SYLLABUS FOR INSTRUMENT MECHANIC TRADE			
FIRST YEAR			
Duration	**ReferenceLearning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 100Hrs. Professional Knowledge 28 Hrs.	Plan and organize the work to make job as per specification applying different types of basic fitting operation and Check dimensional accuracy using precision instruments following safety precaution. *[Basic fitting operation – marking, Hacksawing, Chiseling, Filing, Drilling, Taping and Grinding etc. Accuracy: ± 0.5mm]*	1. Importance of trade training, List of tools & Machinery used in the trade. (01 hr.) 2. Safety attitude development of the trainee by educating them to use Personal Protective Equipment (PPE). (05 hrs.) 3. First Aid Method and basic training. (02 hrs.) 4. Safe disposal of waste materials like cotton waste, metal chips/burrs etc. (02 hrs.) 5. Hazard identification and avoidance. (02 hrs.) 6. Safety signs for Danger, Warning, caution & personal safety message. (01 hr.) 7. Preventive measures for electrical accidents & steps to be taken in such accidents. (02 hrs.) 8. Use of Fire extinguishers. (07 hrs.) 9. Practice and understand precautions to be followed while working in fitting jobs. (02 hrs.) 10. Safe use of tools and	Organization of the Institute, Departments various trades & functions. Types of work, responsibility to be undertaken, incentives and future planning of profession. Safely precautions to be observed in the trade both during 'theoretical Periods' and 'Practical hours/workshop hours' Elementary First Aid. Safety and hazards. Sign boards and types. Hazardous and non-hazardous. Environmental pollution related to the trade-caused, consequences, mitigation and control. (07 hrs.)

		equipments used in the trade. (01 hr.)	
		11. Demonstrationandusesofhandtools- screwdrivers,pliers, spanners,tweezers, tester, wire stripper, electrician knife,steel rule, scriber, punches, hammer. (02 hrs.) 12. Identification of tools &equipments as per desired specifications for marking & sawing. (02 hrs.) 13. Selection of material as per application. (02 hrs.) 14. Visual inspection of raw material for rusting, scaling, corrosion etc. (03 hrs.) 15. Filing- flat & square (Rough finish). (03 hrs.) 16. Filing practice, surface filing, side and checking 90^0 by try square. (03 hrs.) 17. Marking out lines, filling and saving use of vice to given dimensions. (03 hrs.) 18. Filing- Flat, square and Parallel to an accuracy of 0.5mm. (03 hrs.) 19. Use and care non precision instruments such as different types of callipers, gauges, and making tools. (04 hrs.) 20. Practice of marking and measurement with combination set. (04 hrs.) 21. File radios along a marked line (convex and concave) and match. (04 hrs.) 22. Check the internal and	Basic hand tools, types, classification use & metal cutting fundamentals. Filing- Flat, square and Parallel to an accuracy of 0.5mm. Measurement & measuring instruments, Marking tools, Fasteners & Fastening devices. (14 hrs.)

		external radius of curved surface by radius gauge. (03 hrs.) 23. Identify and use of various types of Fasteners & Fastening devices. (03 hrs.) 24. Measurement of Length, Height & Diameter by Vernier callipers and Micrometers. (06 hrs.) 25. Determine positional errors of surfaces and measurements of deformation using dial test indicator. (05 hrs.)	
		26. Carry out maintenances, servicing and calibration Precision Measuring Instruments. (5 hrs.) 27. Familiar with drilling machine operation, care and use. (05hrs.) 28. Select drill bits, reamers and tapes. (03hrs.) 29. Drill through holes and blind holes. (04hrs.) 30. Form internal thread with taps to standard size (Through holes & blind holes). (03hrs.) 31. Form external thread with dies to standard size. (05hrs.)	Precision Measuring Instruments, gauge blocks, sine bar, dial indicators,vernier calipers, micrometers, bevel protractor, thickness gauges. Element & types of screw threads used in instruments, Calculation of drill size for tapping. (07 hrs.)
Professional Skill 25 Hrs. Professional Knowledge 07 Hrs.	Apply a range of skills to execute tube joints, dismantle and assembles tubes and fittings of PI arc &ferrule and test for	32. Flaring of tube and tube joints. (03 hrs.) 33. Cutting and threading of tube length. (04 hrs.) 34. Fitting of tube and per sketch observing conditions used for tube work. (06 hrs.)	Types of tubes used for instrumentation. Tube cutter, Flaring tools, swedging tools, equipment's & fixture required for pipe bending, straightening, thread cutting, method of installation. (07 hrs.)

	leakage. [range of skills- cutting, threading, flaring, bending and joining]	35. Bending of tube cold and hot. (02 hrs.) 36. Fit and assemble tubes, PI arc and ferrule fittings. (05 hrs.) 37. Test leakage and functionality of PI arc and ferrule. (05 hrs.)	
Professional Skill 25 Hrs. Professional Knowledge 07 Hrs.	Identify, test the cable and measure the electrical parameters.	38. Identify the Phase, Neutral and Earth on power socket, use a tester to monitor AC power. (02 hrs.) 39. Construct a test lamp and use it to check mains healthiness. (02 hrs.) 40. Measure the voltage between phase and ground and rectify earthing. (02 hrs.) 41. Identify and test different AC mains cables. (03 hrs.) 42. Prepare terminations, skin the electrical wires /cables using wire stripper and cutter. (03 hrs.) 43. Measure the gauge of the wire using SWG and outside micrometre. (02 hrs.) 44. Refer table and find current carrying capacity of wires. (02 hrs.) 45. Measure AC and DC voltages using multi meter. (03 hrs.) 46. Use the multi meter to measure the various functions (AC V, DC V, DC I, AC I, R) (03 hrs.) 47. Identify the different types of meter for measuring AC & DC parameters (03 hrs.)	Electrical components- conductor, semiconductor & insulators. Standard wire gauge (SWG). Introduction of electricity- static electricity. Current, voltage, P.D, E.M.F, resistance. Electrical circuit - D.C & A.C circuit differences. Importance of grounding. (07 hrs.)

Professional Skill 25 Hrs. Professional Knowledge 07 Hrs.	Test various electrical passiveand active components using proper measuring instruments and compare the data using standard parameter.	48. Identify the different types of passive electronic components. (02 hrs.) 49. Measure the resistor value by colour code and verify the same by measuring with multi-meter. (02 hrs.) 50. Identify resistors by their appearance and check physical defects. (01 hrs.) 51. Practice soldering on IC bases and PCBs. (02 hrs.) 52. Practice de-soldering using pump and wick. (02 hrs.) 53. Join the broken PCB track and test. (02 hrs.) 54. Practice on measurement of parameters in combinational electrical circuit by applying Ohm's Law for different resistor values and voltage sources. (03 hrs.) 55. Measurement of current and voltage in electrical circuits to verify Kirchhoff's Law. (02 hrs.) 56. Verify laws of series and parallel circuits with voltage source in different combinations. (02 hrs.) 57. Measure the resistance, Voltage, Current through series and parallel connected networks using multi meter. (02 hrs.) 58. Identifythe primaryand secondarycells. (01 hr.) 59. Measure and test the voltages of the given	Uses of multimeter. Resistor, Resistivity and colour code, Types of resistors used in instrumentation. Definition and purpose of soldering and desoldering. Soft soldering. Types of soldering irons. Solder & flux. Care & precaution of soldering. De-soldering tools and method of use. Ohm's law & Kirchhoff s laws. Series & parallel circuits. Primary & secondary cells and batteries. {Liquid & dry). Maintenance free batteries construction-charging, efficiency-use, advantage. (07 hrs.)

		cells/battery using analog/digital multi-meter. (1 hr.) 60. Charging anddischarging the battery and Maintain the secondarybattery. &Use a hydro meter to measure the specificgravityof thesecondarybattery. (03 hrs.)	
Professional Skill 25 Hrs. Professional Knowledge 07 Hrs.	Identify, test and use of various types of switches, E.M. relays, Circuit breaker and construct electrical circuits.	61. Dismantle and identify the different parts of a relay. (05 hrs.) 62. Connect a timer relay in a circuit and test for its working. (02 hrs.) 63. Connect a contactor in a circuit and test for its working (02 hrs.) 64. Construct and test series and parallel resonance circuit (03 hrs.) 65. Identify and use SPST, SPDT, DPST, DPDT, tumbler, push button, toggle, piano switches used in electronic industries (04 hrs.) 66. Make a panel board using different types of switches for a given application (05 hrs.) 67. Wind a solenoid and determine the magnetic effect of electric current. (04 Hrs.)	Switches and types. Magnet and magnetism, magnetic properties. Magnetic campus and its uses. Explanation ofElectro-magnetism, Advantages, disadvantages-application-types E.M. relays. Types- uses of Solenoids. Circuit breakers and their working. (07 hrs.)
Professional Skill 25 Hrs. Professional Knowledge	Estimate, Assemble, install and test wiring system.	68. Identify various conduits and different electrical accessories. (03 hrs.) 69. Practice cutting, threading of different sizes & laying	Principles of alternating current, A.C & DC electricity, types of wave forms, time period and frequency, peak to peak values, RMS values,

07 Hrs.		Installations. (08 hrs.) 70. Draw layouts and practice in PVC Casing-capping, Conduit wiring with minimum to a greater number of points of minimum 15 mtrs. length. (08 hrs.) 71. Wire up PVC conduit wiring to control one lamp from two different places. (04 hrs.) 72. Draw layouts and practice Wiring for instrument panel. (02 hrs.)	Average values. (07 hrs.)
Professional Skill 25Hrs. Professional Knowledge 07Hrs.	Test various electrical passiveand active components using proper measuring instruments and compare the data using standard parameter.	73. Identify the different types of inductors. (03hrs.) 74. Measure the inductor value by written/colour code and verify the same by measuring with LCR meter. (04hrs.) 75. Identify inductor by their appearance and check physical defects. (02hrs.) 76. Measure quality factor of inductors in series and parallel circuits with voltage source in different combination. (03hrs.) 77. Identify the different types of capacitor and check by multi-meter whether open or short. (03hrs.) 78. Identify capacitor by their appearance and check physical defects. (02hrs.) 79. Measure charge, energy store of capacitor in series and parallel circuits with voltage source in different combination. (03hrs.)	Inductor and Inductance, types of inductors, Factors affecting the value of inductance, self-inductance (L), Mutual inductance (M), Inductors in series and parallel, Q factor of the coil. Capacitance, types of capacitor, unit of capacitance, factors affecting the value of capacitors, charge, energy stored in capacitors. Capacitors in series and parallel. Capacitors in DC circuit, RC time constant. (07 hrs.)

		80. Construct and test RC time constant circuit. (02hrs.) 81. Identify the different capacitors and measure capacitance of various capacitors using LCR meter. (03hrs.)	
Professional Skill 25 Hrs. Professional Knowledge 07 Hrs.	Verify characteristics of resonance circuits.	82. Measure capacitive and inductive reactance with increase/decrease the input frequency of the circuit. (03 hrs.) 83. Measure current & voltage and determine the characteristics of RL, RC and RLC in AC series circuits. (03 hrs.) 84. Measure the resonance frequency in AC series circuit and determine its effect on the circuit. (05 hrs.) 85. Measure current & voltage and determine the characteristics of RL, RC and RLC in AC parallel circuits. (04 hrs.) 86. Measure the resonance frequency in AC parallel circuit and determine its effects on the circuit. (05 hrs.) 87. Measure Current, voltage, power, energy and power factor in three phase circuits. (05 hrs.)	A.C.-impedance, Inductive reactance, capacitive reactance. AC current through - R, L, C circuits. Resonance in RLC circuit. Importance - of series and parallel resonance, properties. Impedance, Admittance, Q- factor. (07 hrs.)
Professional Skill 50Hrs. Professional Knowledge	Plan, execute commissioning, testing and evaluate performance of AC & DC motors and	88. Identify parts and terminals of different types of single-phase AC motors. (03 hrs.) 89. Install, connect and determine performance of	Introduction of AC and DC generators working principles, construction. Operation, field magnets, armature windings,

14Hrs.	generators.	single-phase AC motors. (05 hrs.) 90. Start, run and reverse the direction of rotation of single-phase AC motors. (03 hrs.) 91. Practice on speed control of single-phase AC motors. (06 hrs.) 92. Identify parts and terminals of different types of single-phase DC motors. (05 hrs.) 93. Install, connect and determine performance of single-phase DC motors. (06 hrs.) 94. Start, run and reverse the direction of rotation of single-phase DC motors. (04 hrs.) 95. Install an alternator, identify parts and terminals of alternator. (04 hrs.) 96. Connect, start and run an alternator and build up the voltage. (04 hrs.) 97. Perform speed control of DC motors - field and armature control method. (04 hrs.) 98. Connect, start and run three phase induction motors by using DOL, star-delta and auto-transformer starters. (03 hrs.) 99. Identify parts and terminals of different type of stepper motors. (03 hrs.)	commutator and brushes, EMF equation. Faraday's Law, Lenz's Law, Fleming's left Hand and right-hand rules. DC motors working principles, construction,operation, types. Different speed controlling techniques of DC motors. AC motors, induction motors, three phase motors, stepper motors. (14hrs.)
Professional Skill 25 Hrs. Professional	Execute testing, evaluate performance and maintenance of	100. Verify terminals, identify components and calculate transformation ratio of single-phase transformers.	Transformer, types, transformation ratio. Open circuit test and short circuit test, regulation Auto

Knowledge 07 Hrs.	transformer.	(03 hrs.) 101. Identifytheprimaryandsecondarytransformerwindings,test the polarity andMeasure the primary and secondary voltage of different transformers. (02 hrs.) 102. Perform OC and SC test to determine and efficiency of single-phase transformer. (05 hrs.) 103. Determine voltage regulation of single-phase transformer at different loads and power factors. (04 hrs.) 104. Verify and measure voltage regulation of auto transformer at different loads. (06 hrs.) 105. Perform series and parallel operation of two single phase transformers. (03 hrs.) 106. Identify the terminals and measure voltage & current of PT and CT transformer. (02 hrs.)	transformer. Current measurement. Instrument transformer. Potential transformer and current transformer. (07 hrs.)
Professional Skill 50 Hrs. Professional Knowledge 14 Hrs.	*Plan, select, and carry out measurement, extension of range, overhauling, testing and calibration of 'D' Arsonval meter, PMMC meter.*	107. Familiar with absolute and different types of secondary instruments. (02 hrs.) 108. Identify the instrument specification and internal construction. (02 hrs.) 109. Overhaul, check, fault find, repair, test of voltmeter and ammeter. (03 hrs.) 110. Identify different types of	**Basics of electrical measuring instruments-** Types - absolute and secondary instruments. Types of secondary instruments, Essential of electrical measuring instruments- deflecting torque, controlling torque, damping torque etc, Types of controlling torques-

		torques. (02 hrs.) 111. Install, wire up and test the spring control and gravity control operation. (02 hrs.) 112. Familiar with damping and identify various functional element like- air friction damping, fluid friction damping and eddy current damping. (04 hrs.) 113. Study the construction circuit operation and adjustment for correct functioning of zero errors on voltmeter and ammeter. (04 hrs.) 114. Identify different parts, its function and operation of PMMC instruments. (04 hrs.) 115. Find the minimum and maximum measurable range of the meter. (04 hrs.) 116. Check the accuracy, sensitivity and maximum power capability of ammeter & voltmeter. (5hrs.) 117. Test the shunt and series resistance of various range of ammeter. (04 hrs.) 118. Practice multipliers for different range extension of voltmeter and ammeter. (5hrs.) 119. Determine errors in meter movement and find the resistance. (9 hrs.),	spring control, gravity control. Types of damping - air friction damping, fluid friction damping, eddy current damping **DC** instruments - 'D[1] Arsonval meter, PMMC meter- working principle, method of working, moving coil operation. Construction-damping, magnetic shielding, bearings. Terminology -parallax error, (FSD) full scale deflection reading, measurement value, meter sensitivity, accuracy. Meter resistance, maximum power, capability etc. Ideal and practical characteristics of ammeter, voltmeter. **Meter range extension -** Converting galvanometer into ammeter, voltmeter. Range extension of voltmeter, ammeter. Shunt resistance and series resistance value calculation. Meter resistance, meter FSD identification techniques. (14 hrs.)

Professional Skill 75 Hrs. Professional Knowledge 21 Hrs.	Select, perform electrical/electronic measurement, earthing installation service and calibrate MI instruments, electro dynamometer instruments, Induction type and Special instruments- voltage tester, continuity tester, rotation tester, phase sequence indicator, synchronising, synchronouscope, frequency meter, thermocouple type ammeter.	120. Identify the different types of Ohm meter. (01 hr.) 121. Test and calibrate of various type of Ohm meter. (02 hrs.) 122. Prepare pipe earthing and measure earth resistance by earth tester / megger. (6 hrs.) 123. Prepare plate earthing and measure earth resistance by earth tester / megger. (6 hrs.) 124. Test earth leakage by ELCB and relay. (02 hrs.) 125. Identify different parts, its function and operation of Dynamometer type instrument and MI. (03 hrs.) 126. Overhaul, check and fault find of Dynamometer type instrument. (03 hrs.) 127. Test and calibrate Dynamometer type instrument. (04 hrs.) 128. Measure the power using wattmeter. (03 hrs.) 129. Test and calibrate wattmeter. (03 hrs.) 130. Familiar with the construction of energy meter and ampere hour meter. (03 hrs.) 131. Overhaul, check and fault find of ampere hour meter. (03 hrs.) 132. Test and calibrate ampere hour meter. (03 hrs.) 133. Measure power in single	**Ohm meters-** measuring electrical resistance. Basic construction of Ohm meter, working method of ohmmeter. Types of Ohm meter - series and shunt type of ohm meters. Megger/insulation tester, earth tester - construction working advantages and disadvantages of various types of ohm meter. AC **instruments** - types of AC measuring instruments -MI, electro dynamometer type, Working principle, construction, advantages and disadvantages of MI instruments and electro dynamometer instruments. Various applications. Electro dynamometer applications - as voltmeter, ammeter, power measuring instrument, energy measuring instrument, power factor meter etc. AC voltage and current measurement using PMMC meter (rectifier type). Induction type meters - working principle construction and operation of induction type instruments. Construction and Applications - single phase and three phase energy meter, watt meter. Walt hour meter, Ampere Hour meter, power factor meter etc. Special instruments: voltage

		and three phase circuit using voltmeter &ammeter. (05 hrs.) 134. Overhaul and maintenance of KWH meter and energy meter. (02 hrs.) 135. Test and calibrate KWH meter and energy meter. (03hrs.) 136. Measure power factor in three phase circuit by using power factor meter and verify the same with voltmeter, ammeter and wattmeter readings. (02 hrs.) 137. Practice of usevoltage tester to Test electrical power in circuit, to test for proper grounding, to determine whether adequate voltage is present in a wire. (02 hrs.) 138. Test continuity of wires, circuit and switches using continuitytester. (02 hrs.) 139. Practice to used rotation tester to: - determine 3 phase indication; Indication of phase rotation and Indication of motor rotation direction of runningmotor. (02 hrs.) 140. Determines the phase sequence of the three-phase supply system using Phase sequence indicator. (02 hrs.) 141. Identify different parts of	tester, continuity tester, rotation test, phase sequence indicator, synchronizing, the synchroscope, _ frequency meter. Thermocouple type ammeters. (21 hrs.)

		frequency meter and Measure the frequency of a periodic electrical signal. (02 hrs.) 142. Identify different parts of frequency meter AND Measure the frequency of a periodic electrical signal. (02 hrs.) 143. Identify different parts /section; check its function and operation of phase sequence meter and synchronoscope. (02 hrs.) 144. Practice to useSynchroscope for synchronizing the electrical machines. (02 hrs.)	
Professional Skill 100 Hrs. Professional Knowledge 28 Hrs.	Identify, Test various analog and power electronics components, Construct, test and analyze the circuit functioning.	145. Identify different types of diodes, diode modules and their specifications. (03hrs.) 146. Test the power diode, Zener diode, tunnel diode, photo diode using multi meter and determine forward to reverse resistance ratio. (04hrs.) 147. Determine V-I characteristics of semiconductor diode. (04hrs.) 148. Measure the voltage and current through a diode in a circuit and verify its forward characteristic. (04hrs.) 149. Measure the voltage and current through a Zener diode in a circuit and verify its forward and reverse	Semiconductor, Covalent bond, Doping, Intrinsic and extrinsic semiconductor. PN junction diode, Forward and Reverse characteristics. Specification of diodes (data sheets). Applications of diode. Special semiconductor diode-Zener diode, tunnel diode, Photo diode. **Transistors.** Defining transistors, NPN& PNP transistor, Symbol, operation, Biasing of Transistor & mode of Application. Transistor CB, CC, CE Amplification, current gain, voltage gain, and power gain. Introduction to FET, MOSFET. **Rectifiers:** half wave rectifier, full wave (bridge & center

		characteristic. (02hrs.) 150. Identify and check different type of transistors their package and specification. (02 hrs.) 151. Construct and test fixed-bias, emitter-bias and voltage divider-bias transistor amplifier. (03 hrs.) 152. Construct and Test a common emitter amplifier with and without bypass capacitors (03 hrs.) 153. Construct and Test common base amplifier. (03 hrs.) 154. Construct a single stage amplifier and measure current gain, voltage gain & power gain. (02 hrs.) 155. Identify different power electronic components, their specification and terminals. (03 hrs.) 156. Construct and test a FET Amplifier. (03 hrs.) 157. Identify variousPower MOSFET by its number and test by using multimeter. (02 hrs.) 158. Identify different heat sinks used with power MOSFET test circuit with a small load. (01 hr.) 159. Identify different types of transformers and test. (03 hrs.) 160. Identify the primary and secondary transformer windings and test the	tapped) rectifier. Voltage multipliers. Filters: Introduction, purpose and use of ripple filter. Types of filters. Capacitance filter, inductance filters, RC filters, LC filters, voltage dividers and bypass filters. **Voltage regulators.** Introduction & purpose Zener regulators, shunt regulators, series regulators, IC regulators, variable regulators. (28 hrs.)

		polarity (02 hrs.) 161. Construct and test a half wave, full wave and Bridge rectifier circuit. (05hrs.) 162. Construct and test different filter circuit used in rectifier and measure output voltage with load. (04hrs.) 163. Measure ripple voltage, ripple frequency and ripple factor of rectifiers for different load and filter capacitors. (04hrs.) 164. Construct and test voltage doubler and Tripler. (03 hrs.) 165. Construct and test Zener based voltage regulator circuit. (8hrs.) 166. Construct and test Zener based shunt regulator. (9hrs.) 167. Construct and test Zener and transistor-based series regulator. (09hrs.) 168. Construct and test a +12V fixed voltage regulator. (04hrs.) 169. Construct and test a fixed +15ve and –15ve voltage regulator using ICs. (04hrs.) 170. Construct and test a 1.2V – 30V variable output regulated power supply using IC LM317T and its characteristics. (05 hrs.)	
Professional Skill 25 Hrs. Professional	Detect the faults and troubleshoot SMPS, UPS, inverter, converterand	179. Identify the components/devices and draw their corresponding symbols. (02 hrs.)	**Power Supply units.** Introduction, purpose & use. UPS and SMPS, inverters and converters and their

Knowledge 07 Hrs.	Thyristor family.	180. List the defect and symptom in the faulty SMPS. (02 hrs.) 181. Measure / Monitor major test points of computer SMPS. (03 hrs.) 182. Troubleshoot the fault in the given SMPS unit. Rectify the defect and verify the output with load. Record your procedure followed for trouble shooting the defects. (04 hrs.) 183. Identify front panel control & indicators of UPS. (02 hrs.) 184. Open top cover of a UPS; identify its isolator transformers, the UPS transformer and various circuit boards in UPS. (03 hrs.) 185. Perform load test to measure backup time. (02 hrs.) 186. Install and test an inverter. (03 hrs.) 187. Troubleshoot the fault in the given inverter unit. Rectify the defects and verify the output with load. (02 hrs.) 188. Construct and test thyristor-based devices and check SCR, DIAC, TRIAC and other discrete components. (02 hrs.)	applications. **Thyristor devices:** basic description and applications of SCR, TRIAC, DIAC. (07 hrs.)
Professional Skill 25 Hrs.	Identify, place, solder and desolder	189. Measure and plot input and output characteristics of a	General characteristics of an amplifier, Concept of

Professional Knowledge 07 Hrs.	and test different SMD, discrete components with due care and following safety norms using proper tools/setup.	CE amplifier. (05 hrs.) 190. Check for cold continuity of PCB. (03 hrs.) 191. Solder the SMD components from the given PCB. (04 hrs.) 192. De-solder the SMD components in the same PCB. (04 hrs.) 193. Identify loose /dry solder, broken tracks on printed wired assemblies. (04 hrs.) 194. Repair solder mask and damage pad. (03 hrs.) 195. Construct and test a CE amplifier and measure the AC & DC load line. (02 hrs.)	amplification. Types of Amplifiers. Effect of temperature. DC load line and AC load line. PCB basic construction, applications. Lay outing circuit on PCB. (07 hrs.)
Professional Skill 25 Hrs. Professional Knowledge 07 Hrs.	Identify, Test various analog and power electronics components, Construct, test and analyze the circuit functioning.	**Oscillators** 196. Demonstrate Colpitts oscillator, Hartley oscillator circuits and compare the output frequency of the oscillator by CRO. (07 hrs.) 197. Construct and test a RC phase shift oscillator circuits. (05 hrs.) 198. Construct and test a crystal-controlled oscillator circuit. (05 hrs.) 199. Construct and test a clapp oscillator circuits. (04 hrs.) 200. Construct and test different type of ICs based Oscillator circuit. (04 hrs.)	**Oscillator's** oscillations, oscillation frequency, basic working principle and working of Talk circuit, Crystal controlled oscillators, Phase shift oscillators, RC phase shift oscillators, Colpitt, Clapp, Hartley, and IC oscillators. (07 hrs.)
Professional Skill 50Hrs.; Professional Knowledge	Construct and test different circuits using operational amplifiers circuits and execute the	201. Use analog IC tester to test the various analog ICs. (03 hrs.) 202. Construct and test various Op-Amp circuits Inverting,	**Operational Amplifier.** Differential amplifier, ideal op-amp. Op-amp with feedback, advantages of feedback.

14Hrs.	result.	Non-inverting and Summing Amplifiers. (08 hrs.) 203. Construct and test Differentiator and Integrator circuits. (05 hrs.) 204. Construct and test a voltage to current and current to voltage converter circuit using Op-amp. (04 hrs.) 205. Construct and test Instrumentation amplifier (05 hrs.) 206. Identify the pin configuration and check the output voltage of the pins. (03 hrs.) 207. Construct and test Astable timer circuit using IC 555. (03 hrs.) 208. Construct and test mono stable timer circuit using IC 555. (06 hrs.) 209. Construct and test VCO (V to F Converter) using IC 555. (05 hrs.) 210. Construct and test 555 timers as pulse width modulator (05 hrs.) 211. Construct and test automatic delay on circuit using 555 IC and other discrete components. (03 hrs.)	Inverting and Non inverting and inverting amplifier, Op-amp as summer, differential amplifier. V to I converter and I to V converter, Instrumentation amplifier Basics of op- amp applications - integrator, differentiator, Introduction of timers (555) and its applications. (14hrs.)
Professional Skill 150 Hrs. Professional Knowledge 42Hrs.	Identify, test and Verify all digital ICs. Assemble, test and troubleshoot various digital circuits and	212. Identify different Logic Gates (AND, OR, NAND, NOR, EX-OR, EX-NOR, NOT ICs) by the number printed on them. (05hrs.) 213. Verify the truth tables of all	**Number systems;** binary, octal, decimal and hexadecimal number system. Conversion of number systems. Boolean algebra, binary addition, subtraction, multiplication and

	digital instruments.	Logic Gate ICs by connecting switches and LEDs. (06hrs.) 214. Construct and verify the truth table of all the gates using NAND and NOR gates. (06hrs.) 215. Use digital IC tester to test the various digital ICs (TTL and CMOS). (07hrs.) 216. Construct and verify the truth table of all the gates using DTL circuit. (05hrs.) 217. Construct Half Adder circuit using ICs and verify the truth table. (03 hrs.) 218. Construct Full adder with two Half adder circuit using ICs and verify the truth table. (04hrs.) 219. Construct Half subtractor and full subtractor circuit using ICs and verify the truth table. (02 hrs.) 220. Construct the adder cum subtractor circuit and verify the result. (02hrs.) 221. Identify different Flip-Flop (ICs) by the number printed on them. (03 hrs.) 222. Construct and test R-S flip-flop using IC7400 with clock and without clock pulse. (03 hrs.) 223. Verify the truth tables of JK Flip-Flop using ICs by connecting switches and LEDs. (06 hrs.) 224. Construct and test 7493 as	division. 1's and 2's compliment, BCD code, ASCII code, gray code. **Logic Circuits.** Basic gates-AND, OR and NOT gates. De-Morgan \s Theorem. Universal gates - NAND and NOR gates. Special gates - Ex-OR, Ex -NOR gates and Buffer and its applications. Basic digital ICs, function, digital application, logic symbols. Adders - Half adder, full adder Subtractor - Half subtractor, full subtractor. Flip flops - RS flip flop, clocked RS flip flop, JK flip flop, Basics of Counters and registers. Multiplexer and de--multiplexer. Encoder and decoder. BCD display, BCD to decimal decoder. BCD to 7 segment display circuits. Digital meters: displays: LED, 7 segment display, LCD, CRT, electro- luminescent displays, electro-phoretic image display, liquid vapor display, dot matrix display. (28 hrs.)

		a modulus-12 counter. (04 hrs.) 225. Construct and test a four-bit Synchronous binary counter using 74163. (05 hrs.) 226. Construct and test synchronous Decade counter. (04 hrs.) 227. Construct and test an up/down synchronous decade counter using 74190 and monitor the output on LEDs. (04 hrs.) 228. Construct and test a multiplexer and de-multiplexer circuit using ICs. (04 hrs.) 229. Identify and test common anode and common cathode seven segment LED display using multi meter. (03 hrs.) 230. Construct and test octal to binary encoder & decoder circuit using IC 74148 and IC 74132. (03 hrs.) 231. Construct and test decimal to BCD encoder using IC 74147 and seven segment LED display. (04 hrs.) 232. Construct and test seven segment LED display decoder with IC 7447. (05 hrs.) 233. Measure current flowing through a resistor and display it on LED Module. (07 hrs.)	

		234. Identify different parts, its function and operation of LCD, CRT, Electro-luminescent displays, electro-phoretic image display, liquid vapour display and dot metrix display. (05hrs.)	
		235. Identify different parts, its function, operation &specification of D/A and A/D circuits. (04 hrs.) 236. Construct and test Digital to Analog (D/A) Binary Weighted resistor converter by using op-amps. (04 hrs.) 237. Construct and test Digital to Analog (D/A) converter using R-2R ladder network circuit. (04 hrs.) 238. Construct and test Digital Ramp Analog to Digital Converter (ADC) circuit. (04 hrs.) 239. Perform the interfacing of IEEE 488.2 standard with a single controller can control up to 15 different instrument connected star topology. (03 hrs.) 240. Identify different pins, signal and source of RS232. (02hrs.) 241. Perform the interfacing of RS232 to the PC. (02 hrs.) 242. Convert RS-485 signals to RS-232 signals using RS-485 to RS-232 converter. (02	**A/D and D/A converters,** Introduction, weighted register D / A converter, binary(R-2R) ladder D / A converter, specification for D / A converter, Ramp or counter type A/D converter, GPIB (general purpose interface bus) IEEE - 488, RS 232. (07hrs.)

		hrs.)	
		243. Identify different parts, its function and operation of frequency meter, phase measuring meter, time measuring instrument and digital capacitance meter. (04 hrs.) 244. Identify LED Display module and its decoder/driver ICs. (03 hrs.) 245. Display a word on a two-line LED. (03 hrs.) 246. Measure/current flowing through a sensor and display it on a LED module (DPM). (03 hrs.) 247. Practice on measuring instruments in single and three phase circuits e.g. Phase sequence meter and Frequency meter etc. (03 hrs.) 248. Identify the different capacitors and measure capacitance of various capacitors using digital capacitance meter. (04 hrs.) 249. Practice on time measuring instrument to measure the time in different electrical control circuit. (05 hrs.)	Digital meters: frequency meter, phase measuring meter, and time measuring instruments. Digital capacitance meter. (07hrs.)
Professional Skill 25 Hrs. Professional	Measure the various parameters by CRO and execute the result with standard	250. Identify the different front panel control of a CRO. (06 hrs.) 251. Measure the Amplitude,	CRO:introduction and applications of CRO, functional block diagram of CRO, CRT power supply.

Knowledge 07 Hrs.	one.	Frequency and time period of typical electronic signals using CRO. (07 hrs.) 252. Take a print of a signal from DSO by connecting it to a printer and tally with applied signal. (07 hrs.) 253. Identify different types of CRO probes used to measure the signals. (05 hrs.)	Various types of probes. Applications of various types of CROs like dual beamCRO, Dual trace CRO, storage oscilloscope. (07 hrs.)
Professional Skill 75 Hrs. Professional Knowledge 21 Hrs.	Install and setup operating system and related software in a computer &Practicewith MSoffice and application software related to instruments.	254. Identify PC components and devices. (02 hrs.) 255. Practice on windows interface and navigating windows. (04 hrs.) 256. Customize the desktop settings and manage user accounts. (05 hrs.) 257. View system properties and control panel details. (04 hrs.) 258. Install necessary application software for windows i.e. office package and media player. (03 hrs.) 259. Familiar with Multi Media System consisting of CD ROMS, DVD ROMS, Sound Cards. (03 hrs.) 260. Burn data, video and audio files on CD/DVD using application software. (04 hrs.)	Introduction to Computer, Block diagram of PC, software familiarization of Multimedia System consisting of CD ROMS, DVD ROMS, Sound Cards. (07hrs.)
		261. Identify different parts, its function and operation of CPU. (05 hrs.) 262. Familiar with different CPU operations. (08 hrs.)	Computer Hardware, Computer systems, computer hardware, CPU, CPU operations, ROMs and RAMs, I/P and O/P and peripheral

		263. Identify various computer peripherals and connect it to the system. (07 hrs.) 264. Dismantle and assemble the desktop computer system. (05 hrs.) 265. Replace RAM and ROM from CPU. (04 hrs.) 266. Install driver for printer and print document using different commands. (06 hrs.) 267. Identify different parts, its function and operation of modem. (05 hrs.) 268. Install a modem to the computer to send and receive data over a telephone line or a cable or satellite connection. (04 hrs.) 269. Construct and test DAC and ADC using computer network circuit. (06 hrs.)	equipments, terminals, printers, MODEMS, Data interface, ADC and DAC. (14 hrs.)
Professional Skill 50Hrs. Professional Knowledge 14Hrs.	Identifyvariousfunctional blocks of a microprocessorsystem, identifyvarious I/O Ports, write and executive simple program and Interfaceamodel application with the microprocessor kit and run the application.	270. Identify various ICs & their functions on the given Microprocessor Kit. (5hrs.) 271. Identify the address range of RAM & ROM. (2hrs.) 272. Measure the crystal frequency, connect it to the processor. (04hrs.) 273. Identify the port pins of the processor & configure the ports for Input & Output operation. (04hrs.) 274. Use 8085 microprocessor, connect 8 LED to the port, blink the LED with a switch.	Introduction to microprocessor microcomputers, Memories Intel 8085. Architecture Instruction set of 8085, Microprocessor. 1. Data transfer group. 2. Arithmetic group. 3. Logic group. (07hrs.)

		(05hrs.) 275. Familiar with instruction set of 8085 microprocessor Data transfer group, Arithmetic group and Logic group. (05hrs.)	
		276. Perform addition and subtraction of two 8-bit numbers using 8085 microprocessors. (05 hrs.) 277. Demonstrate entering of simple programs, execute &monitor the results. (08 hrs.) 278. Write a programme in assemble language load accumulator with 8-bit data and transfer the data accumulator to B register. (03 hrs.) 279. Write a programme in a assemble language data to load two 8-bit data into two memory location add them result be store in another memory location. (04 hrs.) 280. Identify different parts, pins diagram, function and operation of 8255. (05 hrs.)	Basic Programming of 8085 such as adding, subtraction of two 8-bit numbers, etc. Block diagram and pin' diagram 8255 and its operation. Microprocessor applications. (07 hrs.)

Project Work/Industrial Visit (optional)

Broad Areas:

a) Regulated & Unregulated Power Supply
b) BatteryMonitor& Charger
c) EmergencyLight
d) Electronic Fan Regulator
e) SCR, Using UJT Trigger Circuit.
f) Dimmer circuit using Triac and Diac.
g) DancingLEDs
h) DigitalClock
i) EventCounter
j) A to D Convertor.

SYLLABUS FOR INSTRUMENT MECHANIC TRADE			
SECOND YEAR			
Duration	**ReferenceLearning Outcome**	**Professional Skills (Trade Practical) With Indicative Hours**	**Professional Knowledge (Trade Theory)**
Professional Skill 75 Hrs. Professional Knowledge 27 Hrs.	Identify the parameters of measurement systems. Identify, select, test, wire & Execute the operation of different process sensors by selecting appropriate signal conditioning for stress, strain, load displacement and Thickness.	281. Identification of various instruments by their specifications. (04hrs.) 282. Finding the range, span and accuracy of instrument (example- ammeter, voltmeter etc.). (04hrs.) 283. Identifying the measuring units of instrument and Calculating resolution, multiplication factor of meter (multirange meter or analog multimeter). (04 hrs.) 284. Test the voltmeter/ammeter using std. voltage/ current source for total range. Check the dead zone, repeatability, reproducibility,drift,Dead band,backlash, hysteresis. (09 hrs.) 285. Check the speed of response and lag of measuring instruments. (04 hrs.) 286. Identify the strain gauge type, cantilever or load cell specification. (04 hrs.) 287. Check the strain gauge using ohm meter / multimeter. (04 hrs.)	Scopeandnecessityof instrumentation. Fundamentalsofmeasurement 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. Temperature&electricalunits. Instrument characteristics Staticcharacteristics– accuracy, precision, sensitivity,resolution dead zone, repeatability, reproducibility,drift,Dead band,backlash, hysteresis. Dynamiccharacteristics– speed response,fidelity,lag. Error,deviation,true value, data. Types of errors- systematic, random& illegitimateerror. Certainty/uncertainty, validity Of result.Measuring system Response.Introduction, amplitude responses, Phase

		288. Measure the load using strain gauge instrument. [using half (two), quarter(one), full (four) strain gauges on bridge]. (04 hrs.) 289. Determine the sensitivity, liner range of strain gauge measurement. (04 hrs.) 290. Make null balance and gain adjustment. Calibrate strain gauge instrument by adjusting zero and span. (04 hrs.) 291. Identifying the various parts of LVDT. Study the specification of LVDT like range, exiting frequency, voltage, sensitivity etc. (04 hrs.) 292. Identifying the coils in LVDT. Verifying the connection of secondary coils. Testing the LVDT coils using multimeter. (03 hrs.) 293. Verify the LVDT characteristics by changing the displacement. (04 hrs.) 294. Determine the liner range and sensitivity, resolution of LVDT. (04 hrs.) 295. Measure the phase difference of LVDT secondary coils on CRO. (04 hrs.) 296. Calibrate the LVDT by adjusting zero and span. (03 hrs.) 297. Identify Construction	response, Delay,risetime&slew rate. Damping&its importance. Statisticalanalysis – arithmetic mean,deviation fromthe meanaverage deviation, standard deviation. Stress &Strain Measurement. Introduction toStrain gauges, types ofstraingaugesand differences. Applicationsof straingauges,load cells. LVDT, RVDT,advantages andlimitations. (27hrs.)

		&Operation of instruments used for Displacement, Acceleration, and Thickness. (03hrs.) 298. Test and calibrate displacement meter, accelerometer and thickness instruments. (05hrs.)	
Professional Skill 50 Hrs. Professional Knowledge 18 Hrs.	Select, Installs, services and calibrate instruments for motion, speed, position, acceleration, vibration & record the data.	299. Identify different parts, its function &Operation of vibrometers and accelerometer and Study of Construction. (07hrs.) 300. Measure the vibration of motor/ machine. (06hrs.) 301. Servicing and maintenance vibrometers & accelerometer. (07hrs.) 302. Identify different parts, its function &Operation of mechanical tachometer and Study Construction. (06hrs.) 303. Measure the speed of motor. (05hrs.) 304. Identify different parts, its function &Operation of eddy current, type AC and DC tachometer. (08 hrs.) 305. Servicing and maintenance of mechanical and electrical tachometer. (06 hrs.) 306. Identify different parts/section, its function &Operation and useStroboscope and find motion of object. (05hrs.)	Measurementofmotion, velocity / vibrometersand acceleration. Difference betweentachometer and speedometers. Types oftachometers-Eddy currenttype, AC and DC tachometer.Stroboscope and its applications. seismic instrument. (18 hrs.)
Professional Skill 150Hrs.	Identify different unit of pressure,	307. Familiar with different unit of pressure and conversion.	PrincipleofPressurein Liquids&Gases.Propertiesof

Professional Knowledge 54Hrs.	terms and operation of basic instruments. Perform maintenance, Servicing calibration and installation of field pressure gauges, switches, electronic pressure indicators and transmitters for absolute, atmospheric, gauge, vacuum and differential pressure measurement.	(02 hrs.) 308. Study the specifications, construction and identifying various parts of android barometer. (04 hrs.) 309. Measure the atmospheric pressure using barometer. (04 hrs.) 310. Check the changes in barometer by applying the air using suction and blow pumps (simple pumps). (03 hrs.) 311. Identify the various types of manometers. (02 hrs.) 312. Identify specification and construction of each manometer and find their range, scale type, resolution, type of liquid using, tube material, isolation valve types, fitting types and sizes, zero adjustment and spirit bubbler etc. (02 hrs.) 313. Measure the differential pressure, gauge pressure and vacuum pressure using U tube manometer. (02 hrs.) 314. Measure gauge and vacuum pressure using well type and inclined manometer. (02 hrs.) 315. Dismantle and assemble the manometer. Cleaning the glass tube, aligning the gravity balances etc. (02 hrs.)	matterPrinciplesofliquid pressure, units of pressure Liquids pressureandvolume, densityand specificgravity. Factorsaffecting liquid pressure.Pressure relationwith volume,temperatureandflow. Units ofpressureand unit conversions. Types ofpressure:absolute, gauge, atmospheric andvacuum pressuresand their relationships. Barometers,manometerstypes andapplications. (09hrs.)

		316. Calibrate the manometer using standard gauge. (02 hrs.)	
		317. Identify the various types of pressure gauges – gauge pressure, vacuum pressure, absolute, compound etc.(04 hrs.) 318. Identify the basic specifications of gauge like range, resolution, size of dial, type of sensor (symbol), sealed type, liquid filled or dry, number scales, connection type, threading size and type-(male, female NPT/SAE), body material, mounting type (back or bottom) etc. (03 hrs.) 319. Dismantle and assemble the pressure gauge (bourdon tube, diaphragm type), Identify the various parts like sensing element, link, liver, pinion gear, hair spring, pointer size shape material, sensor material etc.(03 hrs.) 320. Measurement of gauge pressure and vacuum pressure using bourdon tube / diaphragm gauge.(03 hrs.) 321. Measurement of differential pressure using diaphragm/ capsule gauge.(02 hrs.) 322. Identify specifications of pressure switch – range, differential pressure span,	Types of pressure sensing elements-bourdon tube, diaphragms, capsules, and bellows. Eachontypes, shapes, material used for various applications, ranges advantages and limitations. Pressureswitches typesand applications. (09hrs.)

		contact types, contacts current rating, number of contacts etc.(02 hrs.) 323. Dismantle and assemble the pressure switch – identify the various parts- sensing elements, control spring, pressure and differential pressure adjustment screws, shaft arrangement pivoting, contacts relay operation and change of contacts. Type of material using for various parts etc. (04 hrs.) 324. Connect and operate the pressure switch with load at various pressure and differential pressure settings. Make adjust the errors screws. (04 hrs.)	
		325. Identify the basic specifications of pressure indictor/ transmitter (electronic) like range, resolution, size of display, type of sensor (symbol), sealed type, number scales, connection type, tap threading size and type- (male, female NPT/SAE), body material, mounting type (back or bottom) etc. (05 hrs.) 326. Test and operating the pressure transmitter with supply, milli ammeter, pressure source (pneumatic/hydraulic).	Electricalpressure transducers. Method of conversion, primary and secondary pressure transducers. Potentiometricpr. Transducers, Capacitivepr. transducers, reluctance-servo pressure transducers, strain gauge pressure transducers, piezo electric pressure transducer. Differentials pressure transducers. (09hrs.)

		Finding the resolution, accuracy etc.(04 hrs.) 327. Familiar with pressure calibrator controls and settings. (04 hrs.) 328. Calibrating the pressure gauge using standard meter/ pressure calibrator. (04 hrs.) 329. Measuring gauge, vacuum and differential pressure using DP transmitter. (04 hrs.) 330. Calibrating the DP transmitter using standard meter / pressure calibrator. (04 hrs.)	
		331. Study the specification, construction and identification of various parts in Mcleod Gauge. (03 hrs.) 332. Measuring low pressure/ vacuum using McLeod gauge. (03 hrs.) 333. Study construction, Operation and use of thermalconductivity gauges& measure the vacuum. (04hrs.) 334. Study construction, & Operation of piranigauges, & measure the vacuum. (04hrs.) 335. Study specifications, construction, Operation of Standard Calibrator/Dead weight Tester. (03hrs.) 336. Test & calibrate of Pressure	Low Pressure Measurement. Vacuum, gauges, thermal conductivity gauges, pirani gauges, thermocouple gauges, slack diaphragm. Ionization gauge, McLeod gauge, capacitance manometers. Method ofpressure instrument calibration. Dead weight tester and comparators/manifolds. (09hrs.)

		gauges, indicators, transmitters with Dead weight Tester. (04 hrs.) 337. Test & calibrate of Pressure gauges, indicators, transmitters with comparator Tester. (04 hrs.)	
		338. Familiar with pressure Installation components, impulse line, safety guideline and accessories. (06 hrs.) 339. Installation of pressure gauge in pipeline with safety valve and pig tail /siphon etc. measuring pressure in flow line. (07 hrs.) 340. Installation and testing of pressure switch and pressure relief valve with compressor. (08 hrs.) 341. Installation and testing of pressure switch with solenoid and alarm in process line. (06 hrs.) 342. Fault finding in pressure gauge. (08 hrs.) 343. Simple fault finding in pressure transmitter. (08 hrs.) 344. Fault finding in pressure process line. (07hrs.)	Pressure Instrument Installation and Servicing. Elements of pressure transmitters, Installationcomponents, pressuretaps, Isolation valve, instrument piping, connections and fittings blow down valve, instrument valve, pulsation damper, diaphragm seal, pressure transmitter, Installation, procedure, locating and mounting, piping, electrical wiring placing into service, guidelines for periodic maintenance, troubles shooting and repair, instrument shop safety. (18hrs.)
Professional Skill 100Hrs. Professional Knowledge 36Hrs.	Recognize the fundamental of fluid flow, terms, different unit of flow, read specification of flow	345. Familiar with flow units on instruments and converting in various forms. (01hr) 346. Familiar with specifications of flow meter.(02 hrs.) 347. Measurement of pressure in	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, Reynolds number,

	meters. And fluid pump. Perform the maintenance, Servicing and calibration and installation of variable DP flow meters / head flow meters, variable area flow meters, positivedisplacemen tmeters, Electronic type flow meters and mass flow meters for fluids flow measurement.	flow line with different flow rates. (03 hrs.) 348. Measurement of flow rate using fixed volume tank. (02hrs.) 349. Operating fluid pump and observing the pressure at input and output. verifying flow variation by adjusting bypass line. (02hrs.) 350. Study the construction of venturi tube. Measuring inlet outlet thought, tap sizes. Identifying material end connection types etc. (02hrs.) 351. Identifying various types of orifices. Identifying various parts. (02hrs.) 352. Identifying the flow nozzle and identifying various parts. (02hrs.) 353. Identifying the pitot tube and its parts. (01hr) 354. Measurement of DP of venturi and orifice using manometer. (02hrs.) 355. Measurement of DP using DP gauge. (02 hrs.) 356. Adjusting the valves of manifold and observing the changes in DP gauge. (02 hrs.) 357. Calibrating the pneumatic DP transmitter for flow rate measurement. (02 hrs.) 358. Calibration electronic DP transmitter for flow rate. Verifying the square root	relation between flow rate and pressure, area, quantity. Typesof flow meters –head type, variable area type, quantitative flow meters. Mass flow meters. Head type of flow meters: working principle, types- venturi tube, orifice plates and its shapes. Pitot tube, flow nozzles, constructions, tapings, advantages, limitations, applications, materials used for various flows. Types of secondary devices used to measure for flow rates. Open channel flow meters- principle of open channel flow, weirs, notches and flumes. Various shapes and their applications, maintenance, Variable area type flow meter- Rota meter, 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. Positive Displacement. Meters. Advantages and disadvantages of positive displacement meters, piston meter, oscillating piston meter, rotating vane meter, notating disk meter, lobed impeller and oval flow meter, calibrating positive displacement meters.

		relation and linear relation of DP. (02 hrs.) 359. Installing a head type flow meter with venturi or orifice, manifold and DP, milli ammeter or indicator, supply. Measuring flow rate in line. (02hrs.) 360. Calibrating head type flow meter with standard volumetric tank. (02hrs.) 361. Dismantling, checking, overhauling and calibration of D.P.cell/ transmitter. (Pneumatic & electronic). (02hrs.) 362. Identify and carry out preventive maintenance. (02hrs.) 363. Study of construction of weirs,notches andflumes theirshapeandconnectionsa nd use. (03hrs.) 364. Study of construction and identifying various parts of rotameter. (03 hrs.) 365. Dismantling,checking overhauling andcalibration of Rota meters. (05hrs.) 366. Identify and carry out preventive maintenance of Rota meters. (04 hrs.) 367. Install and testing of Rota meters in flow line. Vertical alignment. (04 hrs.) 368. Measurement of flow rate and calibrating rotameter. (03 hrs.) 369. Identification of various	Target flow meters, turbine flow meter, magnetic flow meters, vertex flow meter. Construction, working principle, advantages and disadvantage, applications. Carioles mass flow meter, thermal flow meters and summary basics of ultrasonic flow meters. The Doppler hit method. The beam deflection method, frequency difference method. (36hrs.)

		types of quantitative flow meter. Read the specification of various typesofpositivedisplacemen tmeters. (03hrs.) 370. Dismantle, identify different parts, its function, AND operation of various typesof positivedisplacement meters. (04hrs.) 371. Study the dial of flow meters and calculating flow indicated on display. (03hrs.) 372. Installation, testing and calibrating quantitative flow meter. (03hrs.) 373. Dismantle andassemble quantitative flow meters like Oscillatingpiston type, Rotating vane meter, Lobed impeller andoval flow meter. (03hrs.) 374. Identify and carry out preventive maintenance ofpositivedisplacement flow meters. (03hrs.) 375. Study the specifications, construction and identify the various parts of turbine flow meter. (04hrs.) 376. Installation, testing and calibration of turbine flow meter. (04hrs.) 377. Study the specifications, construction and identify the various parts of vortex flow meter. (04hrs.) 378. Installation, testing and	

		calibration of vortex flow meter. (04hrs.) 379. Study the specifications, construction and identify the various parts of ultrasonic flow meter. (04hrs.) 380. Installation, testing and calibration of ultrasonic flow meter. (04hrs.)	
Professional Skill 25 Hrs. Professional Knowledge 09 Hrs.	Identify, operate, maintain, troubleshoot and calibrate the devices for solid flow measuring system & verify the result within standard.	381. Study the specifications, construction and identify the various parts of mass flow meter. (04 hrs.) 382. Installation, testing and calibration of mass flow meter. (04 hrs.) 383. Measuring semi solid liquid flow rate using flow meter. (04 hrs.) 384. Calibrating and adjustment of flow meter for solid flow. (04 hrs.) 385. Identify and carry out maintenance& preventive maintenance of solid flow measuring system. (05 hrs.) 386. Service and calibrate solid flow meter. (04hrs.)	Meteringtheflowofsolid particles.Measuring volumetricand mass flow rate of solids,volumetricsolids flow meter, mass flow meterfor solids, belt type solid metersbelttypesolidmeters beltspeedsensingand signal processing, slurries, constant weight feeders. (09 hrs.)
Professional Skill 75Hrs. Professional Knowledge 27Hrs.	Identify, select, wire & Execute the operation of different types of level instruments use for liquid level and solid level. Carry out maintenance, Servicing,calibration and Installation.	387. Familiar with open and closed process vessel for liquid and solid measuring system. (02 hrs.) 388. Measurement of liquid level using stick gauge and converting liquid level into volume and mass (using specific gravity). (03 hrs.) 389. Study the construction and	Principles of level measurement. Types of level measurements-solid and liquid, volume and mass, mechanical and electrical type. Surface sensing gauges, storage tank gauges, sightglasses, magnetic gauges, buoyancy, displacement gauges. Factors need to

		operation of various types of sight glasses. (03 hrs.) 390. Installation, testing and calibration of liquid level indicator. (03 hrs.) 391. Cleaning the glass tube and operating the isolation valves, calibrating zero adjustments. (03 hrs.) 392. Identify different parts, its function, and operation of various types of floats and displacers liquid level indicators. (03 hrs.) 393. Calibrating and Measuring the liquid level using float type, displacer type level systems. (03 hrs.) 394. Identify test and use different types of level switches for liquid vessel. (03 hrs.) 395. Identify and carry out maintenance& preventive maintenance of displacers liquid level indicators and switches. (03 hrs.) 396. Measuring the liquid level of open and close tank using pressure / DP gauge. Converting liquid height into pressure using liquid density. (03 hrs.) 397. Calibrating DP transmitter for liquid level measurement. Adjusting square root to linear scale display. (03 hrs.) 398. Installation, testing	consider for open and closed channel level measurements level switches, mercury level switches in high pressure tank, level detectors, magnetic reed switches. Pressure head instruments. Hydrostatic pressure, specific gravity, pressurized fluids, pressure head instrumentation, air bellows, U- tube manometers, air purge systems, liquid purge systems, force balance diaphragm system. Electrical method conductivity and capacitance method for. measuring the liquid level, capacitance probes, zeroand span adjustments, sonic level detectors,point level detection. Solid level measurement Using weight to determine level, sonic solid level measurement with microwaves, using capacitance probes to measure solid level, diaphragm switches, nuclear gauges, microwave solid level detectors. (27hrs.)

		measurement of liquid level using air purge level measurement. (03 hrs.) 399. Service and calibrate different types level indicators and transmitters. (02 hrs.) 400. Identify and carry out maintenance& preventive maintenance of above level indicators and transmitters. (02 hrs.) 401. Construct and operate conductivity probe Level indicator. (03 hrs.) 402. Construction and operation of capacitanceprobes indicating transmitters and sonic level detector. (03 hrs.) 403. Install and test capacitanceprobes indicating transmitters and sonic level detector. (03 hrs.) 404. Service and calibrate capacitance probes indicating transmitters and sonic level detector. (03 hrs.) 405. Identify and carry out maintenance& preventive maintenance of above level indicators and transmitters. (04 hrs.) 406. Study the construction, operation and use of load cell technique todetermine solid level in vessel. (04 hrs.)	

		407. Study the construction, operation and use of different types of solid level switches. (04 hrs.) 408. Study the construction, and operation of capacitance probes transmitters, microwave level detector / gauges. (04 hrs.) 409. Install and test various types of solid level indicating transmitters and sonic level detector. (04 hrs.) 410. Service and calibrate various types of solid level indicating transmitters and sonic level detector. (02 hrs.) 411. Identify and carry out maintenance& preventive maintenance of above level indicators and transmitters. (02 hrs.)	
Professional Skill 25 Hrs. Professional Knowledge 09 Hrs.	List out different unit of temperature, terms and read specification of temperature instruments. Perform measurement,maintenance, Servicing and calibration ofBimetallic and filled system thermometers &thermo switches.	412. Identifying temperature scales on instruments and their ranges Familiar with different unit of temperature and conversion into other. (04hrs.) 413. Identify different types of heating sources and their controls and study the safety futures. (04hrs.) 414. Study the construction, operation and use of temperature-controlledoilbath/furnacefo	Temperature measurement. Temperature,heat, specific heat, changing physical state Fahrenheit and Celsius temperature scales Rankin and Kelvin scales, calibration of temperature scales primary and secondary standards. Industrial application of temperature measuring instruments with compensating link & precautions to be taken. Bimetallic and fluid filled temperature instruments.

		rlowandhightemperature. (02hrs.) 415. Identify different types of thermometers and measure the temperature &Check the accuracy. (02hrs.) 416. Dismantling identify different parts, its function, adjustment, assemble and operation of Bimetallic and fluidfilled (liquid, gas and vapour) system thermometers & thermo switches. (03hrs.) 417. Install and test various types of thermometers and switches. (02hrs.) 418. Service and calibrate various types of thermometers and switches. (03hrs.) 419. Identify and carry out maintenance& preventive maintenance of thermometers and switches. (05 hrs.)	Bimetallic thermometers, liquid-in-glass thermometers, filled system thermometers, thermometer bulbs, capillary & bourdon tube, temperature transmitters for filled system, advantages & disadvantages of filled systems. (09 hrs.)
Professional Skill 50Hrs. Professional Knowledge 18Hrs.	Identify, select, evaluate performance, install, service and calibrate temperature Indicators, Transmitters (RTD'S, Thermistors and Thermocouples types) various type of pyrometers and instruments for humidity.	420. Identify and check different types of RTD's, and Thermistors for temperature measurement. (02hrs.) 421. Verify the characteristics of different types of RTD's, and Thermistors. (03hrs.) 422. Study circuit operation of signal conditioner for RTD's, and Thermistors. (03 hrs.) 423. Install and test various	Electrical temperature instrument. Resistance thermometer, how it works, RTD bridge circuits, lead wire error, RTD elements. (06hrs.)

		types of two and three wire RTD transmitters. (03hrs.) 424. Service and calibrate various types of RTD transmitters using temperature calibrator or resistors. (03hrs.) 425. Identify and carry out maintenance& preventive maintenance of various types of RTD transmitters. (03hrs.)	
		426. Identify and check different types of Thermo-couples,Ex-tension wires and protecting wells. (02hrs.) 427. Verify the characteristics of different types of Thermocouples. (02hrs.) 428. Study circuit operation of signal conditioner for Thermocouples based indicator and transmitters. (03 hrs.) 429. Install and test various types of Thermocouples based indicator and transmitters. (03hrs.) 430. Service and calibrate various types of Thermocouples based indicator and transmitters using temperature calibrator or milli volt source. (03 hrs.) 431. Identify and carry out maintenance& preventive maintenance. (03hrs.)	protecting wells for RTD, advantages and disadvantages of RTDs, thermistors, thermocouples, Ex-tension wires,compensating for changes in reference junction temperature, construction of thermocouple junction, types of thermocouple, advantages and disadvantages of thermocouples. (06hrs.)

		432. Construct and Operate Optical and Radiation pyrometer. (02hrs.) 433. Measure high temperature using Optical and Radiationpyrometer. (02 hrs.) 434. Identify and carry out maintenance& preventive maintenance for Optical and Radiation pyrometer. (02 hrs.) 435. Identify and check different types of humidity sensors. (02 hrs.) 436. Measure the relative humidity using humidity sensors. (03hrs.) 437. Identify specifications, controls and construction of thermal imager. (03hrs.) 438. Measure the various points like motor, drilling point, hill person temperature etc. using thermal imager. (03hrs.)	Pyrometry. Molecular activity and electromagnetic radiation, defining pyrometry, effects of emittance, effects of temperature, wavelength and radiated energy, pyrometers and wavelengths, using of optical and radiation pyrometer, Measurement of humidity. Thermal imagers. (06hrs.)
Professional Skill 25 Hrs. Professional Knowledge 09 Hrs.	Identify, select, Operate, maintain, Service and calibrate different types of recorders.	439. Identify different types of recorders and their connections and controls. (02 hrs.) 440. Practice recording of variable signal. (03 hrs.) 441. Study the construction, operation and use of circular chart recorder for temperature or pressure or mV or mA. (04hrs.) 442. Study the construction, operation and use strip	Recorders. Introduction to recorders, Construction, working principle, various parts installation and use of pneumatic and electronic recorders.Strip-chart, circular chart. (09 hrs.)

		chart recorder-pneumaticand electronic recorders. (04hrs.) 443. Calibrating electronic recorder. (02 hrs.) 444. Calibrating pneumatic recorder. (03 hrs.) 445. Overhaul, check, fault find, repair, test of pneumatic, electronic recorders. (single point &multipoint). (03hrs.) 446. Studyof paperlessLCD/LED recorder. (02hrs.) 447. Identify and carry out maintenance& preventive maintenance. (02 hrs.)	
Professional Skill 50Hrs. Professional Knowledge 18Hrs.	Identify different types ofFinal control elements and role.Identify different valve body, constructional feature, Dismantle, inspectparts, replace parts, recondition, check, andresettingof control valves with actuators, convertors & positioners. Install and test the performance.	448. Identify different final control elements in process control loop. (02 hrs.) 449. Identifying valve regulator, dismantlingand checking various parts.(02hrs.) 450. Study the specifications and construction of valve actuator. (02hrs.) 451. Installation and testing valve actuator (pneumatic) with control valve. (01 hr.) 452. Calibrating valve positioner with control valve.(01 hr.) 453. Study the construction and specifications current to pressure converter.(01 hr.) 454. Calibrating current to pressure converter.(01 hr.) 455. Calibrating voltage to current converter.(01 hr.) 456. Study the specifications and constructions of electro	Final control elements in process loops. Final control elements, actuators, load set Point compensation, feedback loops, control variables, effects of disturbances on performance, parts of final control sub-system, control signal, electric control signals, fluidic control signals, Pneumatic and Hydraulic Actuators. Pneumatic principles, effects of changing pressure, pressure /volume/ temperature relationship, effectsof changing temp. Pneumatic actuators, diaphragm actuator, spring and springless actuators, direct and reverse acting actuator, piston actuator, positioner, Electrical actuators and their advantages. (06hrs.)

		pneumatic positioner.(01 hr.) 457. Installation and testing electro pneumatic positioner with control valve.(01 hr.) 458. Calibrating electro pneumatic positioners with control valve. (01 hr.) 459. Dismantle, fault finding, repair, clean, reassemble and test of actuators and positioners.(01 hr.)	
		460. Identifying various pneumatic Piping tubing andfitting.(01 hr.) 461. Identifying various types of valves. Examine the specifications, construction and various parts of globe, ball, butterfly rotary, split body valves. (02hrs.) 462. Identify the cut sections ofvarious types ofcontrolvalves and identify internal parts and its function.(01 hr.) 463. Record specification of linear, equal, percentage quick opening control valves.(01 hr.) 464. Record the characteristic of control valves.(01 hr.) 465. Remove and install control valves with service line. (02 hrs.) 466. Dismantling, reconditioning, checking, replacing parts and resetting of control	Control valves. Control valves functions and components, types‘ of control valves, based on valve flow characteristics-liner, equal percentage, quick openingvalves, 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, other control valves, control valve mechanical considerations, selecting control valves, valve positioner.(06hrs.)

		valves. (02 hrs.) 467. Carry out maintenance of control valves. (01hr) 468. Identifying the proximity switch and study the specifications, constructions, No. of contacts etc. (02 hrs.) 469. Installation and testing micro and limit switches with the load. Verifying its function. (02 hrs.) 470. Installation and testing capacitance or inductive proxy with the load (buzzer/ indicator etc). testing its function. (02 hrs.) 471. Installation and testing, adjusting the range of IR or ultrasonic proxy with load. (02 hrs.) 472. Installation of proxy with relay and operating high current load (like motor or AC lamp etc.). (02 hrs.)	
		473. Identify cut sections of various types of control valves. (02 hrs.) 474. Identify Feed water control system. (02 hrs.) 475. Identify final control elements in system and manually control feed water rate at desire value. (02hrs.) 476. Operate of, sequential. Control and block valves. (02hrs.) 477. Operate of electromechanical and	Control elements applications. Feed water control system works, sequential. valve control, control and block valves, applying relays in final control elements, relay logic in operation, automatic valve control, controllers and activators, turbine control System, throttle and governor valves and activators. Introduction of internal parts of different types of control valves.(06hrs.)

		solid-state relay. (01 hr.) 478. Service & test and use electromechanical and solid-state relay. (01 hr.) 479. Design and test sequential. Logic operation using relay. (03hrs.) 480. Identify turbine control system operation. (01 hr.)	
Professional Skill 50 Hrs. Professional Knowledge 18 Hrs.	Identify fundamental of automatic control system and various functional elements in control loop. Identify, select, Install, wire, configure, test the performance, maintain, and service various types of ON-OFF and PID controllers (electronicand pneumatic).	481. Familiar with process control system and identify various functional elements. (03 hrs.) 482. Study construction & operation of thermostatic pressure and humidity switches. (02 hrs.) 483. Service and maintenance above switches. (04 hrs.) 484. Install, wire up and test the control operation. (04 hrs.) 485. Study construction & operation of ON-OFF Electronic and pneumatic Controllers. (02 hrs.) 486. Service and maintenance of ON-OFF Electronic and pneumatic Controllers. (04 hrs.) 487. Install, wire up, test and monitor the performance of control operation using ON-OFF Electronic and pneumatic Controllers. (03 hrs.) 488. Practical on PID controller trainer on various process parameters. (03 hrs.)	Introduction tocontrollers. Basic block diagram of control systems. Advantages Process variable and set point, analog controllers, digital controllers, control angles and limits, control loop measuring Pv, amplifying signals final control elements, current proportioning. Hunting&its effect onthe product. Typesofcontrollerandtheir operation. Types of controller, range limit of controllers. (09 hrs.)
		489. Study construction &	ON/OFF controllers, direct and

		operation of PID Electronic / DIGITAL Controllers. (02 hrs.) 490. Service and maintenance of PID Electronic/ DIGITAL Controllers. (04 hrs.) 491. Install, wire up, Configure, test the control operation using PID Electronic / DIGITAL Controllers. (03 hrs.) 492. Verify the steady state and transient responses of PID Electronic / DIGITAL Controllers in P, PI, PD, PID. (04hrs.) 493. Study construction & operation of PID pneumatic Controllers. (02 hrs.) 494. Service and maintenance Of PID pneumatic Controllers. (03 hrs.) 495. Install, connect pneumatic signal, align and test the control operation using PID pneumatic Controllers. (03 hrs.) 496. Verify the steady state and transient responses of PID pneumatic Controllers in P, PI, PD, PID. (04 hrs.)	reverse acting controllers proportional controllers, automatic/manual split control, pneumatic control. Adaptive, limitingand batch control, ratio control system, feed forward, feedback control systems and cascade control system. Comparison between pneumatic and electronic control systems. Basic knowledge on communication protocol.(09 hrs.)
Professional Skill 25 Hrs. Professional Knowledge 09 Hrs.	Tune controller mode and evaluate performance of control loops as per specification and system application	497. Familiar with feed forward and feedback process control system check loop and identify various functional elements. (04 hrs.) 498. Perform the control operation in manual and	Controller models and tuning. Controller tuning, setting, controller modes, proportional mode, off-set, integral mode, reset mode, derivative mode(rate),single, mode controller, two mode controller, three mode

		automatic mode. (04 hrs.) 499. Familiar with Cascadeand ratio process control system. (04 hrs.) 500. Check loop and identify various functional elements. (04 hrs.) 501. Perform the control operation in manual and automatic mode. (05 hrs.) 502. Set "optimum setting for unit process in PID Controller (Electronic and pneumatic). (04 hrs.)	controllers, tuning the control loop, step-change- response method.(09 hrs.)
Professional Skill 50 Hrs. Professional Knowledge 18Hrs.	Identify modules of PLC, its function, Wire and connect the digital I/OS field devices to the I/O Module of PLC,install Software, Hardware and configure plc for operation. Write and execute simple logic and real application programs.	503. Identify each module in a rack and mount in the specified slot. (03 hrs.) 504. Wire and connect the digital I/OS field devices to the I/O Module of PLC. (06 hrs.) 505. Install PLC Programming software and establish communication with PC and PLC. (06 hrs.) 506. Hardware configuration and Prepare the input and output addresses for each slot. (05 hrs.) 507. Prepare and download ladder programs for various switching Gates. (05 hrs.)	Introduction to programmable controllers. History of programmable controllers, general characteristics of programmable controllers, some limitation of PLCs, method of developing PLC programming.(09 hrs.)
		508. Write and execute program logic control operation. (04 hrs.) 509. Develop programs using arithmetic, / data copy operation and execute. (04 hrs.) 510. Write and execute program	Input/output devices. Definition of input /output devices, I/O interface, input modules, output modules, input devices encoders, output devices, the opto-isolators, safety.(09 hrs.)

		on sequence control using timers and counters. (05 hrs.) 511. Develop programs using shift bit operation. (04 hrs.) 512. Interface analog I/p module of plc with sensor. (04 hrs.) 513. Interface analog o/p module of plc with actuator, relay. (04 hrs.)	
		514. Prepare programs based on on-delay and off-delay timers making on and off of a single LED taking one input and one output. (04 hrs.) 515. Two LEDs on and off using pushbutton as an input. first LED on for 3 sec and off for 2 sec, and second Led on for 2 sec and off for 3 sec for continuous cycle till stop is pressed. (04 hrs.) 516. Sequencer task using three LEDs as output and two input pushbuttons one as input (NO) for start and other for stop (NO). (04 hrs.) 517. Configuring the project using analog input and output instructions and implement a on off closed loop control for the given process. (05 hrs.) 518. Development of ladder logic for various tasks related to timers and counter based industrial applications. (04	Processing and programming functions. The processor unit, the memory, memory organization, ladder diagrams, data logger, most used programming symbols, start, stop, station example, other programming symbol timers and counters, data manipulation instructions, alternate PLC symbols. (09 hrs.)

		hrs.) 519. Development of the ladder logic for the running a traffic control with the different display indication. (04 hrs.)	
Professional Skill 50 Hrs. Professional Knowledge 18 Hrs.	Operate, maintain, service, configure, install, WIRE and test HART transmitters /devices (I/O). And Net-working system for instrumentation.	520. Familiar with facilities, function, operation and use HART communicators. (05 hrs.) 521. Study the DD files and uploading DD files.(04 hrs.) 522. Installing & OperatingHART transmitters/devices (I/O).(10 hrs.) 523. Creating tag, measuring the parameter, configuring the parameter values in Hart transmitter using communicator. (04 hrs.) 524. Measure various trends. (02 hrs.)	Digital control systems: need of smart devices, HART transmitters futures, advantages, applications. Working method of HART devices, HART protocol. HART communicators and PC based HART device configuration. Stepsin calibration ofHART devices. Communication. (09 hrs.)
		525. Identify the cables and network components. (02 hrs.) 526. Study various network lines. (02hrs.) 527. Preparation network cables and connectors. Testing network cables. (04 hrs.) 528. Preparation of network cables - serial (RS232/485 standards or equivalent) and Ethernet. (05 hrs.) 529. Connect network connectivity hardware and check for its functioning.	Networking: types of networks used in digital instrument systems. LAN, WAN, Ethernet. Point to point and multi networking. Ring, delta, star connections. Redundant Net. TCP/IP addresses and descriptions. Types of Cable categories (CAT), and their descriptions. Various types of Cable connectors. Advantages and disadvantages of co-axial cable and fiber optic cables. Various tools used in

		(02 hrs.) 530. Dismantle and assemble the desktop computer system. (02 hrs.) 531. Study the operation of Pulse Code Modulation and Demodulation. (03 hrs.) 532. Connect any one data output of the decade counter to the Data Inputs of the FSK Modulator and measure output waveform. (03hrs.) 533. Identify and adjust the frequency of the sampling pulse generator and level of modulating signal to obtain the PWM waveform on CRO. (02 hrs.)	networking- wire cutter, crimp tool, memory blade holder, memory blade cartridge, cable strip tool with blade cassettes. Terminators and extra connectors, taps, calibration tool etc. fundamentals: modulation and demodulation, signal to noise ratio, digital communication basics-PWM, PCM, FSK. (09 hrs.)
Professional Skill 50 Hrs. Professional Knowledge 18 Hrs.	Identify the different modules of DCS, function, Wire and connect I/OS field devices to the I/O Modules, install Software, Hardware and configure DCS for operation with HMI. Write and execute DCS AND SCADA programs FOR real application.	534. Familiar with different faculties and function of DCS system. (03hrs.) 535. Identify the different modules of DCS and different process instruments in process plant. (03hrs.) 536. Wire and connect the I/O Module of DCS to field signals. (04 hrs.) 537. Install DCS Programming software and establish communication with PC and DCS. (05hrs.) 538. Set the communication between DCS and SCADA System. (03hrs.) 539. Concept of Tag/Points Generation. (04 hrs.)	Fundamentals of SCADA and DCS. History of DCS development. Basic architecture, description advantages and disadvantages, applications. Terminology- RTU (remote transmitting unit, central monitoring station, types of communications, field instruments and types. (09 hrs.)

		540. Attaching points to the display Element. (03 hrs.)	
		541. Practice HMI, operator panel and touch panel operation and related software. (10hrs.) 542. Set up and configure HMI with PLC. (05hrs.) 543. Animate objects on a HMI screen to monitor motor status. (05hrs.) 544. Use security features to do tag logging and command execution. (05hrs.)	Field bus: futures, advantages, architecture, basic block diagram, working. Work station, Human Machine Interface (HMI). Controller (with basic types), filed bus interfacing modules, gateway, network manager, I/O modules, field bus devices (I/0), remote transmission panel (RTP), Ethernet. Electronic device description language (EDDL) and device description (DD). Field bus power supply and its function. Introduction of digital and multi drop communication protocol Vendors. Futures- library, call up, various visualized futures, Reports (alarms, events), history, trading etc. (09 hrs.)
Professional Skill 50 Hrs. Professional Knowledge 18 Hrs.	Identify, check constructional Feature and function of hydraulic pump, and hydraulic power system, accumulator, hydraulic hoses and fitting, Hydraulic components. Build AND test hydraulic control circuit.	545. Familiarization of - Hydraulics trainer and safety measure to handle hydraulic system. (02hrs.) 546. Practice symbolic representation of Hydraulic components. (04hrs.) 547. Familiar with hydraulic hoses and fitting. (04hrs.) 548. Feature and function of hydraulic pump and hydraulic power system. (5hrs.) 549. Feature and function of	BasicHydraulics: Principles of Hydraulics.Fluid power andhydraulics, force, weight and mass,pressure,work,power, energy,incompressibility and non-diffusion,hydrostatic pressure, Pascal'slaw, transmission of fluid power, fluid flow in pipes, Bernoulli's principle, the effect of heat on liquids. A typical hydraulic power system. Hydraulic Fluids. Functions of

		hydraulic accumulator. (5hrs.) 550. Identification Hydraulic components and check its function. (03hrs.) 551. Service and test different types of valves. (02hrs.)	Hydraulic fluids, physical properties, viscosity, viscosity index, viscosity and pressure, power point, fluid selection, component protections, chemical properties, system contamination, water, dissolve air, foaming, corrosion and rusting, types of hydraulic fluids. (09 hrs.)
		552. Design hydraulic circuit for double acting cylinder actuation. (04 hrs.) 553. Calculation relating to cylinder motion. (02 hrs.) 554. Design hydraulic circuit using Pilot operated check valve. (04 hrs.) 555. Design hydraulic circuit using Pressure reducing Valve. (04 hrs.) 556. Design hydraulic circuit Using Pressure relief & Pressure regulating valve. (04 hrs.) 557. Design hydraulic Pressure sequencing circuit. (04 hrs.) 558. Design hydraulic circuit using Pressure compensated flow control. (03 hrs.)	Directional control valves. Directional control valve classification, review of two way valves, 'globe, gauge, plug, needle, ball, automatic two way valves, check valves, pilot operated check valves, spool valves, three ways pool valves, controlling hydraulic motors, NO and NC valves, holding valves, four and five way valves, rotary spool valves, schematic symbols, flow ratings, accessories. (09 hrs.)
Professional Skill 50 Hrs. Professional Knowledge 18 Hrs.	Lay out construction feature, operate, maintain of air compressor, air Distribution system, pneumatic associate components, piping,	559. Study construction operation and use of air compressor. (04 hrs.) 560. Identify different devices in air Distribution system and study construction. (04 hrs.) 561. Operation and use of air	Pneumatic principles, mass, pressure, work and energy, compressibility, law of pneumatics, transmission of pneumatic fluid power, pneumatic leverage, air properties, airflow in pipelines,

	tubing and fitting. Build and test pneumatic control circuit.	filters, regulators and lubricator. (6 hrs.) 562. Practice and use ofPneumatic Piping, tubingandfitting. (Metallic and non-metallic.) (5 hrs.) 563. Draw Symbolic representation of different Pneumatic components, various supply elements such as Compressors, pressure regulating valve, service unit etc. (6 hrs.)	viscosity of air pressure, Bernoulli'slaw, components of pneumatic power system. Primaryairtreatment.Air treatment,preliminary filtering, relative. Humidity, effects of moisture, waterremoval, dew point,moisture separators,oil scrubbers, air dryers, (deliquescent and absorption type) air receivers. Secondary air treatment. Methods of treatment, Contaminate separation, contaminate filtration and filter classification and rating, types ofmedia surface filters, depth filters, absorption filters,Lubricatingtheair. (09 hrs.)
		564. Set up a system to provide Pneumatic (air) supply of 20 psi output from the available compressor. (02 hrs.) 565. Build a pneumatic circuit of a single acting cylinder being controlled by 3 way 2 position directional control valves.(02hrs.) 566. Build a pneumatic circuit of a double acting cylinder being controlled by 5 way 2 position directional control valves.(02 hrs.) 567. Build a pneumatic AND,OR circuit by 3 way 2 position directional control valves to operate double acting	Piping houses and fittings. Requirement of piping, airflow, piping dimensions and safetyfactors, piping connections,compressed air piping applications, metallic tubing, tubing bending and tubefitting, tube installation, nonmetallic tube houses, hose fittings and coupling, hose installation. (09 hrs.)

		cylinder.(02 hrs.) 568. Build a pneumatic circuit of a pilot controlled double acting cylinder of being controlled by 3 way **2** position directional control valves and **5** way **2** positions valve. (04 hrs.) 569. Build a pneumatic circuit to test logical latch circuit by 5 way 2 position, 3 way **2** valve direction control valves. (03hrs.) 570. Build a pneumatic circuit to control oscillation of piston by pilot operated 5 way 2 position, 3 way **2** direction control valves. (04 hrs.) 571. Cutting the metallic tube as per dimensions using tube cutter.(02hrs.) 572. Bending the tube in to $90^0$and 45^0 using pipe bending tools.(02hrs.) 573. Installation of simple piping diagram.(02hrs.)	
Professional Skill 25 Hrs. Professional Knowledge 09 Hrs.	Identify constructional feature, operate, maintain, service and calibrate of Analyticalinstruments.	574. Study the circuit operation of pH meter conductivity meter and dissolved oxygen Meter.(02 hrs.) 575. Wire up pH meter electrode to pH meter. (02 hrs.) 576. Calibrate pH meter using buffer solution. (05 hrs.) 577. Determination of pH (by pH meter). (05 hrs.) 578. Wire up conductivity meter to electrode and find the electrolytic conductivity of	Analyticalinstruments. Exposuretobasicanalytical instruments. Typesof electrodesusedforPH measurements.RelationofPH andmV.PHindicatorand controllers.Conductivity meters.Dissolvedoxygenmeter . (09 hrs.)

		solution. (06 hrs.) 579. Service and maintenance of conductivity meter&Dissolvedoxygen meter. (05 hrs.)	

Project Work/Industrial Visit

Broad areas:

a) Automatic waterlevelcontroller.
b) On- Off temperature controller.
c) Speed controller.
d) Steppermotorcontrol.
e) Safety alarm system.
f) Automatic door system.
g) Event control.
h) Humidity control.
i) Built a pneumatic control for double acting cylinder.
j) Regulated & Unregulated Power Supply
k) BatteryMonitor& Charger
l) EmergencyLight
m) Electronic Fan Regulator
n) SCR Using UJT Trigger Circuit.
o) Dimmer circuit using Triac and Diac.
p) DancingLEDs
q) DigitalClock
r) EventCounter
s) A to D Convertor.