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 125 Hrs.; Professional Knowledge 35 Hrs.	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.	**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. (07 hrs.)
		7. Familiarization with glassware used in chemical lab (25 hrs.) 8. Find out action of acids & bases on metals and alloys. (15 hrs.) 9. Determine PH of different solutions by using Ph paper & PH meter. (20 hrs.) 10. Determine boiling point of different liquids. (12 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. (14 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. (28 hrs.)
Professional Skill 225 Hrs.; Professional Knowledge 63 Hrs.	Perform basic workshop operations using suitable tools for measuring, holding, cutting, filing, riveting, drilling, reaming and threading. Observing suitable care & safety.	**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. (08 hrs.) 16. Practice safety precautions while working in fitting jobs. (10 hrs.)	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. (14hrs.)

		17. Workshop practice on filing and hacks awing. (10 hrs.) 18. Practice simple fitting job in workshop, fitting and drilling. (10 hrs.)	
		19. Cut square size job as per drawing from MS flat by using hacksaw blade. (12 hrs.) 20. Hold the job using bench vice. (01 hr.) 21. Measure the selected job using steel rule, calipers and Vernier caliper. (11 hrs.) 22. Prepare edges of square size job using proper tools and equipment. (20 hrs.) 23. Finally check flatness and squareness using try square, surface gauges etc. (06 hrs.)	**JOB HOLDING DEVICES:** Description, construction and uses of different job holding devices such as vice, 'V' Block. (14hrs.)
		24. Hold the job using bench vice. (01 hrs.) 25. Prepare another four edges job using proper tools and equipments. (14 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.(07hrs.)
		28. Make simple step fitting job (male and female) (40hrs.) 29. Mark drilling position on a job. (03 hrs.) 30. Operate centre drill for drilling a hole. (07 hrs.)	**LINEAR MEASUREMENT:** Description, construction, calculation and uses of different Linear Measuring Instruments - Vernier Caliper, Vernier Depth gauge, Height gauge, Micrometer outside,

			Bevel protector.(14hrs.)
		31. Practice of drilling (08hrs.) 32. Determine the reaming drill size. (01 hrs.) 33. Practice of reaming (04hrs.) 34. Practice of counter sinking (06 hrs.) 35. Practice of counter boring. (06 hrs.)	**DRILLING, REAMING AND THREADING:** Nomenclature and uses of Drill, Reamer, and Thread. (07hrs.)
		36. Determine the tap drill size for internal threading. (03 hrs.) 37. Make BSW or Metric thread using tap. (10 hrs.) 38. Make BSW or Metric thread using die. (12 hrs.)	**THREADS:** Description, nomenclature and uses of different types of threads - metric, BSW, BSF, BSP etc. Calculation oftap drill size.(07 hrs.)
Professional Skill 75Hrs.; Professional Knowledge 21Hrs.	Plan and organize the work in familiar predictable/routine environment for different types of welding/riveting/seaming and allied operations	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. (05hrs.)
		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)(05 hrs.)
		46. Practice lightening. (04hrs.) 47. Practice carburizing flame adjustment. (05hrs.) 48. Practice Neutral flame adjustment. (04hrs.)	**GAS WELDING:** Principal of Gas Welding. Safety precaution before, after & during Gas Welding. Common Gas used in Welding

		49. Practice Oxidize flame adjustment. (05hrs.)	**OXY-ACETYLENE WELDING:** Equipment's such as cylinder trolley, regulator, blow pipe, Hose pipe, Assembling, care & maintenance.(05hrs.)
		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. (06 hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 21 Hrs.	Apply and execute various physical properties of materials and verify different physical laws by operating various instruments.	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 electrolysis. (06 hrs.) 61. Determine mechanical equivalent of heat by Joule's method. (08 hrs.)	**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, Kirchhoff's law, Wheatstone's bridge, applications of Wheatstone bridge. **ELECTROLYSIS:**

		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.)	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. (21hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.	Identify, test various electrical components using proper measuring instruments and apply this knowledge to troubleshoot power supplies.	**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. (14hrs.)
Professional Skill 100 Hrs.; Professional Knowledge 28 Hrs.	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. (03 hrs.) 73. Dismantle, part testing part repairing, part replacement and assemble, adjustment, calibration, final testing of Moving iron instrument. (03 hrs.)	**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. (14hrs.)

		74. Dismantle, part testing part repairing, part replacement and assemble, adjustment, calibration, final testing of Wattmeter. (03 hrs.) 75. Dismantle, part testing part repairing, part replacement and assemble, adjustment, calibration, final testing of P.F.meter. (03 hrs.) 76. Dismantle, part testing part repairing, part replacement and assemble, adjustment, calibration, final testing of frequency meter. (03 hrs.) 77. Dismantle, part testing part repairing, part replacement and assemble, adjustment, calibration, final testing of Energy meter. (03 hrs.) 78. Measurement of voltage, current & resistance in different circuits using voltmeter, ammeter and multimeter. (04 hrs.) 79. Measure directly & indirectly of electrical power & energy using watt meter and energy meter. (06hrs.) 80. Calibrate energy meters. (06 hrs.) 81. Test Insulation using megger. (08hrs.) 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) (04 hrs.) 87. Identify different types of capacitors (03hrs.) 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. (06hrs.) 91. Find values and power rating of resister. (05hrs.) 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. (07 hrs.)
		93. Identify live, neutral and earth on power socket using test lamp. (05 hrs.) 94. Use a tester to monitor AC power. (06 hrs.) 95. Read and interpret the settings, sockets on analog and digital multi-meters. (07 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. (07 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs	Plan and execute soldering & de-soldering of various electrical/electronic components in different circuits.	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	**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

		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 gun for specific requirement. Soldering and De-soldering stations and their specifications. (07hrs.)
Professional Skill 100 Hrs.; Professional Knowledge 28 Hrs.	Test various electronic components using proper measuring instruments and compare the data using standard parameter.	103. Find various types of diode (solid state) (06hrs.) 104. Check various types of diode. (04hrs.) 105. Find characteristics of diode. (07 hrs.) 106. Find the characteristics of Zener diode. (04 hrs.) 107. Construct and test Zener based voltage regulator circuit. (04 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. (07hrs.)
		108. Construct rectifiers (half wave) (08 hrs.) 109. Construct rectifiers (full wave) (08 hrs.) 110. Construct bridge (four diodes) for full wave rectifier. (09 hrs.) 111. Construct a rectifier with capacitor filter circuit. (05 hrs.) 112. Construct a rectifier with inductor filter circuit. (05 hrs.) 113. Construct a rectifier with RC filter circuit. (05 hrs.) 114. Find ripple factors in	**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 dividers and bypass filters. (14hrs.)

		rectifiers. (Half wave and full wave) in various filter circuits. (10 hrs.)	
		115. Identify PNP and NPN transistor. (03 hrs.) 116. Record the different specification of transistor using data book (02 hrs.) 117. Identify the different transistors with respect to different packing style. (03 hrs.) 118. Identify power switching transistor. (04 hrs.) 119. Measure E-B, C-B and C-E terminal resistance and infer (05 hrs.) 120. Identify by its number and testing of FET. (04 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. (07hrs.)
Professional Skill 125Hrs.; Professional Knowledge 35Hrs.	Assemble simple voltage regulators and electronic power supply circuit and test for functioning.	122. Assemble various types of simple fixed voltage regulator on zero PCB. (10 hrs.) 123. Assemble variable voltage regulator on zero PCB (10hrs.) 124. Assemble a simple power supply unit regulated 12V, 1Amp. (15hrs.) 125. Identify different fixed ± voltage regulator ICs of different current ratings (78xx/79xx series) along with i/o, reference pins. (10hrs.) 126. Identify proper heat sinks for different IC based	**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 frequently occurring faults and their remedies. Concept of UPS, OFFLINE and ONLINE. Difference between Inverters and UPS. (21hrs.)

		voltage regulators. (12hrs.) 127. Verify the input voltage and observe the fixed output for the above-mentioned series. (18hrs.)	
		128. Modulate various signals using AM and FM on the trainer kit and observe the waveforms. (25 hrs.) 129. Demodulate various signals using AM and FM on the trainer kit and observe the waveforms. (25 hrs.)	**ADVANCED COMMUNICATION:** Need of Modulation, types of modulation. Demodulation techniques. Introduction to AM, FM & PWM. (14hrs.)
Professional Skill 100 Hrs.; Professional Knowledge 28 Hrs.	Perform basic computer hardware like identify of various parts, connect cables, replace parts, and test of desktop computer.	**Computer Hardware,** 130. Identify various indicators, cables, connectors and ports on the computer cabinet. (04hrs.) 131. Demonstrate various parts of the system unit and motherboard components. (06hrs.) 132. Identify various computer peripherals and connect it to the system. (04hrs.) 133. Disable certain functionality by disconnecting the concerned cables SATA/ PATA. (06hrs.) 134. Replace the CMOS battery and extend a memory module. (06hrs.) 135. Test and Replace the SMPS (05hrs.) 136. Replace the given DVD and HDD on the system (04hrs.) 137. Dismantle the desktop computer system. (08hrs.) 138. Assemble desktop computer	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 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

		system. (08hrs.) 139. Identify different types of cables and network components e.g. Hub, switch, router, modem etc. (06hrs.) 140. Prepare terminations, make UTP and STP cable connectors and test. (10 hrs.) 141. Connect network connectivity and wireless connectivity hardware and check for its functioning connectivity (09hrs.) 142. Boot the system from different options. (06hrs.) 143. Practice various futures of OS. (05 hrs.) 144. Perform maintenance of computer using standard tools provided in the OS. (03 hrs.) 145. Install the printer driver software and test for prints outs. (02 hrs.) 146. Install the antivirus software and scan the system. (03 hrs.) 147. Install the MS Office software and test for prints outs. (02hrs) 148. Use start Manu, check available programs in computer.(02hrs) 149. Create folder and files. (01 hr)	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 Cards, connectors, media and firewall. Difference between PC & Server. (28hrs)
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.	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 100Hrs.; Professional Knowledge 36Hrs.	Perform troubleshoot, calibrate, test and repair of pressure measuring, indicating and controlling field instruments and analyze the data.	**Pressure Measurement** 153. Check bourdon tube pressure gauge (04 hrs.) 154. Dismantle the bourdon tube pressure gauge. (08 hrs.) 155. Fault find out the bourdon tube pressure gauge. (03 hrs.) 156. Rectify the faulty bourdon tube pressure gauge. (05hrs.) 157. Assemble the bourdon	**STATIC CHARACTERISTICS:** Accuracy, precision, sensitivity, resolution dead zone, repeatability, reproducibility, drift, Dead band, backlash, hysteresis. **DYNAMIC CHARACTERISTICS:** Speed response, fidelity, and lag. Error, deviation, true value, data. Types of errors- systematic, random & illegitimate error.

		tube pressure gauge. (05 hrs.) 158. Calibrate Bourdon tube pressure gauge. (05 hrs.) 159. Calibrate Diaphragm type pressure gauge. (05 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.)	Certainty/ uncertainty, validity of result. Measuring system Response. (18hrs.)
		163. Test the mechanical transducer Bourdon tubes, Diaphragms, with standard calibrator. (08 hrs.) 164. Test the electrical transducer Inductive type, Resistance type, Capacitive type with standard calibrator. (09 hrs.) 165. Test the analogue and digital transducer with standard calibrator. (08 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. (09hrs.)
		166. Measure differential pressure using U tube manometer, well type manometer and inclined limb type manometer. (5 hrs.) 167. Measure atmospheric pressure using different	Different type of Pressure measuring Instruments **MANOMETERS:** (well tube, 'U' Tube & Inclined Tube) & Barometers. **GAUGES:** Pressure Gauges, Vacuum Gauge, Compound Gauge & Absolute Pressure Gauge. lts

		types of Barometer. (5 hrs.) 168. Test the various type pressure transmitters with standard calibrator. (5hrs.) 169. Test the various type pressure switches with standard calibrator. (5 hrs.) 170. Test the pressure safety valve with standard calibrator. (5 hrs.)	construction uses Principle of operation. Importance of calibration in Metrology. (09hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09Hrs.	Plan and execute Erection and commission of field control loop system for pressure.	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 125Hrs.;	Perform troubleshoot,	**Temperature Measurement** 178. Identify different types	**TEMPERATURE MEASUREMENT:**

Professional Knowledge 45 Hrs.	calibrate, test and repair of temperature measuring and indicating, controlling and recording field instruments and analyze the data.	of thermometer and thermo switches for temperature with their function. (05 hrs.) 179. Dismantle and identify parts of its function, adjustment, assemble and operation of Bimetallic and liquid field system thermometer. (03 hrs.) 180. Service and calibrate various types of thermometers. (03hrs.) 181. Measure temperature by different temperature sensor with the help of automatic temperature-controlled oil bath/ furnace. (08hrs.) 182. Calibrate Filled system temperature indicator. (03hrs.) 183. Calibrate bimetallic thermometer (03 hrs.)	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. (09hrs.)
		184. Check different types of Thermocouples like 'J', 'K', 'T' etc. (03 hrs.) 185. Identify and check different types of RTD (06 hrs.) 186. Identify and check different types of Thermistors. (03 hrs.) 187. Maintain & repair the thermocouple. (13 hrs.)	**TEMPERATURE MEASUREMENT BY ELECTRICAL METHOD:** Thermistor, Thermocouple& RTD their ranges, construction, principle of operation. Thermocouples Ex-tension wires, compensating for changes in reference junction temperature, construction of thermocouple junction, types of thermocouple, advantages and disadvantages of

			thermocouples.(09hrs.)
		188. Check digital temperature indicator. (03 hrs.) 189. Set up the temperature loop system. (05 hrs.) 190. Calibrate the temperature transmitter (capillary type). (06 hrs.) 191. Calibrate the temperature transmitter (electronic) using suitable calibrators. (05 hrs.) 192. Find out the error of temperature transmitter. (03 hrs.) 193. Correct the temperature transmitter for useable. (03 hrs.)	**DIGITAL TEMPERATURE INDICATORS:** Types of Temperature Transmitter. Types of Temperature Indicator, Temperature Scanner. (09 hrs.)
		Calibrate the switches 194. Bimetal strip temperature switch. (04 hrs.) 195. Liquid filled temperature switch. (04 hrs.) 196. Reed temperature switch. (04 hrs.) 197. Thermostat type temperature switch. (04 hrs.) 198. Thermocouple type temperature switch. (04 hrs.) 199. Calibrate the thermostat. (05 hrs.)	**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. (09 hrs.)
		200. Use the thermocouple pyrometer for temperature	Types of pyrometers IR Temp Guns, Radiation & Filament Type. Introduction of

		measurement. (05 hrs.) 201. Use the optical pyrometer for temperature measurement. (05 hrs.) 202. Use the radiation pyrometer for temperature measurement. (05 hrs.) 203. Use electronic temperature calibrator for checking and calibration of above instruments. (10 hrs.)	temperature calibrator. (09 hrs.)
Professional Skill 100Hrs.; Professional Knowledge 36Hrs.	Perform troubleshoot, calibrate, test and repair of flow measuring and indicating field instruments. Erection, commission and analyze the data.	**Flow Measurement** 204. Check flow restrictors. (03 hrs.) 205. Concept the orifice plates. (03 hrs.) 206. Shape and connect Concentric Orifice plate. (03 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.) 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.)	**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. (09hrs.)

		213. Shape and connect Rectangular Venturi tube. (02 hrs.)	
		214. Construction of rotameter and measure fluid flow by rotameter. (03 hrs.) 215. Check the rotameter. (01 hr.) 216. Fault finds the rotameter. (04 hrs.) 217. Dismantling of rotameterand identify the parts of it and scale. (04 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.(09 hrs.)
		223. Measure flow using Vortex flow meter. (03 hrs.) 224. Measure flow using Magnetic flow meter. (05 hrs.) 225. Measure flow using thermal mass flow meter. (05 hrs.) 226. Measure flow using Coriolis mass flow meter. (03 hrs.) 227. Measure flow using Turbine flow meter. (03	**VOLUMETRIC AND MASS TYPE:** Turbine flow meter, magnetic flow meters, vertex flow meter ultrasonic flow meter, Thermal mass flow meter, advantages and disadvantage. Coriolis Mass flow meter. (09 hrs.)

		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.)	
		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 Rate Using Solid Flow Meter. (09 hrs.)	**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.(09 hrs)
Professional Skill 125Hrs.; Professional Knowledge 45 Hrs.	Perform troubleshoot, calibrate, test and repair of level measuring, indicating and controlling field instruments and analyze the data.	**Level Measurement** 236. Use sight glass for level measurement. (05 hrs.) 237. Use hook type level indicator for level measurement. (05 hrs.) 238. Use float type indicator for level measurement.	**PRINCIPLES OF LEVEL MEASUREMENT:** Types of level measurements-solid and liquid, Mechanical and Electrical type. Storage tank gauges, sight glasses, buoyancy. Factors need to

		(04 hrs.) 239. Use static pressure indicator for level measurement. (04 hrs.) 240. Indirect level measurement Use air purge indicator for level measurement. (04 hrs.) 241. Identify working and part of mercury level switches, magnetic reed switches. (03 hrs.)	consider for open and closed channel level measurements. **LEVEL SWITCHES:** Mercury level switches in high pressure tank, level detectors, magnetic reed switches. (09 hrs.)
		242. Service the level measuring instruments. (08 hrs.) 243. Schedule maintains the level measuring instrument. (04 hrs.) 244. Repair the level measuring instrument. (06 hrs.) 245. Get ready the Controlling instrument for level control. (07 hrs.)	Pressure head instruments. Hydrostatic pressure, specific gravity, pressurized fluids, U-tube manometers, air purge systems. (09 hrs.)
		Method of liquid level measurement 246. Use ultrasonic type for liquid level measurement. (06 hrs.) 247. Use capacitance probes type for liquid level measurement. (07 hrs.) 248. Use Conductivity type for liquid level measurement. (06 hrs.) 249. Use Diaphragm switch type level detector for liquid level	**LIQUID LEVEL MEASUREMENT:** Electrical method conductivity 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

		measurement. (06 hrs.) **Method of Solid level measurement.** 250. Use ultrasonic type for solid level measurement. (06 hrs.) 251. Use capacitance probes type for solid level measurement. (07 hrs.) 252. Use microwave type for solid level measurement. (06 hrs.) 253. Use Diaphragm switch type level detector for solid level measurement. (06 hrs.)	microwaves, using capacitance probes to measure solid level and point type level detection.(18 hrs)
		254. Calibrate differential pressure transmitter (Diaphragm and Air Trap) for level measurement. (07 hrs.) 255. Calibrate the electronic level indicator. (06 hrs.) 256. Configure the ultrasonic level detector. (06 hrs.) 257. Calibrate capacitance type level indicator. (06 hrs.)	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.(09 hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 27 Hrs.	Apply safe working practice, follow instructional manual and handle calibrator and communicator.	258. Take safety precaution during calibration. (08 hrs.) 259. Observe the name plate which is fixing with the instruments. (08 hrs.) 260. Practice to follow up the instructional manual for instruments under calibration. (08 hrs.)	Classification of instrument according to accuracy. Generation of calibration report. (18 hrs.)

		261. Handle universal calibrator. (14 hrs.) 262. Handle hart communicator with calibrator. (12 hrs.)	
		263. Identify the parts of the PH meter. (02 hrs.) 264. Operate the PH meter. (04 hrs.) 265. Measure PH value. (04 hrs.) 266. Control the PH. (03 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.(09hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Perform troubleshoot, calibrate and repair electronic/pneumatic converters and safety valves.	271. Identify the function of 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.)	**CONVERTERS:** Principle, Construction, operation of I to P, and P to I Converters, Types of Manometer (ELCTRONIC & PNEUMATIC). (09 hrs.)
Professional Skill 50 Hrs.;	Perform calibrate, test and repair the various type recorder	276. Identify function of parts and working of the Strip chart	**RECORDERS:** Theory of Integrating system in recording processes

Professional Knowledge 18 Hrs.	of different type process parameters.	recorder. (03 hrs.) 277. Identify function of parts and operation of Circular chart recorder. (03 hrs.) 278. Select and check the recorders. (02 hrs.) 279. Adjust time travel. (03 hrs.) 280. Change recording chart and recording pen/ink. (02 hrs.) 281. Find the fault of recorder. (03 hrs.) 282. Rectify and repair minor parts. (03 hrs.) 283. Find error and adjust it. (03 hrs.) 284. Calibrate the selected recorder. (03 hrs.)	variables, Multi-pens recorder and cam arrangements. Study of Strip Chart & Circular chart recorders. (09 hrs.)
		285. Select and repair the strip chart recorder. (07 hrs.) 286. Select and repair the circular chart recorder. (07 hrs.) 287. Provide different type recorders to the trainees to check calibration individually. (06 hrs.) 288. Demonstrate about paperless recorder. (05 hrs.)	Paperless recorder. Punching and Dot systems, Errors and Adjustment in various Electrical & Electronic Recorders. (09 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18	Perform calibrate and test various transmitter for various process parameter.	289. Installing and operating HART transmitters and devices I/O. (10 hrs.) 290. Calibrate and adjust the HART transmitter for	**SMART DEVICES:** HART transmitters, Its advantages & applications. HART protocol. HART communicators and PC based

Hrs.		temperature. (10 hrs.) 291. Calibrate and adjust the HART transmitter for level. (10 hrs.) 292. Calibrate and adjust the HART transmitter for flow. (10 hrs.) 293. Configure and calibration of HART devices (10 hrs.)	HART device configuration. Steps in calibration of HART devices. (18 hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 27 Hrs.	Select suitable controller, perform process control, troubleshoot and calibrate various controllers in chemical plant.	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.). (03 hrs.) 297. Check the proportional controller. (04 hrs.) 298. Set/adjust proportional band. (04 hrs.) 299. Calibrate the proportional controller. (05 hrs.) 300. Check calibration and set reset action of selected controller. (05 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.)	**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 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. (18 hrs.)

		304. Calibrate the PID controller. (05 hrs.)	
		305. Measure and control in different loop parameters in chemical plant. (25 hrs.)	**CHEMICAL PLANT INTRODUCTION:** Transmitters, valves, process vessels, controller and software. (09 hrs.)
Professional Skill 75 Hrs.; Professional Knowledge 27 Hrs.	Plan and execute erection, commission, overhaul and repair the final control elements with accessories.	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. (05 hrs.) 311. Techniques of replacement of valve parts like diaphragm, sealing rings, plug etc. (06 hrs.) 312. Lapping of valve seat for leak proof. (05 hrs.) 313. Erection, commission and calibrate the control valve with positioner. (08 hrs.) 314. Identify the diaphragm actuated control valve with three characteristics. (06 hrs.)	**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 & Electronic valve positioner. Solenoid valve. (18 hrs.)
		315. Use pipe/tube fittings like union, elbow, socket, reducer, straight coupling, tee, connector etc. and also push fit connectors. (25	Piping houses and fittings. Requirement of piping, air flow, piping dimensions and safety factors, piping connections, compressed air piping applications, metallic

		hrs.)	&nonmetallic tubing used in instrumentation PU, copper & SS). (09 hrs.)
Professional Skill 50Hrs.; Professional Knowledge 18Hrs.	Basic working and Identification of faults in process control based on PLC, SCADA and DCS	316. Identify the PLC trainer kit with accessories. (04 hrs.) 317. Demonstrate the functions of PLC. (04 hrs.) 318. Prepare logic gates. (04 hrs.) 319. Create small program on PLC (start- run-shutdown). (06 hrs.) 320. Prepare a programme on timer and counters. (04 hrs.) 321. Demonstrate about SCADA and DCS operating control system. (03 hrs.)	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. (09 hrs.)
		322. Use DCS trainer kit with complete communication system on process trainer. (13 hrs.) 323. Use SCADA trainer kit with complete communication system on process trainer. (12 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). (09hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18	Operate packed distillation column and carry out maintenance of triple effect evaporator,	324. Carry out maintenance of heat exchanger. (shell and tube) (10 hrs.) 325. Carry out maintenance	Concept of the heat exchanger. Concept the chillier. Concept the stream trap. **HEAT TRANSFER:**

Hrs.	heat exchanger and chiller.	of chiller. (07 hrs.) 326. Carry out maintenance of stream trap. (06 hrs.) 327. Operate packed distillation column with DCS/PLC system. (15 hrs.) 328. Operate triple effect evaporator. (12 hrs.)	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.(18 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Plan and execute automatic process control block diagram and others field-based control systems.	329. Prepare block diagram of automatic process control system. (25 hrs.) 330. Prepare various field-based control system in industry through industrial visit (Protocol). (25 hrs.)	**FIELD BUS:** industrial visit, (Protocol). (18hrs.)
Project work / Industrial visit			