471
(xiv) MIN/N 9472
(xv) MIN/N 9473
(xvi) MIN/N 9474
(xvii) MIN/N 9475
(xviii) MIN/N 9476
(xix) MIN/N 9477
(xx) MIN/N 9478
(xxi) MIN/N 9479
(xxii) MIN/N 9480
(xxiii) MIN/N 9481
(xxiv) MIN/N 9482
(xxv) MIN/N 9483
(xxvi) MIN/N 9484
(xxvii) MIN/N 9485

4. GENERAL INFORMATION

Name of the Trade	**INSTRUMENT MECHANIC (CHEMICAL PLANT)**
Trade Code	DGT/1057
NCO – 2015	7311.0100, 7311.0101, 7311.0400, 7412.0100, 3132.0200, 3132.0400, 3133.9900, 3134.0100
NOS Covered	MIN/N9401, MIN/N 9402, MIN/N 9461. MIN/N 9462, MIN/N 9463, MIN/N 9464, MIN/N 9465, MIN/N 9466, MIN/N 9467, MIN/N 9468, MIN/N 9469, MIN/N 9470, MIN/N 9471,MIN/N 9472, MIN/N 9473, MIN/N 9474, MIN/N 9475, MIN/N 9476, MIN/N 9477, MIN/N 9478, MIN/N 9479, MIN/N 9480, MIN/N 9481, MIN/N 9482, MIN/N 9483, MIN/N 9484, MIN/N 9485
NSQF Level	Level - 4
Duration of Craftsmen Training	Two Years (2400 hours + 300 hours OJT/Group Project)
Entry Qualification	Passed 10th class examination with Science and Mathematics or with vocational subject in same sector or its equivalent.
Minimum Age	14 years as on first day of academic session.
Eligibility for PwD	LD, LC, DW, AA, LV, DEAF, AUTISM
Unit Strength (No. Of Student)	20 (There is no separate provision of supernumerary seats)
Space Norms	104 Sq. M
Power Norms	8 KW
Instructors Qualification for	
(i) Instrument Mechanic (Chemical Plant) Trade	B.Voc/Degree in Chemical/ Instrumentation/ Process Control instrumentation/ Engineering/ Technology from AICTE/UGC recognized Engineering College/ University with one year experience in relevant field OR 03 years Diploma Chemical/ Instrumentation/ Process Control instrumentation/ Engineering/ Technology AICTE/ recognized board of technical education or relevant Advanced Diploma

	(Vocational) from DGT with two years' experience in relevant field. OR NTC/ NAC passed in trade of "Instrument Mechanic (Chemical Plant)" with 3 years' experience in the relevant field. **Essential Qualification:** Relevant regular/RPL variants of National Craft Instructor Certificate (NCIC) under DGT. ***Note: - Out of two Instructors required for the unit of 2(1+1), one must have Degree/Diploma and other must have NTC/NAC qualifications. However, both of them must possess NCIC in any of its variants.***
(ii) Workshop Calculation & Science	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the engineering trades with three years' experience. **Essential Qualification:** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants NCIC in RoDA or any of its variants under DGT
(iii) Engineering Drawing	B.Voc/Degree in Engineering from AICTE/UGC recognized Engineering College/ university with one-year experience in the relevant field. **OR** 03 years Diploma in Engineering from AICTE / recognized board of technical education or relevant Advanced Diploma (Vocational) from DGT with two years' experience in the relevant field. **OR** NTC/ NAC in any one of the Mechanical group (Gr-I) trades

	categorized under Engg. Drawing'/ D'man Mechanical / D'man Civil' with three years' experience. **<u>Essential Qualification:</u>** Regular / RPL variants of National Craft Instructor Certificate (NCIC) in relevant trade **OR** Regular / RPL variants of NCIC in RoDA / D'man (Mech /civil) or any of its variants under DGT.
(iv) Employability Skill	MBA/ BBA / Any Graduate/ Diploma in any discipline with Two years' experience with short term ToT Course in Employability Skills. (Must have studied English/ Communication Skills and Basic Computer at 12th / Diploma level and above) OR Existing Social Studies Instructors in ITIs withshort term ToT Course in Employability Skills.
(v) Minimum Age for Instructor	21 Years
List of Tools and Equipment	As per Annexure – I

5. LEARNING OUTCOME

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

5.1LEARNING OUTCOMES

FIRST YEAR:

1. Separate the mixture of liquids and prepare standard solutions. Perform various types of titration and separate elements from mixtures. Measure PH, and conductivity of various substances following safety precautions.(NOS:MIN/N9461)
2. Perform basic workshop operations using suitable tools for measuring, holding, cutting, filing, riveting, drilling, reaming and threading. Observing suitable care & safety (NOS:MIN/N9462)
3. Plan and organize the work in familiar predictable/routine environment for different types of welding/riveting/seaming and allied operations. (NOS:MIN/N9463)
4. Apply and execute various physical properties of materials and verify different physical laws by operating various instruments. (NOS:MIN/N9464)
5. Identify, test various electrical components using proper measuring instruments and apply this knowledge to troubleshoot power supplies. (NOS:MIN/N9465)
6. Select and execute electrical/ electronic measurement of single range meters and calibrate the instrument and record the data. (NOS:MIN/N9466)
7. Plan and execute soldering & de-soldering of various electrical/ electronic components in different circuits. (NOS:MIN/N9467)
8. Test various electronic components using proper measuring instruments and compare the data using standard parameter. (NOS:MIN/N9468)
9. Assemble simple voltage regulators and electronic power supply circuit and test for functioning. (NOS:MIN/N9469)
10. Perform basic computer hardware like identify of various parts, connect cables, replace parts, and test of desktop computer. (NOS:MIN/N9470)
11. Read and apply engineering drawing for different application in the field of work. (NOS:MIN/N9402)
12. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)

SECOND YEAR:

13. Identify and select various field instruments as per the applications. (NOS:MIN/N9471)
14. Perform troubleshoot, calibrate, test and repair of pressure measuring, indicating and controlling field instruments and analyze the data. (NOS:MIN/N9472)
15. Plan and execute Erection and commission of field control loop system for pressure. (NOS:MIN/N9473)
16. Perform troubleshoot, calibrate, test and repair of temperature measuring and indicating, controlling and recording field instruments and analyze the data. (NOS:MIN/N9474)
17. Perform troubleshoot, calibrate, test and repair of flow measuring and indicating field instruments. Erection, commission and analyze the data. (NOS:MIN/N9475)
18. Perform troubleshoot, calibrate, test and repair of level measuring, indicating and controlling field instruments and analyze the data. (NOS:MIN/N9476)
19. Apply safe working practice, follow instructional manual and handle calibrator & communicator. (NOS:MIN/N9477)
20. Plan execute and repair Electronic / Pneumatic converter and safety valves. (NOS:MIN/N9478)
21. Perform calibrate, test and repair the various type recorder of different type process parameters. (NOS:MIN/N9479)
22. Plan, execute, calibrate and test transmitter for various process parameter. (NOS:MIN/N9480)
23. Select suitable controller, perform process control, troubleshoot and calibrate various controllers in chemical plant. (NOS:MIN/N9481)
24. Plan and execute erection, commission, overhaul and repair the final control elements with accessories. (NOS:MIN/N9482)
25. Basic working and Identification of faults in process control based on PLC, SCADA and DCS. (NOS:MIN/N9483)
26. Operate packed distillation column and carry out maintenance of triple effect evaporator, heat exchanger and chiller. (NOS:MIN/N9484)
27. Plan and execute automatic process control block diagram and others field bus control systems. (NOS:MIN/N9485)
28. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)

6. ASSESSMENT CRITERIA

LEARNING OUTCOMES	ASSESSMENT CRITERIA
FIRST YEAR	
1. Separate the mixture of liquids and prepare standard solutions. Perform various types of titration and separate elements from mixtures. Measure PH, and conductivity of various substances following safety precautions. (NOS:MIN/N9461)	Perform distillation column operation.
	Perform various type solution preparation.
	Perform conception about mixture and compounds.
	Perform about corrosion detection.
	Perform operation of PH meter and accessories of it.
2. Perform basic workshop operations using suitable tools for measuring, holding, cutting, filing, riveting, drilling, reaming and threading. Observing suitable care & safety. (NOS:MIN/N9462)	Read & interpret the information on drawings and apply in executing practical work.
	Select appropriate measuring instrument such vernier callipers, steel rule (as per tool list).
	Measure dimension of the components & record data to analyse the with given drawing
	Perform basic fitting operations viz., Hacksawing, filing, drilling and reaming to close tolerance as per specification to make the job.
	Identify Tools and equipments for riveting and make these available for use in a timely manner.
	Ascertain and select tools and materials for the job and make this available for use in a timely manner.
	Make a square job by drilling, reaming, filing, etc. check measurement, flatness and squareness by steel rule and try-square.
	Select and ascertain tools for the fitting job and make this available for use in a timely manner.
	Make a step fitting jobby drilling, reaming, filing, etc. check measurement, flatness and squareness by steel rule try-square
	Measure dimension of the components & record data to analyze

	the with given drawing
	Perform basic fitting operations viz., Hack sawing,
3. Plan and organize the work in familiar predictable/ routine environment for different types of welding/ riveting/ seaming and allied operations. (NOS:MIN/N9463)	Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	Recognize and report all unsafe situations according to site policy.
	Identify and take necessary precautions on fire and safety hazards and report according to site policy and procedures.
	Prepare list of appropriate materials by interpreting detail drawings and determine quantities of such materials.
	Ensure dimensional accuracy of assembly by using different instruments/gauges.
	Plan and select the nozzle size, working pressure, type of flame, filler rod as per requirement.
	Prepare, set and tack the pieces as per drawing.
	Set up the tacked joint in specific position.
	Deposit the weld following proper welding technique and safety aspect.
	Carry out visual inspection to ascertain quality weld joint.
4. Apply and execute various physical properties of materials and verify different physical laws by operating various instruments. (NOS:MIN/N9464)	Verify law of parallelogram of force using mechanical board.
	Determine mechanical advantage, velocity ratio and percentage efficiency of Simple Machine.
	Determine Young's Modulus. By Searle's apparatus.
	Verify Ohm's law.
	Measure Electric cell parameters by series & parallel connection.
	Determine specific resistance using Wheatstone's bridge.
	Verify Faraday's first law of electrolysis.
5. Identify, test various electrical components using proper measuring instruments and apply this knowledge to troubleshoot power supplies. (NOS:MIN/N9465)	Follow and maintain procedures to achieve a safe working environment in line with occupational health and safety regulations and requirements.
	Determine the polarities.
	Identify phase and neutral using test lamp.
	Make an electrical circuit using various components
	Measure voltage, current, resistance using multimeter.

	Measure the wire dia. using SWG and micrometer.
6. Select and execute electrical/ electronic measurement of single range meters and calibrate the instrument and record the data. (NOS:MIN/N9466)	Plan work in compliance with standard safety norms.
	Identify the type of electronic and electrical instruments.
	Determine the measurement errors while measuring resistance, voltage and current by multimeter.
	Measure the value of resistance, voltage and current using digital multimeter.
	Identify the different types of resistors.
	Measure the resistor values using colour code and verify the reading by measuring in multi meter.
	Identify the power rating using size.
	Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter, voltmeter and ammeter.
	Calibrate various electrical measuring instruments like ammeter, voltmeter, wattmeter, energy meter using standard (master) instruments.
	Test insulation using megger.
7. Plan and execute soldering & de-soldering of various electrical/ electronic components in different circuits. (NOS:MIN/N9467)	Plan work in compliance with standard safety norms.
	Solder the given components
	Identify and test the variac.
	Avoid waste, ascertain unused materials and components for disposal, store these in an environmentally appropriate manner and prepare for disposal.
	Desolder the given components.
	Practice soldering on components, lug and board with safety.
8. Test various electronic components using proper measuring instruments and compare the data using standard parameter. (NOS:MIN/N9468)	Identify the passive /active components by visual appearance, Code number and test for their condition.
	Plan work in compliance with standard safety norms.
	Identify the power rating using size.
	Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter.
	Find the diode and its characteristics
	Construct half wave rectifiers
	Construct full wave rectifiers
	Construct full wave bridge rectifiers
	Identify different transistors and test by multimeter.
	Find the transistor and its characteristics
	Identify the different capacitors and measure capacitance of various capacitors using digital multimeter.

	Ascertain and select tools and materials for the job and make this available for use in.
9. Assemble simple voltage regulators and electronic power supply circuit and test for functioning. (NOS:MIN/N9469)	Assemble fixed voltage regulators.
	Assemble variable voltage regulators.
	Assemble simple power supply unit.
	Assemble simple power supply unit regulated 12V 1 Amp.
	Construct and test voltage regulator circuit.
	Identify proper heat sinks for different IC based voltage regulators.
	Ascertain and select tools and materials for the job and make this available for use in.
10. Perform basic computer hardware like identify of various parts, connect cables, replace parts, and test of desktop computer. (NOS:MIN/N9470)	Identify various indicators, cables, connectors and ports on the computer cabinet.
	Identify various computer peripherals and connect it to the system.
	Replace the CMOS battery and extend a memory module.
	Test and Replace the SMPS.
	Replace the given DVD and HDD on the system.
	Dismantle the desktop computer system.
	Assemble the desktop computer system.
	Disable certain functionality by disconnecting the concerned cables SATA/ PATA.
	Demonstrate various parts of the system unit and motherboard components.
11. Read and apply engineering drawing for different application in the field of work. (NOS:MIN/N9402)	Read & interpret the information on drawings and apply in executing practical work.
	Read &analyze the specification to ascertain the material requirement, tools and assembly/maintenance parameters.
	Encounter drawings with missing/unspecified key information and make own calculations to fill in missing dimension/parameters to carry out the work.
12. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

SECOND YEAR	
13. Identify and select various field instruments as per the applications. (NOS:MIN/N9471)	Identify the various types field instruments.
	Identify electrical instruments ammeter, voltmeter and watt meter etc.
	Identify electronic instruments transmitters, indicators, controllers and recorders etc.
	Identify pneumatic instruments pressure gauge, pressure regulator, pressure control valve etc.
14. Perform troubleshoot, calibrate, test and repair of pressure measuring, indicating and controlling field instruments and analyze the data. (NOS:MIN/N9472)	Check visually and identify the defects of instruments.
	Rectify the defective instrument using proper tools and equipments as per required.
	Inspect the all assemble part in visually.
	Rectify or replace the defective internal parts as proper specified.
	Assemble all dismantling parts as reverse direction which is done at the procedure of assembled.
	Check the condition of dismantling instruments and make it at suitable condition and usable.
	Set the pressure as requirement.
	Maintain all the safety precaution and cleanliness.
	Calibrate the instruments in proper way and execute plan and utilize suitable calibrator.
	Care & maintain different types of pressure measuring instruments as per schedule.
15. Plan and execute Erection and commission of field control loop system for pressure. (NOS:MIN/N9473)	Find the fault in pressure control loop system and it rectify by using suitable tool and equipment
	Mount the pressure control loop instruments in field in proper place and proper way as per drawing
	Check the all mounting instruments by master instruments and calibrators.
	Make sure the whole path of loop systems working well and healthy condition.
	Maintain all the safety precaution and cleanliness and collect data from various services
16. Perform troubleshoot, calibrate, test and repair of temperature measuring and indicating, controlling and recording field instruments and analyze the data.	Plan work in compliance with standard safety norms.
	Identify different types of temperature switches and its contact with proper connections.
	Construct the different temperature switches and its function.
	Mount the temperature switches and temperature sensing elements in proper place

(NOS:MIN/N9474)	Care and maintain all the safety precaution for handling the temperature sensing elements.
	Test and calibrate different type thermocouples for temperature measurement.
	Test and calibrate resistance thermometers using temperature-controlled oil bath.
	Make sure the temperature transmitter functionally ok and usable condition before mounting it in field control loop system.
	Measure high temperature in non-contact method using radiation pyrometer and optical pyrometers
	Take care to handle different types of pyrometer for temperature measurement and calibrate it.
17. Perform troubleshoot, calibrate, test and repair of flow measuring and indicating field instruments. Erection, commission and analyze the data. (NOS:MIN/N9475)	Calibrate and test Rota meter with standard tools and equipments
	Assembled and dismantle Rota meter for flow measurement as proper way
	Replace the parts of this flow measurement meter
	Care and maintain the flow measuring instrument and schedule maintain
	Calibrate the different type of flow measuring instrument apply different method.
	Set up the calibration of flow measurement by using volumetric flow meter
	Measure liquid flow using transmitter and data record.
	Calibrate/test variable Head or differential flow meter.
	Calibrate/test variable area flow meter.
	Calibrate/test magnetic flow meter.
	Prepare a flow control loop in field using flow measuring instruments, indicating and controlling instruments like transmitters, flow restrictors, flow control valve, flow meter totalizer etc with proper fittings and connectors.
18. Perform troubleshoot, calibrate, test and repair of level measuring, indicating and controlling field instruments and analyze the data. (NOS:MIN/N9476)	Check various type level measuring instruments in proper way
	Care and maintain level measuring instruments
	Find and rectify the fault of level measuring instruments.
	Perform troubleshoot and Calibrate the transmitter for level measurement
	Check different type level detectors.
	Measure liquid level using ultrasonic type liquid level detector.
	Measure liquid level using capacitance type liquid level detector.
	Measure liquid level using direct method.

19. Apply safe working practice, follow instructional manual and handle calibrator & communicator. (NOS:MIN/N9477)	Observe the name plate which is fixing with the instruments.
	Operate universal calibrator for calibration
	Operate hart communicator
	Operate PH meter for PH measurement
	Operate conductivity meter for conductivity measurement
20. Plan, execute and repair I to P converter and safety valves. (NOS:MIN/N9478)	Repair and recondition the I to P and P to I converter in proper way.
	Function of safety valve and its care and maintenance.
	Calibrate I to P and P to I converter with standard calibrator.
	Install it in proper way and safely.
21. Perform calibrate, test and repair the various type recorder of different type process parameters. (NOS:MIN/N9479)	Find the fault and rectify the fault of recorder.
	Repair and rectify the recorder using suitable tools and equipments.
	Replace chart, pen and ink of recorder as require.
	Calibrate the recorder with standard calibrator and accessories.
22. Plan, execute, calibrate and test transmitter for various process parameter. (NOS:MIN/N9480)	Connect properly the accessories of transmitter.
	Perform adjustment and tube/pipe connection with proper fittings and connector.
	Calibrate the transmitter with standard calibrator in various process parameters.
	Care and maintenance the transmitter and mount in various process controls look system as require.
23. Select suitable controller, perform process control, troubleshoot and calibrate various controllers in chemical plant. (NOS:MIN/N9481)	Perform to set the value of controller as require.
	Set the time to control action of controller as require in chemical plant.
	Calibrate the transmitter with standard calibrator in various process parameters in chemical plant.
	Erection and commission the transmitter in process control look system.
	Set proportional band and reset action in controller.
	Measure and control in different loop parameters in chemical plant.
	Calibrate proportional controller
	Calibrate PID controller
24. Plan and execute erection, commission, overhaul and repair the final control elements with accessories.	Plan work in compliance with standard safety norms.
	Dismantle the control valve with standard tools and equipments.
	Recondition the control valve as suitable condition for changing or repairing the valve parts as per fault detection.

(NOS:MIN/N9482)	Assembled all parts as reverse direction of assemble procedure.
	Calibrate the control valve using standard set up.
	Erection and commission the valve with valve positioner.
	Perform erection and commission of control valve in process control system as final control element and pipe/tube with suitable fittings and connector.
	Prepare block diagram of automatic process control system.
25. Basic working and Identification of faults in process control based on PLC, SCADA and DCS. (NOS:MIN/N9483)	Identify the PLC trainer kit with accessories.
	Demonstrate the functions of PLC.
	Prepare logic gates.
	Create small program on PLC.
	Prepare a programme on timer and counters.
	Demonstrate about SCADA and DCS operating control system.
	Use DCS trainer kit with complete communication system on process trainer.
	Use SCADA trainer kit with complete communication system on process trainer.
26. Operate packed distillation column and carry out maintenance of triple effect evaporator, heat exchanger and chiller. (NOS:MIN/N9484)	Carry out maintenance of heat exchanger. (shell and tube)
	Carry out maintenance of chiller.
	Carry out maintenance of stream trap.
	Operate packed distillation column with DCS/PLC system.
	Operate triple effect evaporator.
27. Plan and execute automatic process control block diagram and others field bus control systems. (NOS:MIN/N9485)	Prepare block diagram of automatic process control system.
	Prepare various field bus control system (Protocol).
28. Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)	Solve different mathematical problems
	Explain concept of basic science related to the field of study

SYLLABUS FOR INSTRUMENT MECHANIC (CHEMICAL PLANT) TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 100Hrs.; Professional Knowledge 20Hrs.	Separate the mixture of liquids and prepare standard solutions. Perform various types of titration and separate elements from mixtures. Measure PH, and conductivity of various substances following safety precautions. (NOS:MIN/N9461)	**Trade and Orientation** 1. Visit to various sections of the institute and identify location of various installations. (05 hrs.) 2. Identify safety signs for danger, warning, caution & personal safety message. (03 hrs.) 3. Use of personal protective equipment (PPE). (05 hrs.) 4. Practice elementary first aid. (05 hrs.) 5. Preventive measures for electrical accidents & steps to be taken in such accidents. (02 hrs.) 6. Use of Fire extinguishers. (05 hrs.)	Familiarization with the working of Industrial Training Institute system. Importance of safety and precautions to be taken in the industry/shop floor. Introduction to PPEs. Introduction to First Aid. Response to emergencies e.g., power failure, fire, and system failure. Importance of housekeeping & good shop floor practices. Occupational Safety & Health**:** Health, Safety and Environment guidelines, legislations & regulations as applicable. (04hrs.)
		7. Familiarization with glassware used in chemical lab (20 hrs.) 8. Find out action of acids & bases on metals and alloys. (10 hrs.) 9. Determine PH of different solutions by using Ph paper & PH meter. (15 hrs.) 10. Determine boiling point of different liquids. (07 hrs.)	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 Atom, molecule, Element, compound, mixture, Physical change, chemical change, Acids,

		11. Determine melting point of different solids. (09 hrs.) 12. Measure conductivity of different liquids using conductivity meter. (14 hrs.)	bases, salts-their properties. Molecular weight, equivalent weight, atomic weight, Normality, molarity. Metals & Non-Metals Water- sources, hard and soft water, causes and removal of hardness, water for industrial purposes. Introduction to Effluent treatment plant (CETP). Corrosion- causes, effects and prevention. Allotropy of hydrogen, carbon, phosphorus and Sulphur **ORGANIC CHEMISTRY:** Introduction, purification processes, organic reactions-substitution, addition, Elimination, rearrangement reactions, examples. Nomenclature-Basic rules for Common name & IUPAC name system for alkanes, alkenes & alkynes, their examples, Definition of pH, pH scale, measurement of pH. Conductivity. (16hrs.)
Professional Skill 175Hrs.; Professional Knowledge 32Hrs.	Perform basic workshop operations using suitable tools for measuring, holding, cutting, filing, riveting, drilling, reaming and threading. Observing suitable	**Hand tools and their uses** 13. Identify the different hand tools. (05 hrs.) 14. Selection of proper tools for operation and precautions in operation. (07 hrs.) 15. Care & maintenance of trade tools. (07 hrs.) 16. Practice safety precautions while working in fitting jobs.	Description, const ruction and uses of different hand tools such as Files, Chisels, Hacksaw & Hammer, etc. Description, construction and uses of different marking tools such as steel rule, caliper, punches, scribing block, etc. (07hrs.)

	care & safety. (NOS:MIN/N9462)	(10 hrs.) 17. Workshop practice on filing and hacks awing. (10 hrs.) 18. Practice simple fitting job in workshop, fitting and drilling. (08 hrs.)	
		19. Cut square size job as per drawing from MS flat by using hacksaw blade. (10 hrs.) 20. Hold the job using bench vice. (01 hr.) 21. Measure the selected job using steel rule, calipers and Vernier caliper. (07 hrs.) 22. Prepare edges of square size job using proper tools and equipment. (15 hrs.) 23. Finally check flatness and squareness using try square, surface gauges etc. (04 hrs.)	**JOB HOLDING DEVICES:** Description, construction and uses of different job holding devices such as vice, 'V' Block. (08hrs.)
		24. Hold the job using bench vice. (01 hrs.) 25. Prepare another four edges job using proper tools and equipments. (10 hrs.) 26. Measure all dimension using measuring instruments like steel rule, caliper, vernier caliper etc. (05 hrs.) 27. Mark parallel lines & curve lines using scriber, divider, surface gauge and dot punch. (05 hrs.)	**LINEAR MEASUREMENT:** Description, construction, calculation and uses of different Linear Measuring Instruments - Vernier Caliper, Vernier Depth gauge, Height gauge, Micrometer outside, Bevel protector.(03hrs.)
		28. Make simple step fitting job (male and female) (28 hrs.) 29. Mark drilling position on a job. (03 hrs.) 30. Operate centre drill for	**LINEAR MEASUREMENT:** Description, construction, calculation and uses of different Linear Measuring Instruments - Vernier Caliper,

		drilling a hole. (05 hrs.)	Vernier Depth gauge, Height gauge, Micrometer outside, Bevel protector.(08hrs.)
		31. Practice of drilling (06 hrs.) 32. Determine the reaming drill size. (01 hrs.) 33. Practice of reaming (03 hrs.) 34. Practice of counter sinking (04 hrs.) 35. Practice of counter boring. (04 hrs.)	**DRILLING, REAMING AND THREADING:** Nomenclature and uses of Drill, Reamer, and Thread. (03hrs.)
		36. Determine the tap drill size for internal threading. (03 hrs.) 37. Make BSW or Metric thread using tap. (05 hrs.) 38. Make BSW or Metric thread using die. (08 hrs.)	**THREADS:** Description, nomenclature and uses of different types of threads - metric, BSW, BSF, BSP etc. Calculation oftap drill size.(03 hrs.)
Professional Skill 75Hrs.; Professional Knowledge 14Hrs.	Plan and organize the work in familiar predictable/routine environment for different types of welding/riveting/seaming and allied operations(NOS:MIN/N9463)	39. Use safety equipment in relevant workshop. (10hrs.) 40. Take general precaution in welding workshop. (07hrs.)	**GAS WELDINGSAFETY:** Safety& General precautions observed in welding workshop. Importance of Welding in maintenance of chemical plant and equipment's. Welding terms and their definition. Types of welding. (03 hrs.)
		41. Copper tube fitting flaring practice (02 hrs.) 42. Copper tube fitting ferrule joint (02 hrs.) 43. Fit nut and bolt with over pipe flanges. (06hrs.) 44. Practice riveting on metal sheet. (06hrs.) 45. Practice seaming on metal sheet. (06hrs.)	**METAL JOINING METHOD:** General introduction aboutMechanical method (Riveting, Nut bolting, Seaming etc.) Thermal method (Soldering, Brazing & Welding)(03hrs.)
		46. Practice lightening. (04hrs.) 47. Practice carburizing flame	**GAS WELDING:** Principal of Gas Welding.

		adjustment. (05hrs.) 48. Practice Neutral flame adjustment. (04hrs.) 49. Practice Oxidize flame adjustment. (05hrs.)	Safety precaution before, after & during Gas Welding. Common Gas used in Welding **OXY-ACETYLENE WELDING:** Equipment's such as cylinder trolley, regulator, blow pipe, Hose pipe, Assembling, care & maintenance.(03 hrs.)
		50. Prepare edges using file, try square, steel rule, vernier caliper etc. (10hrs.) 51. Prepare edge joint using arc welding/gas welding with or without filler rod. (08hrs.)	**OXY-ACETYLENE FLAME:** Types of flame, uses & Effect of Atmospheric oxidation. (05 hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 14Hrs.	Apply and execute various physical properties of materials and verify different physical laws by operating various instruments. (NOS:MIN/N9464)	52. Verify law of parallelogram of force using mechanical board. (04 hrs.) 53. Determine co-efficient of static friction by inclined plane. (04 hrs.) 54. Determine mechanical advantage, velocity ratio and percentage efficiency of Simple Machine. (08 hrs.) 55. Operate simple machine e.g., Lever, Pulley, Block & Screw Jack. (04 hrs.) 56. Determine Young's Modulus. By Searle's apparatus. (05 hrs.) 57. Verify Ohm's law. (05 hrs.) 58. Measure Electric cell parameters by series & parallel connection. (06 hrs.) 59. Determine specific resistance using Wheatstone's bridge. (06 hrs.) 60. Verify Faraday's first law of	**PHYSICS** Introduction to Physics, Measurement with Vernier caliper, Micrometer, Wire gauge. Scalar and Vector quantities, their representation, resultant. Triangle and parallelogram laws of forces. Newton's laws of motion, Inertia, force, momentum, types of force. Friction-definition, unit, types of friction, laws of friction, advantages and disadvantages of friction. **ELASTICITY:** Stress, strain, elastic limit, Hooke's law. Types of modulus of elasticity, work done in a stretching wire, determination of Young's modulus **CURRENT ELECTRICITY:** Ohm's law, series & parallel connections, specific resistance,

		electrolysis. (06 hrs.) 61. Determine mechanical equivalent of heat by Joule's method. (08 hrs.) 62. Determine co-efficient of expansion of solid. (04 hrs.) 63. Determine co-efficient of expansion of liquid. (03 hrs.) 64. Determine co-efficient of thermal conductivity of metal rod. (05 hrs.) 65. Determination of density of solid. (04 hrs.) 66. Determination of density of liquid. (03 hrs.)	Kirchhoff's law, Wheatstone's bridge, applications of Wheatstone bridge. **ELECTROLYSIS:** Faraday's laws of electrolysis. Thermodynamics- first law of thermodynamics, mechanical equivalent of heat, 'J' by electrical method. Modes of heat transfer, determination of thermal conductivity. Temperature & its measurement, expansion of solid, liquid and gases. (14 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 07Hrs.	Identify, test various electrical components using proper measuring instruments and apply this knowledge to troubleshoot power supplies. (NOS:MIN/N9465)	**BASIC ELECTRICITY:** 67. Identify ± polarities. (07 hrs.) 68. Identify various electrical components with symbols. (12 hrs.) 69. Use various electrical components. (15 hrs.) 70. Measure electrical wire size using SWG (standard wire gauge) and micrometer. (06 hrs.) 71. Measure voltage, current & resistance. (10 hrs.)	**BASICS ELECTRICAL:** Conductor, semiconductor & insulators. Standard wire gauge (SWG). Introduction of electricity- static electricity. Current, voltage, P.D, E.M.F, resistance. Their units. Electrical circuit - D.C & A.C circuit differences. Importance of grounding. **TYPES OF SWITCHES:** SPST, SPDT, DPST, DPDT, Toggle, etc. (07 hrs.)
Professional Skill 80 Hrs.; Professional Knowledge 16Hrs.	Select and execute electrical/ electronic measurement of single range meters and calibrate the instrument and record the data.	**ELECTRICAL MEASURING INSTRUMENTS:** 72. Dismantle, part testing part repairing, part replacement and assemble, adjustment, calibration, final testing of Moving coil instrument. (02 hrs.) 73. Dismantle, part testing part	**TYPE OF ELECTRICAL MEASURING INSTRUMENTS:** MC & MI, Construction & working principles of Ammeter, Voltmeter, Wattmeter. Energy meter, P.F. meter, frequency meter, multimeter, clamp meter, megger. (08 hrs.)

	(NOS:MIN/N9466)	repairing, part replacement and assemble, adjustment, calibration, final testing of Moving iron instrument. (02 hrs.) 74. Dismantle, part testing part repairing, part replacement and assemble, adjustment, calibration, final testing of Wattmeter. (02 hrs.) 75. Dismantle, part testing part repairing, part replacement and assemble, adjustment, calibration, final testing of P.F.meter. (02 hrs.) 76. Dismantle, part testing part repairing, part replacement and assemble, adjustment, calibration, final testing of frequency meter. (02 hrs.) 77. Dismantle, part testing part repairing, part replacement and assemble, adjustment, calibration, final testing of Energy meter. (02 hrs.) 78. Measurement of voltage, current & resistance in different circuits using voltmeter, ammeter and multimeter. (03 hrs.) 79. Measure directly & indirectly of electrical power & energy using watt meter and energy meter. (04 hrs.) 80. Calibrate energy meters. (06 hrs.) 81. Test Insulation using megger. (07 hrs.)	

		82. Insulation to insulation test. (02 hrs.) 83. Conductor to conductor test. (01 hrs.) 84. Conductor to insulator test. (02 hrs.) 85. Measure high current using clamp meter. (03 hrs.)	
		86. Identify different types of resistor (include NTC, PTC, W/W, linear, preset, VDR, LDR) (03 hrs.) 87. Identify different types of capacitors (02 hrs.) 88. Testing of charging and discharging of capacitor. (02 hrs.) 89. Find out polarity of capacitor. (02 hrs.) 90. Examine the behavior of resistance when connected in series and parallel. (04 hrs.) 91. Find values and power rating of resister. (04 hrs.) 92. Identify resisters and its value Using color code (03hrs.)	**RESISTORS:** Laws of Resistance. Series, parallel and combination circuits, Different Types of resistors &their properties. Different methods of measuring values of resistance. **CAPACITOR:** Construction details, charging, discharging, types, uses. Factors on which capacitance depends. Formulae & simple problems. (04 hrs.)
		93. Identify live, neutral and earth on power socket using test lamp. (04 hrs.) 94. Use a tester to monitor AC power. (04 hrs.) 95. Read and interpret the settings, sockets on analog and digital multi-meters. (05 hrs.) 96. Measure unwanted voltage between the neutral and ground. Reduce it. (07 hrs.)	**BASIC TERMS:** Such as electric charges, Potential difference, Voltage, Current, Resistance, Frequency, Amplitude, Single phase and Three phase power. Familiarization with Digital Multimeter. Uses, handling & precautions of Digital Multimeter. (04 hrs.)

Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs	Plan and execute soldering & de-soldering of various electrical/electronic components in different circuits. (NOS:MIN/N9467)	97. Identify the different types of soldering gun. (03 hrs.) 98. Preparation of component for soldering, cleaning, tinning, luxing. (03 hrs.) 99. Select and practice soldering of different electronic active and passive components on PCB. (03 hrs.) 100. Practice de-soldering the components and clean the surface of track on PCB using de-soldering pump/de-soldering wick. (05hrs.) 101. Repair and test the broken PCB track. (05hrs.) 102. Mount digital ICs on verities of PCBs. (06hrs.)	**SOLDERING:** Different type of soldering guns, relate temperature with wattages, types of tips. Solder materials and their grading. Use of wax and other materials. Selection of a soldering gun for specific requirement. Soldering and De-soldering stations and their specifications. (07hrs.)
Professional Skill 80 Hrs.; Professional Knowledge 16Hrs.	Test various electronic components using proper measuring instruments and compare the data using standard parameter. (NOS:MIN/N9468)	103. Find various types of diode (solid state) (05 hrs.) 104. Check various types of diode. (03 hrs.) 105. Find characteristics of diode. (06 hrs.) 106. Find the characteristics of Zener diode. (03 hrs.) 107. Construct and test Zener based voltage regulator circuit. (03 hrs.)	**STUDY OF SEMICONDUCTOR:** Doping, Intrinsic and extrinsic semiconductor, Covalent bond. PN junction diode, Forward and Reverse characteristics. Specification of diodes (data sheets). Applications of diode. Special semiconductor diode, Zener diode, Photo diode etc. (04hrs.)
		108. Construct rectifiers (half wave) (06 hrs.) 109. Construct rectifiers (full wave) (07 hrs.) 110. Construct bridge (four diodes) for full wave rectifier. (07 hrs.) 111. Construct a rectifier with	**RECTIFIERS:** Half wave rectifier, full wave (bridge & center tapped) rectifier. **Filters:** Introduction, purpose and use of ripple filter. Types of filters. Capacitance filter, inductance filters, RC filters, LC filters, voltage

		capacitor filter circuit. (04 hrs.) 112. Construct a rectifier with inductor filter circuit. (04 hrs.) 113. Construct a rectifier with RC filter circuit. (04 hrs.) 114. Find ripple factors in rectifiers. (Half wave and full wave) in various filter circuits. (08 hrs.)	dividers and bypass filters. (08 hrs.)
		115. Identify PNP and NPN transistor. (02 hrs.) 116. Record the different specification of transistor using data book (02 hrs.) 117. Identify the different transistors with respect to different packing style. (02 hrs.) 118. Identify power switching transistor. (03 hrs.) 119. Measure E-B, C-B and C-E terminal resistance and infer (04 hrs.) 120. Identify by its number and testing of FET. (03 hrs.) 121. Identify by its number and testing of MOSFET. (04 hrs.)	**TRANSISTORS:** Defining transistors, NPN & PNP transistor, Symbol, operation, Biasing of Transistor & mode of Application. Introduction to FET, MOSFET. (04 hrs.)
Professional Skill 100 Hrs.; Professional Knowledge 20 Hrs.	Assemble simple voltage regulators and electronic power supply circuit and test for functioning. (NOS:MIN/N9469)	122. Assemble various types of simple fixed voltage regulator on zero PCB. (07hrs.) 123. Assemble variable voltage regulator on zero PCB (07hrs.) 124. Assemble a simple power supply unit regulated 12V,	**VOLTAGE REGULATORS:** Introduction & purpose of Zener regulators, Regulated Power supplyusing 78XX series, 79XX series, etc. **UPS:** Types of UPS. Block diagram and working principle of different types UPS. Most

		1Amp. (13 hrs.) 125. Identify different fixed ± voltage regulator ICs of different current ratings (78xx/79xx series) along with i/o, reference pins. (08 hrs.) 126. Identify proper heat sinks for different IC based voltage regulators. (10 hrs.) 127. Verify the input voltage and observe the fixed output for the above-mentioned series. (15 hrs.)	frequently occurring faults and their remedies. Concept of UPS, OFFLINE and ONLINE. Difference between Inverters and UPS. (12hrs.)
		128. Modulate various signals using AM and FM on the trainer kit and observe the waveforms. (15 hrs.) 129. Demodulate various signals using AM and FM on the trainer kit and observe the waveforms. (15 hrs.)	**ADVANCED COMMUNICATION:** Need of Modulation, types of modulation. Demodulation techniques. Introduction to AM, FM & PWM. (08 hrs.)
Professional Skill 80 Hrs.; Professional Knowledge 16Hrs.	Perform basic computer hardware like identify of various parts, connect cables, replace parts, and test of desktop computer. (NOS:MIN/N9470)	**Computer Hardware,** 130. Identify various indicators, cables, connectors and ports on the computer cabinet. (03 hrs.) 131. Demonstrate various parts of the system unit and motherboard components. (05 hrs.) 132. Identify various computer peripherals and connect it to the system. (04 hrs.) 133. Disable certain functionality by disconnecting the concerned cables SATA/ PATA. (05 hrs.)	Basic blocks of a computer, Components of desktop and motherboard. Hardware and software, I/O devices, and their working. Different types of printers, HDD, DVD. Various ports in the computer. Windows OS MS widows: Starting windows and its operation, file management using explorer, Display & sound properties, screen savers, font management, installation of program, setting and using of

		134. Replace the CMOS battery and extend a memory module. (05 hrs.) 135. Test and Replace the SMPS (04 hrs.) 136. Replace the given DVD and HDD on the system (03 hrs.) 137. Dismantle the desktop computer system. (07 hrs.) 138. Assemble desktop computer system. (07 hrs.) 139. Identify different types of cables and network components e.g., Hub, switch, router, modem etc. (05 hrs.) 140. Prepare terminations, make UTP and STP cable connectors and test. (09 hrs.) 141. Connect network connectivity and wireless connectivity hardware and check for its functioning connectivity (07 hrs.) 142. Boot the system from different options. (05 hrs.) 143. Practice various futures of OS. (04hrs.) 144. Perform maintenance of computer using standard tools provided in the OS. (02 hrs.) 145. Install the printer driver software and test for prints outs. (01 hr.) 146. Install the antivirus software and scan the system.	control panel., application of accessories, various IT tools and applications. Concept of word processing, MS word – Menu bar, standard tool bar, editing, formatting, printing of document etc. Excel – Worksheet basics, data entry and formulae. Moving data in worksheet using tool bars and menu bars, Formatting and calculations, printing worksheet, creating multiple work sheets, creating charts. Introduction to power point Basics of preparing slides, different design aspects of slides, animation with slides etc. Concept of Internet, Browsers, Websites, search engines, email, chatting and messenger service. Downloading the Data and program files etc. **Computer Networking: -** Network features - Network Medias Network topologies, protocols- TCP/IP, UDP, FTP, models and types. Specification and standards, types of cables, UTP, STP, Coaxial cables. Network components like hub, Ethernet switch, router, NIC

		(02hrs.) 147. Install the MS Office software and test for prints outs. (01 hr) 148. Use start Manu, check available programs in computer.(01 hr) 149. Create folder and files. (01 hr)	Cards, connectors, media and firewall. Difference between PC & Server. (16 hrs)
ENGINEERING DRAWING (40 Hrs.)			
Professional Knowledge ED- 40 Hrs.	Read and apply engineering drawing for different application in the field of work. (NOS:MIN/N9402)	**Engineering Drawing:** Introduction to Engineering Drawing and Drawing Instruments – Conventions Sizes and layout of drawing sheets Title Block, its position and content Drawing Instrument Free hand drawing of – Geometrical figures and blocks with dimension Transferring measurement from the given object to the free hand sketches. Free hand drawing of hand tools. Drawing of Geometrical figures: Angle, Triangle, Circle, Rectangle, Square, Parallelogram. Lettering & Numbering – Single Stroke Dimensioning Practice Types of arrowhead Symbolic representation – Different symbols used in the related trades Reading of chemical plant Circuit Diagram Reading of Chemical plant Layout drawing	
WORKSHOP CALCULATION & SCIENCE (38 Hours)			
Professional Knowledge WCS- 38 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)	**Workshop Calculation & Science:** **Unit, Fractions** Classification of unit system Fundamental and Derived units F.P.S, C.G.S, M.K.S and SI units Measurement units and conversion Factors, HCF, LCM and problems Fractions - Addition, subtraction, multiplication & division Decimal fractions - Addition, subtraction, multiplication& division Solving problems by using calculator **Square root, Ratio and Proportions, Percentage** Square and square root	

		Simple problems using calculator Applications of Pythagoras theorem and related problems Ratio and proportion Ratio and proportion - Direct and indirect proportions Percentage Percentage - Changing percentage to decimal and fraction **Material Science** Types metals, types of ferrous and non ferrous metals Physical and mechanical properties of metals **Mass, Weight, Volume and Density** Mass, volume, density, weight and specific gravity Related problems for mass, volume, density, weight and specific gravity **Speed and Velocity, Work, Power and Energy** Speed and velocity - Rest, motion, speed, velocity, difference between speed and velocity, acceleration and retardation Speed and velocity - Related problems on speed & velocity Work, power, energy, HP, IHP, BHP and efficiency **Heat & Temperature and Pressure** Concept of heat and temperature, effects of heat, difference between heat and temperature, boiling point & melting point of different metals and non-metals Scales of temperature, Celsius, Fahrenheit, kelvin and conversion between scales oftemperature Heat &Temperature - Temperature measuring instruments, types of thermometer, pyrometer and transmission of heat - Conduction, convection and radiation Concept of pressure - Units of pressure, atmospheric pressure, absolute pressure, gauge pressure and gauges used for measuring pressure **Basic Electricity** Introduction and uses of electricity, molecule, atom, how electricity is produced, electric current AC,DC their comparison, voltage, resistance and their units (Only basics) Conductor, insulator, types of connections - series and parallel (Only basics) Ohm's law, relation between V.I.R & related problems (Only basics) Electrical power, energy and their units, calculation with assignments (Only basics) Magnetic induction, self and mutual inductance and EMF generation (Only basics) Electrical power, HP, energy and units of electrical energy (Only basics) **Trigonometry**

		Measurement of angles Trigonometrical ratios
Project work / Industrial visit		

SYLLABUS FOR INSTRUMENT MECHANIC (CHEMICAL PLANT) TRADE			
SECOND YEAR			
Duration	**Reference Learning outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Identify and select various field instruments as per the applications. (NOS:MIN/N9471)	150. Determine electrical instruments like ammeter, voltmeter, watt meter, energy meter, frequency meter etc. (08 hrs.) 151. Determine electronics instruments like transmitter, indicators, controllers and recorders etc. (08 hrs.) 152. Determine pneumatic instruments like transmitter, indicators, controllers and recorders etc. (09 hrs.)	**INTRODUCTION TO INSTRUMENTATION:** Scope and necessity of instrumentation. Fundamentals of measurement systems- functional block diagram of measurement system. Calibration and calibration standards - basic standards, secondary standards, working standards. Fundamental units - The metric system, Base & supplementary units, Derived Units, Multiplying factors and standards of length, mass, time, &frequency. Basic Instrumentation Symbols.(09hrs.)
Professional Skill 90Hrs.; Professional Knowledge 27 Hrs.	Perform troubleshoot, calibrate, test and repair of pressure measuring, indicating and controlling field instruments and analyze the data. (NOS:MIN/N9472)	**Pressure Measurement** 153. Check bourdon tube pressure gauge (04 hrs.) 154. Dismantle the bourdon tube pressure gauge. (07 hrs.) 155. Fault find out the bourdon tube pressure gauge. (03 hrs.) 156. Rectify the faulty bourdon tube pressure gauge. (04 hrs.)	**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,

		157. Assemble the bourdon tube pressure gauge. (04 hrs.) 158. Calibrate Bourdon tube pressure gauge. (04 hrs.) 159. Calibrate Diaphragm type pressure gauge. (04 hrs.) 160. Calibrate vacuum pressure gauge. (05 hrs.) 161. Calibrate Compound pressure gauge. (05 hrs.) 162. Use dead weight tester and comparator for calibration. (05 hrs.)	random & illegitimate error. Certainty/ uncertainty, validity of result. Measuring system Response. (13 hrs.)
		163. Test the mechanical transducer Bourdon tubes, Diaphragms, with standard calibrator. (07 hrs.) 164. Test the electrical transducer Inductive type, Resistance type, Capacitive type with standard calibrator. (08 hrs.) 165. Test the analogue and digital transducer with standard calibrator. (07 hrs.)	**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 types, shapes, material used for various applications, ranges advantages and limitations. Pressure switches types and applications. (07 hrs.)
		166. Measure differential pressure using U tube manometer, well type manometer and inclined limb type manometer.	Different type of Pressure measuring Instruments **MANOMETERS:** (well tube, 'U' Tube & Inclined Tube) & Barometers.

		(5 hrs.) 167. Measure atmospheric pressure using different types of Barometer. (4 hrs.) 168. Test the various type pressure transmitters with standard calibrator. (4 hrs.) 169. Test the various type pressure switches with standard calibrator. (5 hrs.) 170. Test the pressure safety valve with standard calibrator. (5 hrs.)	**GAUGES:** Pressure Gauges, Vacuum Gauge, Compound Gauge & Absolute Pressure Gauge. lts construction uses Principle of operation. Importance of calibration in Metrology. (07 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09Hrs.	Plan and execute Erection and commission of field control loop system for pressure. (NOS:MIN/N9473)	171. Commission and trouble shoot the various type instruments for pressure control loop system. (08 hrs.) **Erection and commission** 172. Install primary Pressure elements. (03 hrs.) 173. Install pressure Gauge. (02 hrs.) 174. Fit the valve. (03 hrs.) 175. Install DP transmitter. (02 hrs.) 176. Install miscellaneous items like pipes/ tube, electrical connections, pipes/ tube fittingsconnector etc. for Pressure measurement system. (03 hrs.) 177. Practice schedule maintenance. (04 hrs.)	**METHOD OF PRESSURE INSTRUMENT CALIBRATION:** Dead weight tester and comparators. Electrical pressure transducers. Method of conversion, primary and secondary pressure transducers. Potentio-metric pr. transducers, Capacitive pr. transducers, strain gauge pressure transducers, piezoelectric. Differentials pressure transducers. Types of Pressure transmitters, principle of construction of different Electronic Transmitters. Study of Pressure Safety valve, Pressure Switch, manifo1ds. Classification of transmitter such as 2-wire, 3-

			Wire& 4-wire Transmitter. (09hrs.)
ProfessionalSkill 95Hrs.; Professional Knowledge 35 Hrs.	Perform troubleshoot, calibrate, test and repair of temperature measuring and indicating, controlling and recording field instruments and analyze the data. (NOS:MIN/N9474)	**Temperature Measurement** 178. Identify different types of thermometer and thermo switches for temperature with their function. (04 hrs.) 179. Dismantle and identify parts of its function, adjustment, assemble and operation of Bimetallic and liquid field system thermometer. (02 hrs.) 180. Service and calibrate various types of thermometers. (02 hrs.) 181. Measure temperature by different temperature sensor with the help of automatic temperature-controlled oil bath/ furnace. (07 hrs.) 182. Calibrate Filled system temperature indicator. (02 hrs.) 183. Calibrate bimetallic thermometer (02 hrs.)	**TEMPERATURE MEASUREMENT:** Definition, Temperature scale, & Units of Temperature & their conversion in between units. Expansion Methods for Temperature Measurement- **Liquid Expansion Type-** Mercury in glass thermometer, steel thermometers, Alcohol in glass thermometer. **Solid Expansion Type-** Bimetallic thermometers. **Gas Expansion Type-** Vapor Pressure/ Gas Filled thermometers. (07 hrs.)
		184. Check different types of Thermocouples like 'J', 'K', 'T' etc. (02 hrs.) 185. Identify and check different types of RTD (05 hrs.) 186. Identify and check different types of	**TEMPERATURE MEASUREMENT BY ELECTRICAL METHOD:** Thermistor, Thermocouple& RTD their ranges, construction, principle of operation. Thermocouples Ex-tension

		Thermistors. (02 hrs.) 187. Maintain & repair the thermocouple. (10 hrs.)	wires, compensating for changes in reference junction temperature, construction of thermocouple junction, types of thermocouple, advantages and disadvantages of thermocouples.(07 hrs.)
		188. Check digital temperature indicator. (02 hrs.) 189. Set up the temperature loop system. (04 hrs.) 190. Calibrate the temperature transmitter (capillary type). (05 hrs.) 191. Calibrate the temperature transmitter (electronic) using suitable calibrators. (04 hrs.) 192. Find out the error of temperature transmitter. (02 hrs.) 193. Correct the temperature transmitter for useable. (02 hrs.)	**DIGITAL TEMPERATURE INDICATORS:** Types of Temperature Transmitter. Types of Temperature Indicator, Temperature Scanner. (07hrs.)
		Calibrate the switches 194. Bimetal strip temperature switch. (03 hrs.) 195. Liquid filled temperature switch. (03 hrs.) 196. Reed temperature switch. (03 hrs.) 197. Thermostat type temperature switch. (03 hrs.) 198. Thermocouple type	**TEMPERATURE MEASUREMENT BY NON-CONTACT METHOD:** Pyrometry. Molecular activity and electromagnetic radiation, defining pyrometry, effects of emittance, effects of temperature, radiated energy, pyrometers and wave lengths, using of optical and radiation pyrometer. (07 hrs.)

		temperature switch. (03 hrs.) 199. Calibrate the thermostat. (04 hrs.)	
		200. Use the thermocouple pyrometer for temperature measurement. (04 hrs.) 201. Use the optical pyrometer for temperature measurement. (04 hrs.) 202. Use the radiation pyrometer for temperature measurement. (04 hrs.) 203. Use electronic temperature calibrator for checking and calibration of above instruments. (07 hrs.)	Types of pyrometers IR Temp Guns, Radiation & Filament Type. Introduction of temperature calibrator. (07 hrs.)
Professional Skill 90Hrs.; Professional Knowledge 27 Hrs.	Perform troubleshoot, calibrate, test and repair of flow measuring and indicating field instruments. Erection, commission and analyze the data. (NOS:MIN/N9475)	**Flow Measurement** 204. Check flow restrictors. (02 hrs.) 205. Concept the orifice plates. (02 hrs.) 206. Shape and connect Concentric Orifice plate. (02 hrs.) 207. Shape and connect Eccentric orifice plate. (03 hrs.) 208. Shape and connect Segmental orifice plate. (02 hrs.) 209. Shape and connect Quadrant orifice plate. (02 hrs.)	**PROPERTIES OF FLUID FLOW:** 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. Types of flow meters - head type, variable area type, quantitative flow meters. (07 hrs.)

		210. Concept the Venturi tube. (03 hrs.) 211. Shape and connect Long-form of classic Venturi tube. (02 hrs.) 212. Shape and connect Eccentric Venturi tube. (02 hrs.) 213. Shape and connect Rectangular Venturi tube. (02 hrs.)	
		214. Construction of rotameter and measure fluid flow by rotameter. (02 hrs.) 215. Check the rotameter. (01 hr.) 216. Fault finds the rotameter. (03 hrs.) 217. Dismantling of rotameterand identify the parts of it and scale. (03 hrs.) 218. Clean the rota meter. (01 hr.) 219. Rectify the rotameter. (02 hrs.) 220. Replace tapper glass tube. (03 hrs.) 221. Installation of rotameter. (03 hrs.) 222. Calibrate the rotameter. (04 hrs.)	**OPEN CHANNEL FLOW METERS:** Principle of open channel flow, weirs, notches and flumes. Various shapes and their applications. Variable area type flow meter-rotameter, constructions, working principle, applications. Various shapes of float, type of materials used for body and float. Factors affecting rotameter performance, measuring gas and liquid flow.(07 hrs.)
		223. Measure flow using Vortex flow meter. (02 hrs.) 224. Measure flow using Magnetic flow meter.	**VOLUMETRIC AND MASS TYPE:** Turbine flow meter, magnetic flow meters, vertex flow meter ultrasonic flow meter,

		(03 hrs.) 225. Measure flow using thermal mass flow meter. (04 hrs.) 226. Measure flow using Coriolis mass flow meter. (03 hrs.) 227. Measure flow using Turbine flow meter. (03 hrs.) 228. Identify different parts and function of positive type displacement flow meters 1) rotating vane type flow meter 2) Oscillating piston type flow meter 3) Nutating disc type flow meter 4) Reciprocating flow meter. (06 hrs.)	Thermal mass flow meter, advantages and disadvantage. Coriolis Mass flow meter. (07hrs.)
		Erecting and commission 229. Install primary flow elements. (03 hrs.) 230. Install pressure trap. (02 hrs.) 231. Fit the valve. (02 hrs.) 232. Install DP transmitter. (02 hrs.) 233. Install miscellaneous items like pipes/ tube, electrical connections, pipes/ tube connector etc. for flow measurement system. (05 hrs.) 234. Practice schedule maintenance. (02 hrs.) 235. Measure Mass Flow	**METERING THE FLOW OF SOLID PARTICLES:** Measuring volumetric and mass flow rate of solids, volumetric solids flow meter, mass flow meter for solids, belt type solid meters belt speed sensing and signal processing, slurries, constant weight feeders.(06 hrs)

		Rate Using Solid Flow Meter. (09 hrs.)	
Professional Skill 95 Hrs.; Professional Knowledge 35 Hrs.	Perform troubleshoot, calibrate, test and repair of level measuring, indicating and controlling field instruments and analyze the data. (NOS:MIN/N9476)	**Level Measurement** 236. Use sight glass for level measurement. (04 hrs.) 237. Use hook type level indicator for level measurement. (03 hrs.) 238. Use float type indicator for level measurement. (03 hrs.) 239. Use static pressure indicator for level measurement. (03 hrs.) 240. Indirect level measurement Use air purge indicator for level measurement. (03 hrs.) 241. Identify working and part of mercury level switches, magnetic reed switches. (02 hrs.)	**PRINCIPLES OF LEVEL MEASUREMENT:** Types of level measurements-solid and liquid, Mechanical and Electrical type. Storage tank gauges, sight glasses, buoyancy. Factors need to consider for open and closed channel level measurements. **LEVEL SWITCHES:** Mercury level switches in high pressure tank, level detectors, magnetic reed switches. (07hrs.)
		242. Service the level measuring instruments. (06 hrs.) 243. Schedule maintains the level measuring instrument. (03 hrs.) 244. Repair the level measuring instrument. (04 hrs.) 245. Get ready the Controlling instrument for level control. (05 hrs.)	Pressure head instruments. Hydrostatic pressure, specific gravity, pressurized fluids, U-tube manometers, air purge systems. (07hrs.)
		Method of liquid level measurement 246. Use ultrasonic type for	**LIQUID LEVEL MEASUREMENT:** Electrical method conductivity

		liquid level measurement. (05 hrs.) 247. Use capacitance probes type for liquid level measurement. (05 hrs.) 248. Use Conductivity type for liquid level measurement. (05 hrs.) 249. Use Diaphragm switch type level detector for liquid level measurement. (05 hrs.) **Method of Solid level measurement.** 250. Use ultrasonic type for solid level measurement. (05 hrs.) 251. Use capacitance probes type for solid level measurement. (05 hrs.) 252. Use microwave type for solid level measurement. (06 hrs.) 253. Use Diaphragm switch type level detector for solid level measurement. (04 hrs.)	and capacitance method for Measuring the liquid level, capacitance probes, zero and span adjustments, Ultrasonic level detectors, Diaphragm switch **SOLID LEVEL MEASUREMENT:** Using weight to determine level, Ultrasonic solid level measurement with microwaves, using capacitance probes to measure solid level and point type level detection.(14 hrs)
		254. Calibrate differential pressure transmitter (Diaphragm and Air Trap) for level measurement. (06 hrs.) 255. Calibrate the electronic level indicator. (05 hrs.) 256. Configure the ultrasonic level detector. (05 hrs.) 257. Calibrate capacitance type level indicator. (03	Differential pressure measurement Diaphragm & Air Trap Electronic Level Measuring Instrument: Variable capacitance, Ultrasonic and Magnetic type level Switches, Radar Type Level Measurement, and Level measurement by Load cell.(07hrs.)

		hrs.)	
Professional Skill 65Hrs.; Professional Knowledge 22Hrs.	Apply safe working practice, follow instructional manual and handle calibrator and communicator. (NOS:MIN/N9477)	258. Take safety precaution during calibration. (07 hrs.) 259. Observe the name plate which is fixing with the instruments. (07 hrs.) 260. Practice to follow up the instructional manual for instruments under calibration. (07 hrs.) 261. Handle universal calibrator. (12 hrs.) 262. Handle hart communicator with calibrator. (10 hrs.)	Classification of instrument according to accuracy. Generation of calibration report. (15hrs.)
		263. Identify the parts of the PH meter. (02 hrs.) 264. Operate the PH meter. (03 hrs.) 265. Measure PH value. (03 hrs.) 266. Control the PH. (02 hrs.) 267. Identify the function of parts and operation of the conductivity meter. (03 hrs.) 268. Operate the conductivity meter. (03 hrs.) 269. Measure conductivity. (03 hrs.) 270. Control the conductivity. (03 hrs.)	**MASTER INSTRUMENT:** Hart communicator and calibrator, Universal Calibrator, PH simulator, Conductivity simulator.(07 hrs.)
Professional	Plan execute and	271. Identify the function of	**CONVERTERS:**

Skill 25 Hrs.; Professional Knowledge 09 Hrs.	repair electronic/pneumatic converters and safety valves. (NOS:MIN/N9478)	parts and operation of I to P and P to I converter. (04 hrs.) 272. Repair I to P converter. (04 hrs.) 273. Calibrate I to P converter. (05 hrs.) 274. Calibrate P to I converter. (05 hrs.) 275. Repair pressure safety valve. (07 hrs.)	Principle, Construction, operation of I to P, and P to I Converters, Types of Manometer (ELCTRONIC & PNEUMATIC). (09 hrs.)
Professional Skill 40 Hrs.; Professional Knowledge 13 Hrs.	Perform calibrate, test and repair the various type recorder of different type process parameters. (NOS:MIN/N9479)	276. Identify function of parts and working of the Strip chart recorder. (02 hrs.) 277. Identify function of parts and operation of Circular chart recorder. (02 hrs.) 278. Select and check the recorders. (02 hrs.) 279. Adjust time travel. (02 hrs.) 280. Change recording chart and recording pen/ink. (02 hrs.) 281. Find the fault of recorder. (02 hrs.) 282. Rectify and repair minor parts. (02 hrs.) 283. Find error and adjust it. (03 hrs.) 284. Calibrate the selected recorder. (02 hrs.)	**RECORDERS:** Theory of Integrating system in recording processes variables, Multi-pens recorder and cam arrangements. Study of Strip Chart & Circular chart recorders. (07hrs.)
		285. Select and repair the strip chart recorder. (06 hrs.) 286. Select and repair the	Paperless recorder. Punching and Dot systems, Errors and Adjustment in various Electrical & Electronic

		circular chart recorder. (06 hrs.) 287. Provide different type recorders to the trainees to check calibration individually. (05 hrs.) 288. Demonstrate about paperless recorder. (04 hrs.)	Recorders. (06hrs.)
Professional Skill 40 Hrs.; Professional Knowledge 13Hrs.	Perform calibrate and test various transmitter for various process parameter. (NOS:MIN/N9480)	289. Installing and operating HART transmitters and devices I/O. (08 hrs.) 290. Calibrate and adjust the HART transmitter for temperature. (08 hrs.) 291. Calibrate and adjust the HART transmitter for level. (08 hrs.) 292. Calibrate and adjust the HART transmitter for flow. (08 hrs.) 293. Configure and calibration of HART devices (08 hrs.)	**SMART DEVICES:** HART transmitters, Its advantages & applications. HART protocol. HART communicators and PC based HART device configuration. Steps in calibration of HART devices. (13hrs.)
Professional Skill 65 Hrs.; Professional Knowledge 22Hrs.	Select suitable controller, perform process control, troubleshoot and calibrate various controllers in chemical plant. (NOS:MIN/N9481)	294. Identify the components of ON-OFF controller. (02 hrs.) 295. Test the ON-OFF type controller. (02 hrs.) 296. Calibrate the ON-OFF type controller with anyone (Pressure, level, flow, temperature.). (02 hrs.) 297. Check the proportional controller. (03 hrs.)	**CONTROLLERS:** (Analog & Digital) Open loop, Closed loop, Feedback control system, Modes of control system, ON-OFF control system, its operation, function, Advantages & disadvantages. Cascade & Ratio control system. Understanding Control Wiring Diagram with Few Examples. Principle of Electronic and

		298. Set/adjust proportional band. (03 hrs.) 299. Calibrate the proportional controller. (04 hrs.) 300. Check calibration and set reset action of selected controller. (04 hrs.) 301. Operate cascade and ratio control trainer. (12 hrs.) 302. Repair /recondition electro pneumatic controller. (05 hrs.) 303. Test the PID controller. (03 hrs.) 304. Calibrate the PID controller. (05 hrs.)	pneumatic controller, Control Lag, Step and Frequency response, what is mean by Proportional, Integral &Derivative Action, Proportional Controller, PI Controller & PID Controller Principle, construction & operation. (14hrs.)
		305. Measure and control in different loop parameters in chemical plant. (20 hrs.)	**CHEMICAL PLANT INTRODUCTION:** Transmitters, valves, process vessels, controller and software. (08hrs.)
Professional Skill 65 Hrs.; Professional Knowledge 22Hrs.	Plan and execute erection, commission, overhaul and repair the final control elements with accessories. (NOS:MIN/N9482)	306. Select the control valve. (diaphragm, glob). (02 hrs.) 307. Dismantle the selected control valve. (06 hrs.) 308. Repair the selected control valve. (06 hrs.) 309. Assemble the selected control valve. (06 hrs.) 310. Calibrate the selected control valve. (04 hrs.) 311. Techniques of replacement of valve parts like diaphragm,	**FINAL CONTROL ELEMENT:** Control valves. Control valves functions and components, types of control valves, based on valve flow characteristics - liner, equal percentage, quick opening valves, globe valves, cage valves, butterfly valves, ball valves, sliding gate valves, diaphragm valves, split body valves, capacitive, inductive type valve, proximity switch, IR switch, micro switch, limit switch, Role Of pneumatic &

		sealing rings, plug etc. (05 hrs.) 312. Lapping of valve seat for leak proof. (04 hrs.) 313. Erection, commission and calibrate the control valve with positioner. (07 hrs.) 314. Identify the diaphragm actuated control valve with three characteristics. (05 hrs.)	Electronic valve positioner. Solenoid valve. (14hrs.)
		315. Use pipe/tube fittings like union, elbow, socket, reducer, straight coupling, tee, connector etc. and also push fit connectors. (20 hrs.)	Piping houses and fittings. Requirement of piping, air flow, piping dimensions and safety factors, piping connections, compressed air piping applications, metallic &nonmetallic tubing used in instrumentation PU, copper & SS). (08hrs.)
Professional Skill 40Hrs.; Professional Knowledge 13 Hrs.	Basic working and Identification of faults in process control based on PLC, SCADA and DCS(NOS:MIN/N9483)	316. Identify the PLC trainer kit with accessories. (03 hrs.) 317. Demonstrate the functions of PLC. (03 hrs.) 318. Prepare logic gates. (03 hrs.) 319. Create small program on PLC (start- run-shutdown). (05 hrs.) 320. Prepare a programme on timer and counters. (03 hrs.) 321. Demonstrate about SCADA and DCS	Introduction to programmable controllers. History of programmable controllers, general characteristics of programmable controllers, some limitation of PLCs, method of developing PLC programming, Types of PLC Input/output devices. Definition of input/output devices, I/O interface, input modules, output modules, input devices encoders. Difference between DCS & PLC. (07hrs.)

		operating control system. (03 hrs.)	
		322. Use DCS trainer kit with complete communication system on process trainer. (10 hrs.) 323. Use SCADA trainer kit with complete communication system on process trainer. (10 hrs.)	Fundamentals of SCADA and DCS. History of DCS development. Basic architecture, block diagram description advantages and disadvantages, applications. Terminology- RTU (remote transmitting unit, central monitoring station, types of communications, field instruments and types. Master & Slave controller in DCS (Redundancy). (06 hrs.)
Professional Skill 40Hrs.; Professional Knowledge 13Hrs.	Operate packed distillation column and carry out maintenance of triple effect evaporator, heat exchanger and chiller. (NOS:MIN/N9484)	324. Carry out maintenance of heat exchanger. (shell and tube) (08 hrs.) 325. Carry out maintenance of chiller. (06 hrs.) 326. Carry out maintenance of stream trap. (06 hrs.) 327. Operate packed distillation column with DCS/PLC system. (10 hrs.) 328. Operate triple effect evaporator. (10 hrs.)	Concept of the heat exchanger. Concept the chillier. Concept the stream trap. **HEAT TRANSFER:** Mechanism of Heat Transfer in solid, liquid and gases and their application in industries, Heat exchangers, coolers, condenser and chillers. Types Of Heat Exchanger, Steam trap **EVAPORATION:** Definition, Types of evaporators. **DISTILLATION:** Concept of distillation, Methods of Distillation.(13hrs.)
Professional Skill 40 Hrs.; Professional Knowledge	Plan and execute automatic process control block diagram and others field-based control	329. Prepare block diagram of automatic process control system. (20 hrs.) 330. Prepare various field-	**FIELD BUS:** industrial visit, (Protocol). (13hrs.)

13Hrs.	systems. (NOS:MIN/N9485)	based control system in industry through industrial visit (Protocol). (20 hrs.)	
WORKSHOP CALCULATION & SCIENCE (18 Hours)			
Professional Knowledge WCS- 18 Hrs.	Demonstrate basic mathematical concept and principles to perform practical operations. Understand and explain basic science in the field of study. (NOS:MIN/N9401)	**<u>WORKSHOP CALCULATION & SCIENCE:</u>** **Friction** Friction - Advantages and disadvantages, Laws of friction, co-efficient of friction, angle of friction, simple problems related to friction Friction - Lubrication Friction - Co- efficient of friction, application and effects of friction in workshop practice **Algebra** Algebra - Addition, subtraction, multiplication & division Algebra - Theory of indices, algebraic formula, related problems **Estimation and Costing** Estimation and costing - Simple estimation of the requirement of material etc., as applicable to the trade Estimation and costing - Problems on estimation and costing	
Project work / Industrial visit			

SYLLABUS FOR CORE SKILLS
1. Employability Skills (Common for all CTS trades) (120 Hrs. + 60 Hrs.)

Learning outcomes, assessment criteria, syllabus and Tool List of Core Skills subjects which is common for a group of trades, provided separately in www.bharatskills.gov.in/dgt.gov.in

ANNEXURE-I

List of Tools and Equipment			
INSTRUMENT MECHANIC (CHEMICAL PLANT) (For batch of 20 Candidates)			
S No.	**Name of the Tools and Equipment**	**Specification**	**Quantity**
A. TRAINEES TOOL KIT (For each additional unit trainees tool kit sl. 1-12 is required additionally)			
1.	Connecting screwdriver	10 X 100 mm	10 Nos.
2.	Neon tester 500 V.	500 V	7 Nos.
3.	Screwdriver set	Set of 7	10 Nos.
4.	Insulated combination pliers	150 mm	7 Nos.
5.	Insulated side cutting pliers	150mm	10 Nos.
6.	Long nose pliers	150mm	7 Nos.
7.	Soldering iron	25-Watt, 240 Volt	10 Nos.
8.	Electrician knife	100 mm	7 Nos.
9.	Tweezers	150 mm	10 Nos.
10.	Digital Multimeter	(3 3/4 digit) ,4000 Counts (3 1/2 digit)	10 Nos.
11.	Soldering Iron Changeable bits	15-Watt, 240 Volt	7 Nos.
12.	De- soldering pump electrical heated, manual operators	230 V, 40 W	10 Nos.
B. SHOP TOOLS, INSTRUMENTS – For 2 (1+1) units no additional items are required			
Lists of Tools:			
13.	Steel Rule - Graduated both in Metric and English Unit	300 mm,	6 Nos.
14.	Try Square	150 mm	6 Nos.
15.	Caliper - Inside Spring -	150 mm	6 Nos.
16.	Caliper - Outside Spring	150 mm	6 Nos.
17.	Divider Spring Type	150 mm	6Nos.
18.	Punch Centre	Diameter - 10 mm and Length - 100 mm	6Nos.
19.	Punch Prick	100 mm	6Nos.
20.	Letter and Number Punch	5mm	1 No.
21.	Scriber- Straight	150 mm	6 Nos.
22.	Hacksaw Frame -	Fixed - 300 mm	6 Nos.
23.	File -	Flat - Bastard - 250 mm	6 Nos.
24.	File -	Flat - Second Cut - 250 mm	6Nos.
25.	File -	Flat - Smooth - 250 mm	6Nos.
26.	File -	Half Round - Second Cut - 250 mm	6 Nos.

27.	File -	Round - Smooth - 250 mm	6Nos.
28.	File -	Triangular - Smooth - 150 mm	6 Nos.
29.	File -	Square - Second Cut - 200 mm	6set.
30.	Chisel -	Cold - Cross Cut - 9 mm X 150 mm	6Nos.
31.	Chisel -	Cold - Flat - 20 mm X 150 mm	6Nos.
32.	Chisel -	Cold - Round Nose - 9 mm X 100 mm	6Nos.
33.	Chisel -	Diamond Point - 9 mm x 150 mm	5 Nos.
34.	Hammer -	Ball Peen - 250 grams	21 No.*
35.	Hammer -	Ball Peen - 500 grams	21 No.*
36.	Screwdriver -	9 X 300 mm	4 Nos.
37.	Drill Twist Set -	Straight Shank - 3 mm to 13 mm by 0.5 mm	1 Nos.
38.	Drill Twist Set -	Straight Shank - 9.8 mm	1 No.
39.	Hand Reamer	Parallel - 10 mm	2 Nos.
40.	Tap set -	12 mm	2 Nos.
41.	Solid die	12 mm with die stock	2 Nos.
42.	Allen Key Set -	Hexagonal - 1 - 12 mm, set of 12 Keys	1 No.
43.	Vernier Depth Gauge	300 mm (L. C. 0.02mm)	1 No.
44.	V Block -	75 x 75 x 50 mm with Clamp (Hardened & Ground)	1 No.
45.	Bench Vice -	125 mm	6 Nos.
46.	Scraper -	Flat - 250 mm	6 Nos.
47.	Scraper -	Half Round - 250 mm	6 Nos.
48.	Scraper	triangular 250 mm	
49.	Rubber Hose -	Oxygen, Diameter = 8 mm, Length = 10 meters	1 No.
50.	Rubber Hose Clips -	1/2 inch	6 Nos.
51.	Tong -	Flat - 300 mm	4 Nos.
52.	cylinder Key		4 Nos.
53.	Plier -	Flat Nose - 200 mm	4 Nos.
54.	Plier -	Round Nose - 100 mm	4 Nos.
55.	Neon Tester -	500 V	20 Nos.
56.	Wire Cutter and Stripper -	150 mm	2 Nos.
57.	Soldering Iron -	Changeable Bit - 15-Watt, 240 Volt	6 Nos.
58.	Allen Key Set -	Hexagonal - 1 - 12 mm, set of 24 Keys	2 Nos.
59.	Manometer,	well type	10 Nos.
60.	Plier -	Side Cutting - 150mm	8 Nos.
C. Machinery			

61.	PLC Training Kit	At least digital 8 input & 8 Output, 4 analog input & output with simulation software and hardware for understanding PLC programming and functioning. Also, WithIndustrial User-friendly SCADA software having with two-way communication for control and data acquisition.	1 No.
62.	Pneumatic controllers for pressure, flow, temperature and level with associated equipment	Pneumatic PID Controller withScale for Set Point & Process, Input/output 0.2 to 1.0 Kg/cm2 and Range 0 to 100 (% or Deg. C) Having with selectable Control Mode & Control Action. with Pneumatic DP transmitters (for pressure, flow & level system) and pneumatically operated diaphragm operated globe type control valves each for parameter to control all four systems with require close loop system.	1 No.
63.	**Electric Work Bench: Type B** 1. Voltmeters (0-230 V AC) 2. Voltmeters (0-230 V DC) 3. Ammeters (0- 5 A AC & DC). 4. Wattmeter Dynamometer (0-3000 W) 5.Power Factor Meter. 6.Vibrating Frequency Meter (0-60 HZ)	With necessary electrical components such as AC/DC voltmeters, AC/DC Ammeters, power factor meter, watt meter, energy meter, frequency meter and ohmmeter to calibrate analog and digital meters using the bench.	1 No.
64.	**Instrumentation Work Bench: Type A** 1.Dual Power Supply - 0 to 30 Volts, 5 Amp 2. Digital Multimeter (3 ½ Digit) 3. Air Filter & Regulator 4. Compressed Air Supply 5. Digital Pressure Indicator for pressure measurement 6. I TO P convertor 7. Utility socket with 230 V AC 8. Oscilloscope 9. Function Generator	1.Dual Power Supply - 0 to 30 Volts, 5 Amp 2. Digital Multimeter (3 ½ Digit) 3. Air Filter & Regulator 4. Compressed Air Supply 5. Digital Pressure Indicator for pressure measurement 6. I TO P convertor 7. Utility socket with 230 V AC 8. Oscilloscope 9. Function Generator	1 No.

List of Equipments			
65.	Fire Extinguisher	Arrange all proper NOCs and equipment from municipal / competent authorities.	As per requirement
66.	Gauge Screw Pitch -	Metric -0.25 to 6 mm	1 No.
67.	Wire Gauge -	Metric	1 No.
68.	Vernier Caliper -	0 - 200 mm with least count 0.02mm	1 No.
69.	Vernier Height Gauge -	0 - 300 mm with least count = 0.02 mm	1 No.
70.	Vernier Bevel Protractor -	300 mm Blade with Acute Angle Attachment	1 No.
71.	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 Nos.
72.	Micrometer - Outside -	0 - 25 mm	1 No.
73.	Micrometer - Outside -	25 - 50 mm	1 No.
74.	Combination Set	300 mm	2 Nos.
75.	Anvil -	50 Kg - with stand	1 No.
76.	Surface Plate -	Granite - 600 x 600 mm with Stand and Cover	1 No.
77.	Acetylene Cylinder		1 No.
78.	Oxygen Cylinders		1 No.
79.	Electric Spark Lighter		6 Nos.
80.	Oxygen Gas Pressure Regulator	Double Stage	1 No.
81.	Gas welding torch with nozzle set		1 No.
82.	Drum -	100 Liters (Optional)	1 No.
83.	Drum -	200 Liters (Optional)	1 No.
84.	Drum -	50 Liters (Optional)	1 No.
85.	Dust Bin -	50 Liters (Optional)	1 No.
PHYSICS LABORATORY			
86.	Instrument for determining 'g' (Simple Pendulum)	To study the simple pendulum experiment.	1 No.
87.	Mechanical board for testing triangle and parallelogram of forces including all accessories	To study law of parallelogram of forces.	2 No.
88.	Inclined plane with pulley, pan,		1 No.

	weights etc.		
89.	Simple machines -	Screw Jack	1 No.
90.	Searle's Apparatus for young's Modulus		2 Nos.
91.	Calorimeter for determining Joule's mechanical Equivalent of heat and specific heat		2 Nos.
92.	Apparatus for measurement of co-efficient of expansion(thermal) of solid (Pullinger's apparatus)	It will consist of a half-meter long chromium plated rod, Steam prepared in copper steam boiler of 2-liter capacity, 2 Thermometers, 1 hot plate of 1kw.	2 Nos.
93.	Apparatus for measurement of thermal conductivity of good and bad conductors	Made up of heater assembly of 0.5 /1 KW, 300 mm (D) test specimens, 8 nos. of J type sensors, Dimmer state, Voltmeter and Ammeter.	1 No.
94.	Thermometers	0 to 110º C	1 No.
95.	Thermometers	0 to 250º C	1 No.
96.	Thermometers	0 to 360 º C	1 No.
97.	Rheostat	25 ohms	2 Nos.
98.	Rheostat	100 ohms	2 Nos.
99.	Rheostat	500 ohms	2 Nos.
100.	Resistance box	0 to 100 ohms	2 Nos.
101.	Resistance box	0 to 500 ohms	2 Nos.
102.	Resistance coils	(2 ohms, 5 ohms, 10 ohms, 100 ohms)	2 Nos.
103.	Ammeter	0 to 1000 mA. (DC)	2 Nos.
104.	Ammeter	0 to 1000 µA. (DC)	2 Nos.
105.	Ammeter	0 to 10 Amp. (AC, DC)	2 Nos.
106.	Voltmeter	0 to 1 volt (DC)	2 Nos.
107.	Voltmeter	0 to 4 volt (DC)	2 Nos.
108.	Voltmeter	0 to 5 volt (DC)	2 Nos.
109.	Voltmeter	0 to 10 volt (DC)	2 Nos.
110.	Battery eliminator		2 Nos.
CHEMISTRY LABORATORY			
Equipment's			
111.	Rods with screw at one end for Electrochemical equivalent 1) Carbon 2) Zinc 3) Copper		2 Nos.
112.	Multi meter(digital)	Digital	2 Nos.

113.	Milli voltmeter	0 - 5mv	2 Nos.
114.	Milli voltmeter	0- 500mv	2 Nos.
115.	Digital Stop Watch	1/10 Second	1 No.
116.	Steam generator (copper) Cap.	500ml	2 Nos.
117.	Boss head		12 Nos.
118.	Bunsen Burners		8 Nos.
119.	Tripods Stand		8 Nos.
120.	Asbestos wire gauge		8 Nos.
121.	Gauge Wire without asbestos		8 Nos.
122.	Clamp holders		12 Nos.
123.	Stands with clamps for burette		12 Nos.
124.	Triangles clay		8 Nos.
125.	Tong -	Flat - 300 mm	8 Nos.
126.	Spatula -	6"	8 Nos.
127.	Spatula -	8"	8 Nos.
128.	First Aid Box		1 No.
129.	Tong Tester -	0 - 25 A	1 No.
130.	Magnifying Glass -	75 mm	1 No.
Consumable			
131.	Safety shoes	(Regular size)	21Nos.
132.	Safety hand gloves Rubber	(Regular size)	21 Nos.
133.	Safety hand gloves leather	(Regular size)	21 Nos.
134.	Ear plug		21 Nos.
135.	Nose mask/dust mask		21 Nos.
136.	Helmet		21 Nos.
137.	Burettes	25ml (MOC- Borosilicate)	8 Nos.
138.	Pipettes	10ml (MOC- Borosilicate)	8 Nos.
139.	H.D.P.E. Distil water bottle		8 Nos.
140.	Measuring cylinder	25 ml Glass (MOC- Borosilicate)	8 Nos.
141.	Measuring cylinder	50 ml Borosilicate Glass	8 Nos.
142.	Measuring cylinder	100 ml Borosilicate Glass	8 Nos.
143.	Volumetric flask	100 ml Borosilicate Glass	8 Nos.
144.	Volumetric flask	500 ml Borosilicate Glass	8 Nos.
145.	Volumetric flask	1000 ml Borosilicate Glass	8 Nos.
146.	Funnels	Dia 4cms Borosilicate Glass	8 Nos.
147.	Beaker	250ml corning Borosilicate Glass	8 Nos.
148.	Beaker	400ml corning Borosilicate Glass	8 Nos.
149.	Bottles for solutions	1000 ml Borosilicate Glass	6 Nos.
150.	Bottles for solutions	2000 ml Borosilicate Glass	6 Nos.
151.	Bottles for solutions	500 ml Borosilicate Glass	6 Nos.
152.	Conical flask -	150 ml Borosilicate Glass	16 Nos.
153.	Conical flask -	250 ml Borosilicate Glass	16 Nos.

154.	China dish -	50 ml Borosilicate Glass	12 Nos.
155.	Watch Glass -	3" dia Borosilicate Glass	8 Nos.
156.	Distilled water still	10 lit.	1 No.
157.	Glass test tubes -	15 ml Borosilicate Glass	50 Nos.
158.	Round Bottom Distillation flask with side neck	500ml Borosilicate Glass	6 Nos.
159.	Condenser for distillation lebig	30 cm long Borosilicate Glass	6 Nos.
160.	Rubber cork of	(2.5 cm, 3cm) size	10 Nos.
161.	Rubber Tubing	(ID- 5mm)	10 Nos.
162.	Rubber Bulbs for pipettes		6 Nos.
PRESSURE MEASURING INSTRUMENT			
Equipments			
163.	Bourdon Tube Type Gauges of Various ranges	Bourdon socket, S.S. movement case, with Various ranges of 150 mm size, with different Ranges like 0 – 3.5 kg/cm2, 0 - 7 kg/ m2, 0 - 10 kg/ cm2, 0 - 30 kg/ cm2. Accuracy: 1 %	2 Nos.
164.	Manometer,	U-tube	2 Nos.
165.	Manometer,	Inclined tube	2 Nos.
166.	Pointer Puller		2 Nos.
167.	Diaphragm Type Gauges -	Various Type	1 No.
168.	Pressure Gauge -	Capsule Type	1 No.
169.	Dead Weight Tester/ Comparators	It will consist of frictionless piston (ram) mounted on a rugged base, with Range of 0.5 – 30 kg/ cm2, Step Size of 0.1 kg/cm2, Accuracy of 0.2 to 0.1 %, to study the calibration of pressure gauge.	1 No.
170.	**Sensor Trainer Kit Containing Following Sensors** 1. Thermocouple 2. RTD 3. Load Cell/ Strain Gauge 4. LVDT 5. Smoke Detector Sensors 6. Speed Sensor 7. Limit Switch 8. Photo sensors 9. Optocoupler 10. Proximity Sensor 11.Anemometer		1 No
171.	Pressure Regulators with Filter	¼" & 1/8" ports size, micron range	4 Nos.

	and Input & Output Gauges	filter, input and output pressure gauges.	
172.	Differential Pressure Transmitter - Pneumatic	Differential pressure transmitter, Orifice plate assembly, Pneumatic PID controller, control valve, actuator, valve positioner, rotameter, air regulator.	1 No.
173.	Pressure and Flow Control loop (With PLC Controller)	Made up of S.S. sump tank, pump, pressure vessel, pressure transmitter, air compressor, rotameter, DP transmitter, orifice plate assembly, PLC modules, HMI modules control valves with Actuators, I/P converters, air regulators, current meters, pressure gauges.	1 No.
TEMPERATURE MEASURING INSTRUMENTS			
Equipment			
174.	Temperature calibration Bath	(-50 to 200 0C) water bath, heater, digital PID controller, Agitator motor, thermocouples and RTD sensors, temperature indicator, with necessary electricals and hardware components for calibration of temperature sensors.	1 No.
175.	Thermometer -	Alcohol is Glass	1 No.
176.	Thermocouple Type Pyrometer with Milli Voltmeter - with different types of Thermocouples	Water bath, heater, PID, temperature indicator, thyristor drive, gear motor with agitator, different thermocouples like J, K, pyrometer.	1 No.
177.	Radiation Pyrometer with Standard Accessories	250 to 900 C deg. Temp. range, DC Power Supply, scalable 4 – 20 mA Output.	1 No.
178.	Optical Pyrometer with Standard Accessories	Digital /Analog display, 800°C to 1500°C Measurement Range with accessories	2 Nos.
179.	Temperature switch		3 Nos.
180.	Thermostats		1 No.
181.	Temperature and Level Control	Rotameters, control valve, I/P	1 No.

	loop (With PLC Controller)	converter, thyristor drive, RTD temperature transmitter and capacitance level transmitter PLC modules, HMI modules.	
182.	Shell and tube heat exchanger	made up of SS shell and tube heat exchanger, tank with heater, SS cold water tank, rotameters, pumps, 6 zone temperature indicators, PID. complete set up To study heat transfer ratio, LMTD. Construction & working of heat exchanger. To study Use of baffles & partitions. Mounted on Suitable Frame Structure.	1 No.
183.	Triple effect evaporator	made up of SS feed tank, cold water tank, steam generator, rotameters, temperature indicator, Shell & Tube type heat exchanger, product vessels and PID. Complete set up	1 No.
FLOW MEASURING INSTRUMENTS			
Equipment			
184.	Rotameter	Made up of SS sump tank, SS measuring tank, pump, suitable range rotameter, required with suitable piping.	1 No.
185.	Flow Meter (Orifice type Ø 1'pipe)	Water flow meter with remote monitoring /controlling facility.	1 No.
186.	Venturi Tube Flow Meter (Orifice type Ø 1'pipe)	Sump tank, measuring tank, pump, Venturi meter, manometer with pressure tapings as required with suitable piping.	1 No.
187.	Vortex Flow Meter (Orifice type Ø 1'pipe)	Sump tank, measuring tank, pump, flowmeter with HART Communication. and with required all fittings accessories.	1 No
188.	Magnetic Flow Meter (Orifice type Ø 1'pipe)	Magnetic flowmeter with HART communication facility along with sump Tank, Measuring Tank, Pump, and accessories with seamless data transfer unit.	2 Nos.

189.	Thermal Mass Flow Meter (Orifice type Ø 1'pipe)	Inline Thermal mass flow meter with digital display, RS 485communicationwith air compressor. complete set up	2 Nos.
190.	Coriolis Mass Flow Meter (Orifice type Ø 1'pipe)	Coriolis mass flowmeter with HART communication, output 4-20Ma along with sump Tank, Measuring Tank, Pump, and accessories with stand, seamless data transfer unit. Mounted on Suitable Frame Structure.	2 Nos.
191.	Turbine Flow Meter (Orifice type Ø 1'pipe)	Turbine flow meter along with sump Tank, Output 4-20MaMeasuring Tank, Pump, and accessories with stand, seamless data transfer unit.	2 Nos.
192.	Solid Flow Measurement Setup	Solid flow meter with Hopper, collection tray, control valve, PID controller, electronic circuit chart recorder, sensor, current meter, seamless data transfer unit. complete working set up	2 Nos.
LEVEL MEASURING INSTRUMENTS			
Equipment			
193.	Sight Glass Level Indicator	Sight Glass Level Indicator with tank, sight glass, scale, drain valve.	1 No.
194.	Float type Level Indicator	Float type Level Indicator with Level Tank , feed and drain valves, float, measuring tap.	1 No.
195.	Static pressure and air purge Level Indicator	Static pressure and air purge Level Indicator with glass tube, SS purge pipe.	1 No.
196.	Show piece Ultra-Sonic Level Indicator	Ultrasonic level indicator with HART communication facility with sump tank, Measurement Tank and pump.	2 Nos.
197.	Variable Capacitance Type Level Indicator	Variable Capacitance Type Level Indicatorwith HART communication facility, sump tank, Measurement Tank and pump.	2 Nos.
198.	Hook type Level Indicator	Hook type Level Indicator Measuring tank, sump tank, S.S.	2 Nos.

		pump, S.S. hook, chromium plated scale.	
199.	Show Piece for Radar Type Level Indicator	**Radar level detector** with HART communication facility Container as measuring tank suitable to transmitter. Overhead tank.	1 No.
200.	**Solid level measurement** using ultrasonic level detector, Microwave level detector, Capacitance probe level detector, Point type level detector.	**Ultrasonic level detector** (non-contact) **Microwave level detector** (non-contact) **Capacitance probe level detector (**contact) **Point type level detector** (contact) All transmitters and sensors with Container as measuring tank suitable to transmitters.	1 No.
201.	PH Meter -	Digital, with PH range of 0 – 14 pH, Millivolt Range of 0 - ± 1999 mV, Temp. Compensation Auto /Manual with auto calibration facility and electrodes.	1 No.
202.	Electronic weight balance Capacity	Electronic weight balance with digital display Capacity 10 kg. Sensitivity 10 Gram	1 No.
203.	Viscosity meter (Digital)*	Measuring range in mpa/Cp, LED /LCD Display with diff Measurement with spindles, Provided with RS 232 interface.	1 No.
204.	Universal Calibrator	Universal Calibrator with 5 Digit display, Measuring Direct Voltage, current, Resistance and Simulations for Thermocouples, RTD & mA.	1 No.
205.	Online pH and Conductivity measurement and control trainer	Online PH measurement with 4-20 mA output, PH electrode, Reactor tank with software.	1 No.
206.	Online Conductivity measurement and control trainer	Online conductivity measurement with 4-20 mA output, Conductivity sensor, Reactor tank with software.	1 No.
207.	HART communicator and calibrator	Microprocessor base HART Communicator calibrator with Full	1 No.

		multi-bus communicator for HART, FOUNDATION Fieldbus and Profibus PA instruments. Touch Screen LCD display.	
208.	Pressure Safety valve (spring tension)		1 No.
209.	**Pneumatic and Electronic Recorders** - Single Point and Multi point, Circular and Strip Chart Types	**Electronics recorder** (circular chart type) Input: 4 - 20 mA, chartdia min 4". **Electronics recorder** (strip chart type) Input: 4 - 20 mA, **Pneumatic recorder:** input 3-15 psi, chart dia min 4".	1 No.
210.	Packed distillation column with DCS / PLC system.	with DCS / PLC system made up of S.S. of 1000 mm (H) 75 mm (D) with sight glasses, feed tank, cold water tank, steam generator, rotameters, temperature Scanner, Shell & Tube type heat exchanger, pumps, Reflux drum, solenoid valve, product collection tank, suitable pipes and fittings, seamless data transfer unit, SCADA, computer, HMI, ethernet.	1 No.
211.	Paperless recorder	No of channels Min: 4 Communication Mode: RS 232 through RS 485 Converter with necessary wiring and fittings	1 No.
212.	**PID Controller Trainer** consisting of Instrument Panel, Digital Computer and Interface System	consisting of Instrument Panel with open card based PID works with Digital Computer and Interface System, hardware to conduct practicals of P, PI, PID, PD, ON-OFF etc.	1 No.
213.	**Control Valve Set** Gate Valves, Globe Valves, Ball Valves, Diaphragm Valves, Butterfly Valves etc. Electrically Actuated, Pneumatic Actuated and Hydraulic Actuated	Gate Valves, Globe Valves, Ball Valves, Diaphragm Valves, Butterfly Valves etc. Electrically Actuated, Pneumatic Actuated and Hydraulic Actuated	1 No.
214.	Experimental diaphragm	Control valve: - Linear with	1 No.

	actuated control valves set-up (Three different characteristics)	positioner, Quick opening, and Equal percentage.	
215.	Tube Cutter		1 No.
216.	DCS Training Kit	True distributed control system having dedicated redundant function controller, power supply, communication modules, and integrated software modules, algorithms for complex process control. consist of small pilot plant with different control action using basic parameters like level, temperature, flow, pressure, ratio, feed forward, cascade.	1 No.
217.	Trainer on RS485 to RS232 Converter	Trainer with software for test communication with computer and Variable Baud Rate	1 No.
218.	Final Control Element – HART or Field Bus Type	Sump tank, measuring tank, rotameter, air regulator, pump, manometer, actuator, valve positioner, current source.	1 No.
219.	**Smart transmitter** for pressure, temperature, flow and level	4-20 mA output of all transmitters, with HART Communication facility.	1 No.
Equipments			
220.	**Chemical plant control parameter trainer** consists of transmitters, valves, pumps and process vessel with all parameter's simulation software		1 No
D. SHOP FLOOR FURNITURE AND MATERIALS- For 2 (1+1) units no additional items are required.			
221.	Black/ White Board with Stand -	4 X 3 Feet	1 No.
222.	Bookshelf/ Glass Shelf (Optional)		1 No.
223.	Discussion Table/ Working Table = L: W:H = 8:4:3 Feet -	Heavy Wooden Top	1 No.
224.	Instructor/ Office Chair		2 Nos.
225.	Instructor/ Office Table		1 No.
226.	Notice Board -	2 X 3 Feet	1 No.
227.	Steel Almirah –	Large (Optional)	2 Nos.
228.	Steel Locker -	12 Pigeon Hole	2 Nos.
229.	Steel Rack (Optional)		1 No.
230.	Stool -	Height 450 mm	10 Nos.

Note: -

1. *All the tools and equipment are to be procured as per BIS specification.*
2. *Internet facility is desired to be provided in the class room.*

ABBREVIATIONS

CTS	Craftsmen Training Scheme
ATS	Apprenticeship Training Scheme
CITS	Craft Instructor Training Scheme
DGT	Directorate General of Training
MSDE	Ministry of Skill Development and Entrepreneurship
NTC	National Trade Certificate
NAC	National Apprentice Certificate
NCIC	National Craft Instructor Certificate
LD	Locomotor Disability
CP	Cerebral Palsy
MD	Multiple Disabilities
LV	Low Vision
HH	Hard of Hearing
ID	Intellectual Disabilities
LC	Leprosy Cured
SLD	Specific Learning Disabilities
DW	Dwarfism
MI	Mental Illness
AA	Acid Attack
PwD	Person with disabilities


कौशलं बलम्