7. TRADE SYLLABUS

SYLLABUS FOR REFRIGERATION & AIR CONDITION TECHNICIAN TRADE			
FIRST YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hrs..**	**Professional Knowledge (Trade Theory)**
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Identify trade related hazards and safety procedures following safety precautions.	1. Identify workshop & machineries. (06 hrs.) 2. Demonstrate Safety precautions and First aid. (06 hrs.) 3. Demonstrate fire fighting (03 hrs.) 4. Demonstrate working at height using PPE's and identify the hazards and take personal safety precautions. (10 hrs.)	Introduction to trade and related industries. General safety precautions and first aids, firefighting equipment and electrical safety. History of Refrigeration and Air conditioning. Function, use and specifications of refrigeration tools, instruments and equipment. Grooming of technicians.(07 hrs..)
Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.	Produce fitting jobs as per drawing (Range of operations: marking, sawing, filing, drilling, reaming, taping and dieing etc.).	5. Identify general tools, instruments & equipment. Care and maintenance of tool, instruments and equipment. (10 hrs.) 6. Perform flat filing, marking, punching and hack sawing to make a job as per drawing. (15 hrs.)	**Fitting** Different types of Fitting hand tools, power tools, - their use. Function, construction, Specification & their application. Machineries and equipment used in fittings like drilling machines, grinding machines – types, specifications and care and maintenance. (07 hrs..)
		7. Perform flat filing, marking, punching, hack sawing, drilling, tapping, reaming, dieing to make a job as per drawing and check using	**Fitting** Precision measuring instruments – Function, construction, Specification & their application.(07 hrs..)

		precision measuring instruments Viz. Vernier calliper, Micrometer, etc. (25 hrs.)	
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Produce Sheet metal components (range of operation – marking, metal cutting, bending, riveting and soldering etc.)	8. Perform Sheet Cutting by straight snip as per drawing. (02 hrs.) 9. Perform Sheet Cutting by bent snip as per drawing. (02 hrs.) 10. Bend, fold and join metal sheets in different process. (03 hrs.) 11. Join sheet metal by using rivet set and snap. (08 hrs.) 12. Solder sheets of metal. (02 hrs.) 13. Prepare a box or funnel with sheet metal as per drawing. (08 hrs.)	**Sheet Metal** Function, construction, working, use, and application, specification of Sheet metal tools, instruments and equipment. Care and maintenance of tools. Types of sheet metal joints (cold and hot) and their use. Rivet & riveting- their types and use. Solder and its composition. (07 hrs..)
Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.	Identify electrical safety. Join different wire, measure power, currents, volts and earth resistance etc. Connect single phase, 3 phase motors i.e. star and delta connections.	14. Demonstrate Electrical safety precautions and First aid. (03 hrs.) 15. Identify, use and maintain electrical tools. (03 hrs.) 16. Prepare simple twist joints of wires. (03 hrs.) 17. Prepare married joints of wires. (03 hrs.) 18. Measure current, voltage, resistance, power, frequency, energy using analog and digital meter through a single phase circuit. (08 hrs.) 19. Test insulation and earth resistance using Megger. (05 hrs.)	**Electrical** Electrical terms such as AC and DCsupply, Voltage, Current, Resistance, Power, Energy, Frequency etc. Safety precautions to be observed while working on electricity. Conductors and Insulators, Materials used as conductors. Series and parallel circuit, open circuit, short circuit, etc. Measuring Instruments such as voltmeter, ammeter, ohm meter, watt meter, energy meter and frequency meter. Earthing and its importance. Earth resistance.

			Insulation and continuity test.(07 hrs..)
		20. Star & Delta connection on a three-phase motor and show line voltage, line current, phase voltage and phase current. (15 hrs.) 21. Three phase power & power factor measurement. (10 hrs.)	Inductors and capacitors. Effects of inductor and capacitors in an AC circuit. Inductive reactance, capacitive reactance, Impedance and power factor. Lagging and leading power factors. Single phase and Three phase supply system. Star and Delta connection and their comparison. Line voltage, Line current, Phase voltage and Phase current. Methods of improving power factor. (07 hrs..)
Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.	Identify the electronic components and their colour code i.e. transistor, capacitor, diode, amplifier, I.C and able to work soldering.	22. Identify electronic components, tools & instrument. (05 hrs.) 23. Colour coding of resistors. (03 hrs.) 24. Verify Ohm's Law. (02 hrs.) 25. Use voltmeter, ammeter and multimeter. (5 hrs.) 26. Practice soldering & de-soldering. (10 hrs.)	**Electronics** Introduction to Electronics. Basic Principles of semiconductors, Principles and application of Diodes. Solder – its composition and paste. (07 hrs..)
		27. Identify transistors, resistors, capacitors, diodes, S.C.R., U.J.T., amplifier and I.C. (03hrs.) 28. Construct and test full wave rectifier using diodes. (02hrs.) 29. Construct and test a bridge rectifier. (03hrs.) 30. Construct and test series voltage regulator circuit.	Rectification, Zener diode as voltage regulator – transistors parameters- CB, CE, CC, configuration, amplification. SCR Photo diodes, photo transistors, multi – vibrator, CR & LR circuit. SCRs, UJTs, ICs. (07 hrs..)

		(02hrs..) 31. Construct and test power supply using fixed voltage regulator ICS. (05hrs.) 32. Identify and test SCR. (02hrs.) 33. Construct and test an electronic timer using UJT & SCR. (03hrs.) 34. Apply OP-AMP, photo transistor and test performance. (05hrs.)	
Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.	Perform gas welding, brazing, soldering observing related safety.	35. Identify gas welding equipment & accessories. (03 hrs.) 36. Demonstrate safety precaution in handling of Oxy-acetylene cylinders, regulators etc. (03 hrs.) 37. Setting up of AIR-LPG, O_2-LPG and O_2-C_2H_2 using can type portable flame set. (04 hrs.) 38. Oxy-acetylene gas welding, brazing and cutting on thin sheet metal. (10 hrs.) 39. Demonstrate Care & Safety of welding tools and equipment. Back fire arrester. (03 hrs.) 40. Set Oxy-acetylene plant, use two stage regulator, adjustment of flame, gas pressure – O_2 and DA. (04 hrs.) 41. Perform brazing between Cu to Cu and Cu to MS, Cu to aluminium pipes. (10 hrs.)	**Welding** Introduction to basic principles of commonly used Welding processes, oxy fuel gas welding / cutting, brazing & soldering, nozzles, base metal and filler metal. Use of flux. Welding tools and equipment type specification and use. Safety method in welding. Method of gas welding, gas used and flames adjustment and pressure setting of O_2 and DA. Difference between soldering and Brazing in terms of temperatures, filler materials, joint strengths andapplication. Use of Oxy Acetylene, Oxy LPG, Air LPG and two stage regulators for brazing/soldering. Description of back fire arrester. (14 hrs..)

		42. Join metal plates by using gas welding (lap joint, butt joint, etc). (13hrs.)	
Professional Skill 100Hrs.; Professional Knowledge 28Hrs.	Identify RAC tools and equipment and recognize different parts of RAC system. Perform copper tube cutting, flaring, swaging, brazing.	**Basic Refrigeration** 43. Identify & use of general hand tools, instruments & equipment used in refrigeration work. (12hrs.) 44. Identify & use of special tools, instruments & equipment used in refrigeration work.(13hrs.)	**Basic Refrigeration** Basic principle of refrigeration, working, use, specifications of refrigeration tools, instruments and equipment. Fundamentals of Refrigeration, units and measurements, Pressure & its Measurements. Thermodynamics law.(07 hrs..)
		45. Identify various refrigeration equipment and components of vapour compression system like compressor, condenser, expansion device and evaporator.Identify and Check vapour absorption refrigeration cycle (VARC) (12 hrs.) 46. Unroll, cut and bend soft copper tubes. (04 hrs.) 47. Swage and make a brazed joint on copper tubing. (10 hrs.) 48. Make flare joints and test them with flare fittings. (10 hrs.) 49. Pinch off copper tubing. (04 hrs.) 50. Use lock ringtool and various fittings of lockring for servicing of appliances. (10 hrs.)	Science related to refrigeration, work, power, energy, force, Heat and Temperature, Different temperature scales, Thermometers, Units of heat, sensible heat, latent heat, super heating and sub-cooling, saturation temperature, pressure, types, units. Types of Refrigeration systems, includingVapour absorption refrigeration cycle (VARC), water – combination. Study the construction and working of vapor compression cycle, low side & high side of vapour compression system. Applications of vapour compressioncycle.Coefficient of Performance (COP), Ton of Refrigeration.(14 hrs..)

		51. Brazing of Cu to Cu, Cu to steel, Cu to brass using AIR LPG suitable in RAC machine. (07 hrs.) 52. Brazing of Cu to Cu, Cu to steel, Cu to brass using Oxy-LPG. (07 hrs.) 53. Brazing of Cu to Cu, Cu to steel, Cu to brass using Oxy-Acetylene. (11 hrs.)	Construction and working of V.C Cycle, fundamental operations, sub cooling and super heating. Study of Ph, Ts, Pv diagram.(07 hrs..)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Test mechanical & electrical components. Perform leak test, vacuuming, gas charging, wiring & installation of refrigerator.	54. Identify electrical and mechanical components of refrigerator. (03 hrs.) 55. Check and replace electrical components of refrigerators. (04 hrs.) 56. Leak test, evacuation, gas charging in refrigerators. (08 hrs.) 57. Wiring circuit of refrigerator. (08 hrs.) 58. Installation of refrigerator. (02 hrs.)	**Refrigerator (Direct cool)** Function, construction, working of single door direct cool refrigerator, specifications, trouble shooting, care and maintenance. Requirement of Vacuum and level of vacuum. (07 hrs..)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Perform door alignment, door gasket fitting, replace door switch.	59. Identify electrical components of direct cool refrigerator. (05 hrs.) 60. Identify mechanical components of direct cool refrigerator. (05 hrs.) 61. Installation of refrigerator. (02 hrs.) 62. Checking door alignment, adjustment of door switch operation & replacing of gaskets. (03 hrs.) 63. Tracing the mechanical components of refrigerator. (03 hrs.)	**Refrigerator (Directcool)** Study the construction &working of direct cool Refrigerator. Study the electrical components of refrigerator. Study the mechanical components of refrigerator and their types. Study the heat exchanger, door gaskets, Heat Insulation materials Care and maintenance of refrigerator. (07 hrs..)

		64. Check, Find Fault and test the electrical and other system components of refrigerator. (07 hrs.)	
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Test compressor motor terminal, start compressor Direct with relay & without relay, technique of flushing, leak testing, replacing capillary & filter drier, evacuation & gas charging.	65. Testing of compressor. (02 hrs.) 66. Identification of motor terminals. (02 hrs.) 67. Start of compressor with and without relay. (03 hrs.) 68. Test performance of direct start refrigerator. (02 hrs.) 69. Cleaning and flushing of evaporator and condenser with dry nitrogen. (02 hrs.) 70. Replacement of capillary tube and drier. (02 hrs.) 71. Installation of gauge manifold in the system. (02 hrs.) 72. Leak testing, evacuation and gas charging in refrigerator. (05 hrs.) 73. Check electrical wiring of refrigerator. (05 hrs.)	Importance of flushing in evaporator and condenser, use of dry nitrogen for flushing, necessity of replacing capillary and drier. Evacuation, leak testing, gas charging method in refrigerator, Refrigerants used in Refrigerators and its properties. Desiccant drying agent. (07 hrs..)
Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.	Check components of frost-free refrigerator (electrical / mechanical), wiring of frost-free freeze & air distribution in refrigerator sector. Leak detection, evacuators & gas charging.	74. Tracing electrical circuit of Frost-Free refrigerator. (07 hrs.) 75. Checking, fault finding and testing of electrical accessories like thermostat, timer, defrost heaters, bi-metal, air louvers etc. and other system components. (10 hrs.) 76. Checking air distribution system. (03 hrs.) 77. Servicing of refrigerator. (03	**Frost Free Refrigerator** Study the construction and working of Frost Free (2 or 3 door) Refrigerator parts particularly, the forced draft cooling, Air Duct circuit, temperature control in Freezer & cabinet of Refrigerator, air flapper / louver used in refrigerator section, automatic defrost system. Study of Electrical accessories & their functions

		hrs.) 78. Testing the performance of refrigerator. (02 hrs.)	(Timer, Heater, Bimetal, Relay, OLP, T/S etc.) Refrigerator cabinet volume calculation. (07 hrs..)
		79. Identify three and four door no frost refrigerator. (07 hrs.) 80. Stripping of components. (07 hrs.) 81. Tracing electric circuit. (03 hrs.) 82. Testing components. (03 hrs.) 83. Leak testing, evacuation, gas charging. (05 hrs.)	**Refrigerator (Inverter Technology)** Study the construction and its workingof two and three door frost free refrigerator Care and maintenance, installation method. (07 hrs..)
Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.	Dismantle, repair and assemble hermetic, fixed and variable speed compressor, and test performance.	84. Acquainting with hermetic compressor of Refrigerator or window type AC. (02 hrs.) 85. Cut the compressor and dismantle. (05 hrs.) 86. Identify different compressor and Service it. (06 hrs.) 87. Lap necessary parts and cut the gasket. (05 hrs.) 88. Assemble the compressor with the new gasket. (07 hrs.)	**Compressor** Function, construction, working,application of compressor,(Fixed speed and variable speed compressor) like Reciprocating, rotary, scroll and inverter type. (07 hrs..)
		89. Dismantle rotary / wobble plate/ swash plate/scroll compressor. (07 hrs.) 90. Identify different parts of dismantled compressor. (08 hrs.) 91. Rectify defects and repair accordingly. (10 hrs.)	Study the construction & working of reciprocating, rotary, scroll, screw and centrifugal compressor, wobble & swash plate compressor. Compressor efficiency factors, wet compression, oil, properties, lubrication methods. (07 hrs..)

Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.	Identify the terminals of sealed compressor and their wiring and measure current, volts, watts and use of DOL starter with different types of motors.	92. Identify terminal sequence of hermetic compressor motor by using digital multimeter and start by DOL starter and measure starting current and running current by using ammeter and AVO meter. (12 hrs.) 93. Identification of terminal sequence of CSIR motor by using digital multimeter and start by DOL starter and measure starting current and running current by using Ammeter and AVO meter. Direct start using ammeter and voltmeter. (13 hrs.)	AC motors and their types. Advantages of AC motor over DC motor. Revolving field theory. Phase splitting theory. Capacitor method and inductor method used to split the single phase. Torque – starting torque and running torque. Split phase induction motors, working principle and construction. Starting winding and running winding. Starting current and running current. Method of changing the direction of rotation (DOR).Capacitor starts induction run motor, working principle and construction. Centrifugal switch and its function. Starter and its necessity.DOL starter and the safety devices incorporated in it. Description of hermetic compressor motor.(07 hrs..)
		94. Start CSR motor through DOL starter and measure starting current and running current and changing of DOR. (07 hrs.) 95. Start shaded pole motor through DOL starter and measure starting current and running current and changing of DOR, dismantle motor identify parts	Capacitor starts capacitor run motor, working principle and construction. Starting capacitor and running capacitor Shaded pole motors, working principle and construction. Torque comparison among various single-phase AC motors. Common faults, causes and remedies in motors. (07 hrs..)

		andassemble. (18 hrs.)	
Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.	Perform selection of Hermetic compressor for different appliances, starting methods, testing controls & safety cut out used in sealed compressor.	96. Select a hermetic compressor of any kind. (04 hrs.) 97. Start the compressor motor by RSIR, CSIR, PSC & CSR method by using different type relay, capacitors, OLP's, etc. (10 hrs.) 98. Check and Test different type relay, Capacitors, OLP's, find out fault, rectify and install. (11 hrs.)	**Motors** Motors used in refrigeration And Air conditioning system, types, construction, working & their starting methods. Function of Starting relay, Capacitors, OLP's. (07 hrs..)
		99. Identify the terminals of a Squirrel cage induction motor. (06 hrs.) 100. Start the motor through DOL starter and measure starting current, running current and show changing of DOR. (05 hrs.) 101. Start the motor through Star Delta or Auto transformer starter and measure starting current, running current and show changing of DOR. (04 hrs.) 102. Familiarise with Slip-ring induction motor and identify it's terminals. (04 hrs.) 103. Start the Slip-ring induction motor through Rotor resistance starter and measure starting current, running current and show changing of DOR. (03 hrs.) 104. Rectify fault through	Production of rotating magnetic field by three phase AC supply. Working principle of three phase induction motor. Terms such as torque, slip, rotor frequency and their relation. Construction of squirrel cage induction motor. Importance of phase sequence. Construction of slip ring induction motor Comparison between SCIM and SRIM. Three phase motor starters such as DOL starter, Star – Delta starter, Auto transformer starter and Rotor resistance starter. Common faults, causes and remedies in three phase AC motors. (07 hrs..)

		insulation test, continuity test, open circuit test and short circuit test. (03 hrs.)	
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Identify the components of control system of Inverter AC and wiring of control system.	105. Explain control circuit of variable speed air conditioners (Inverter ACs). (08 hrs.) 106. Identify components of control system of Inverter ACs including printed circuit board (PCB) NTC,PTC e.g. Power PCB, Filter PCB, Heat sink reactor. (08 hrs.) 107. Wiring of the control system. (09 hrs.)	Working principle of inverter technology, advantages of variable speed technology over fixed speed. Working principle of control system for inverter Air Conditioners (ACs). Printed circuit board (PCB), including power PCB, filter PCB, heat sink and reactor. Wiring diagram. (07 hrs..)
Professional Skill 75 Hrs.; Professional Knowledge 21 Hrs.	Perform servicing & de-scaling of condenser (internals &externals) used in different appliances. Perform Fitting & adjustment of drier, filter & refrigerant controls used in different refrigeration system.	108. Familiarise with different types of condensers used in refrigerators, Bottle coolers, visible coolers, deep freezers, Window and Split AC. (05 hrs.) 109. Clean, flush, service and leak test different type of air-cooled condensers, micro channel condensers. Remove dust from fins in air cooled condenser, micro channel condensers. (10 hrs.) 110. Identify with different types of water-cooled condensers like Shell and Tube type, Tube within tube type, shell, coil & evaporative type, etc. (04 hrs.) 111. Identify different items necessary for de-scaling like diluted Hcl, Pump & motor,	**Condenser** Function of condenser, types, Construction of air-cooled condenser. Effect of chocked condenser. Advantages, de scaling of air-cooled condenser. Effects of air fouling and bypass air in condenser. Types of water-cooled condenser, application, and advantages. Liquid receiver, pump down, application, types, function and working. Description of water-cooled condenser. **Drier**

		hose, etc. (04 hrs.) 112. Dilute acid and water according to amount of scaling and perform de-scaling. (04 hrs.) 113. Fit the pump motor with condenser and start. Take safety measure on concentration of acid which may damage tube. (10 hrs.) 114. Identify drier and capillary tube used in different cooling machines. (03 hrs.) 115. Replace drier and capillary tube at the time of gas charging according to manufacturer's direction. (10 hrs.)	Function of drier, types, application and its advantage. Description of desicants.(14 hrs..)
		116. Install different diameter capillary tube used in different type of cooling machines. (08 hrs.) 117. Install with different types of expansion valves used in small cooling machines and central plant like Automatic expansion valve, Thermostatic expansion valve, hand expansion valve, and electronic expansion valves, etc. (12 hrs.) 118. Test and adjust the expansion valves fitted with machines. (05 hrs.)	**Expansion Valve** Expansion valve used in domestic refrigeration and air conditioning systems. Capillaries, Automatic and Thermostatic Ex. Valves, and electronic expansion valves.(07 hrs..)
Professional Skill 25 Hrs.; Professional	Perform servicing of different evaporator used in different	119. Identify and service different types of evaporators like plate and tube type, Fin and tube type, etc. fitted in	**Evaporator** Working principle, Function, types of evaporators used in refrigerator, water coolers,

Knowledge 07 Hrs.	appliances.	refrigerators, Bottle coolers, water cooler, Window and split AC. (08 hrs.) 120. Perform leak test, flush to remove oil by dry nitrogen. (08 hrs.) 121. Demonstrate different type of defrosting in different machines. (09 hrs.)	bottle coolers, window and split A.C, Super heating in evaporators, Function of accumulator and types. Methods of defrosting. (07 hrs..)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Carry out Recovery and Recycling of Refrigerant used, alternative of CFC, HFC re-cover, transfer & handing of gas cylinders.	122. Identify and explain different colour code of different type refrigerant cylinder like HCFCs (HCFC-22, HCFC-123). HFCs (HFC-134a, HFC-32, R-410A, R-407C and R-404A) and low-Global Warming Potential (GWP) refrigerants like ammonia, R-290, HFC-32, blends of HFCs (R-410A, R-404A, R-407C etc.) and hydro fluoroolefins (HFOs: HFO-1234yf, HFO-1234ze, HFO-1233zd, HFO-1336mz), blends of HFCs and HFOs. (04 hrs.) 123. Identify unknown refrigerant by its idle pressure using head pressure gauge. (04 hrs.) 124. Recover refrigerant from a faulty machine. (06 hrs.) 125. Transfer / Recycle refrigerant from one cylinder to another using ice. (06 hrs.) 126. Measure pressure-temperature of refrigerants including HCFC-22,	**Refrigerant** Classification of refrigerants, nomenclature of refrigerants including chemical name and formulas, hydro chlorofluorocarbons (HCFCs), hydro fluorocarbons (HFCs) and hydro fluoroolefins (HFOs), blends of HFCs and blends of HFCs/HFOs. Climatic impact of refrigerants: Stratospheric ozone depletion, global warming, mechanism of ozone depletion; the Montreal Protocol phase-out schedule of ozone depleting refrigerants (HCFCs) and high global warming refrigerants (HFCs). Brief introduction of Ozone Depleting Substances (Regulation and Control) Rules, 2000 and its amendments. Introduction of properties of refrigerants; environment related properties: Ozone Depleting Potential (ODP), GWP; ODP and GWP of various refrigerants, thermo chemical

		ammonia, R-290, HFC-32, HFC-134a, R-404A, R-407C and R-410A, HFOs. Identify flammability and toxicity of A3 and A2L of refrigerants. (05 hrs.)	properties: flammability and toxicity of refrigerants, lower flammability limit (LFL) and upper flammability limit of A3 and A2L refrigerants. Thermo physical properties: pressure temperature of different refrigerants.(07 hrs..)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Carry out Recovery and Recycling of Refrigerant used, alternative of CFC, HFC re-cover, transfer & handing of gas cylinders. Retrofit CFC/HFC machine with ozone friendly refrigerant with understanding of the compatibility.	127. Demonstrate safe handling of refrigeration cylinders. (04 hrs.) 128. Demonstrate handling of cylinder valves. (03 hrs.) 129. Good servicing practices onTest leak, evacuation and charge refrigerant in refrigerator by weight in capillary system. (10 hrs.) 130. Recover CFC by recovery pump and cylinder on CFC filled domestic refrigerator. (08 hrs.)	Safe handling of flammable refrigerants. Refrigerant leak detection methods, evacuation and charging of refrigerant, temperature glides of refrigerant blends, procedure of charging of refrigerant blends especially the zeotropic blends, hydrocarbon blends, HFC blends (R-404A, R-407C, R-410A) and blends of HFC/HFO. **Retrofitting** Changes of components & practices while retrofitting CFC appliances with HC Refrigerants. Properties of HCs (07 hrs..)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Pack thermal insulation andprevent cooling leakage.	131. Flush the system with dry nitrogen. Evacuate and charge hydrocarbons. (05 hrs.) 132. Test and Use sealed component (Electrical) like thermostat, relay, overload protector etc. (05 hrs.) 133. Identify insulating foam	**Thermal Insulation** Function, types, thermodynamic properties of heat insulation materials used in refrigeration and Air Conditioning systems. Introduction of polyols and foam blowing agents (HCFC-141b, cyclopentane, water, C02, methyl formate, HFO-

		(polyurethane rigid foam and polystyrene). (02 hrs.) 134. Fill with insulation material like PUF and glass wool. (07 hrs.) 135. Pack insulation inside door panel and adjust gasket to prevent air leak. (06 hrs.)	1233zd (E), HFO-1336mzz (Z)). (07 hrs..)
Professional Skill 50 Hrs.; Professional Knowledge 14 Hrs.	Installwindow AC, test Electrical & electronics components & Fault diagnosis & remedial measures.	136. Acquainting with electrical and mechanical components used in window air-conditioner. (05 hrs.) 137. Acquainting with electrical components like selector switch, thermostat switch, relay, starting capacitor, running capacitor, overload protector, remote and PCB control, etc. (06 hrs.) 138. Demonstrate working of mechanical components like compressor condenser, expansion valve (capillary) and evaporator. (05 hrs.) 139. Trouble shooting, installation, tracing wiring circuit. (4 hrs..) 140. Leak testing, evacuation and gas charging. (05 hrs.)	**Window Air Conditioner** Study of construction and working principle of window AC and its components; electrical controls and wiring. Installation, troubleshooting and servicing. Energy Efficiency Ratio (EER) - Energy-efficiency labeling on ACs.(07 hrs..)
		141. Hands on practice on installation of window AC following step by step procedure. (08 hrs.) 142. Install gauge manifold in the system. (04 hrs.) 143. Show discharge pressure and sanction pressure during	**Installation of Window AC** Advantages of proper installation of window AC with emphasis on proper functioning and avoidance of leakage of refrigerant. Selection of installation location considering safety,

		running time. (07 hrs.) 144. Check performance of different parameters i.e. pressure, temperature, pull down time, air flow and current drawn. (06 hrs.)	exclusive availability of power point and obstruction-free air flow from condenser. Step by step procedure for proper installation, and proper inclination of AC cabinet backward/ outward for drainage of condensate.(07 hrs..)
Professional Skill 100 Hrs.; Professional Knowledge 28Hrs.	Perform servicing of electrical& electronic control, test, Installation, wiring, fault finding & remedial measures of different split AC.	**Split AC** 145. Identify various components of split AC like mounted, floor and ceiling mounted, duct able and multi split AC. (04hrs.) 146. Identify electrical circuits. (04hrs.) 147. Test different components and fault finding. (03 hrs.) 148. Leak testing of the system, evacuation and gas charging. (03hrs.) 149. Hands on practice on Installation and trouble shooting. (06hrs.)	**Split AC** Construction and working principle, types, troubleshooting& care and maintenance. Energy Efficiency Ratio (EER) - Energy-efficiency labeling on ACs. Advantages of proper installation with emphasis on proper functioning and avoidance of leakage of refrigerant. Selection of location of indoor and outdoor units ensuring minimum distance between the units, away from flammable materials, if any, good air flow within the cooling space as well as over the condenser. Locate power supply point considering safety and exclusiveness. Step by step procedure forinstallation both for indoor and outdoor unit. Ensure convenient access for drainage of condensate from the cooling coil.

		150. Same as Split ACin the case of **wall mounted split AC.** (16hrs.)	**Split AC (Wall Mounted)** Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit.
		151. Same as Split ACin the case of **floor, Ceiling /Cassette mounted Split AC**. (16hrs.)	**SPLIT A.C (floor, Ceiling /Cassette mounted Split A.C)** Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit.
		152. Same as Split ACin the case of **Ductable split AC**. (16hrs.)	**SPLIT A.C (Ducted**) Study of the Duct able split AC, its Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit.
		153. Same as Split ACin the case of **Multi Split AC.** (16hrs.)	**MULTI SPLIT A.C** Study the construction and working, various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting.

		154. Same as Split ACin the case of **Inverter Split AC**. (16hrs.)	**INVERTER SPLIT A.C.** Study of construction and working principle of inverter AC and its components, electrical circuit and controls, installation, servicing, trouble shooting, fault detection, leak testing and gas charging. Concept of Indian Seasonal Energy Efficiency Ratio ISEER). Energy Efficiency leveling on inverter AC.(28hrs..)
Professional Skill 25 Hrs.; Professional Knowledge 07 Hrs.	Perform servicing of car AC. Fault diagnosis & remedial measures.	155. Identify various mechanical components used in car AC. (02 hrs.) 156. Identify various electrical components used in electrical circuits in car AC. (02 hrs.) 157. Testing of system components & fault finding (03 hrs.) 158. Install gauge manifold to check suction and discharge pressure in charging time and running time. (04 hrs.) 159. Leak testing using dry nitrogen, evacuation and gas charging (HFC-134a, HFO-1234yf and blends of HFCs and HFOs). (04 hrs.) 160. Installation and trouble shooting (03 hrs.) 161. Testing magnetic clutch, compressor overhauling, condenser cleaning and add refrigerant. (05 hrs.) 162. Regular maintenance. (02	**CAR AIR CONDITIONING** Study various components, electrical circuits and wiring diagram, testing components, fault detection, leak testing, Study of good service practice, evacuation, gas charging, Installation, trouble shooting, Magnetic clutch operation, free movement of flywheel (nonfunctioning of clutch), care and maintenance. (07 hrs..)

		hrs.)	
In-plant training / Project work: **Broad Area:** a) Assemble a car A.C Cycle b) Assemble window AC / Split AC			

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SECOND YEAR			
Duration	**Reference Learning Outcome**	**Professional Skills (Trade Practical) With Indicative Hrs.**	**Professional Knowledge (Trade Theory)**
Professional Skill 75 Hrs.; Professional Knowledge 27 Hrs.	Carry out Servicing, dismantling, checking different parts of different types of commercial compressor, re-placing worn out parts, Check lubrication system. Assemble & check performance.	163. Familiarization with commercial type reciprocating compressor and centrifugal compressor. (02 hrs.) 164. Dismantling and checking of compressor & accessories. (10 hrs.) 165. Check and service valve plate and piston assembly. (04 hrs.) 166. Lapping valve plate, Prepare gasket and refit. (05 hrs.) 167. Check belt tension and replace. (04 hrs.)	**COMMERCIAL COMPRESSOR (Fixed & Variable)** Function, types, Construction & working, applications of compressors used in commercial refrigeration. Volumetric efficiency, Capacity control, factor influencing volumetric efficiency. (09 hrs.)
		168. Check and test lubricating system. (06 hrs.) 169. Servicing of filter and oil pump. (08 hrs.) 170. Checking and servicing of capacity control of compressor. (07 hrs.) 171. Measure power consumption of compressor with respect to the evaporator/condenser temperature variation. (04 hrs.)	Compressor lubricant oil, types, properties, types of lubrication methods such as splash, forced feed. (09 hrs.)
		172. Checking and servicing of main end and rear end bearing and shaft seal assembly. (10 hrs.) 173. Cutting gasket. (04 hrs.)	Study the Construction and working principle of different commercial compressor (Open and Sealed type) (Reciprocating, centrifugal,

		174. Fitting and testing. (06 hrs.) 175. Assemble compressor and Test overall efficiency. (05 hrs.)	screw, scroll compressor). (09 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Perform Servicing of different types of water-cooled condenser.	176. Servicing of water-cooled condenser and receiver. (09 hrs..) 177. Testing its performance by inlet and outlet pressure and temperature. (03 hrs.) 178. Necessary repairing for tube leakage. (03 hrs.) 179. De-scaling by diluted HCl to increase efficiency. (10 hrs.)	**WATER COOLED CONDENSER** Study the water-cooled Condenser, its type and capacity, construction and working, de scaling, application. (09 hrs.)
		180. Pump down the gas for necessary servicing and repairing. (09 hrs.) 181. Servicing and repairing evaporative type condenser. (08 hrs.) 182. Test efficiency of condenser. (08 hrs.)	Evaporative condenser-Types and their function, construction and application. Liquid receiver, function. Drier, types and application. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Perform servicing of and performance test of Cooling tower.	183. Servicing of natural draft, forced draft and induced draft cooling tower. (08 hrs.) 184. Clean its nozzles, louvers, sumps, strainers etc thoroughly. (06 hrs.) 185. Remove algae and fungi from different parts. (05 hrs.) 186. Assemble and test performance. (06 hrs.)	**COOLING TOWER** Cooling tower, types, Construction, capacity, advantage & disadvantages of different types of cooling tower. Efficiency, approach and Cooling tower range. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Conduct servicing, backwash & re-generate Water treatment plantof circulating water.	187. Dismantle water circulating pumps. (06 hrs.) 188. Identify different parts of pump, service the impeller of different types. (05 hrs.) 189. Change or repair defective	**WATER TREATMENT** Necessary, Causes of water contamination control of scale deposit, corrosion and algae, Water softening and De-scaling method, pump

		parts. (06 hrs.) 190. Assemble and test performance. (08 hrs.)	and fan used. Regenerate and backwash. (09 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Perform fitting of expansion valve, adjustment of refrigerant flow according to heat load.	191. Familiarize with thermostatic and Electronic expansion valve.(03 hrs.) 192. Installation and testing of thermostatic and Electronic expansion valve.(10 hrs.) 193. Connect external and internal equalizer.(04 hrs.) 194. Show superheat adjustment positioning of the sensing bulb. (08 hrs.)	**EXPANSION VALVE** Types and function, construction, working principle, & their advantage &disadvantages. Thermostatic Expansion Valves (TXV), Automatic Expansion Valves (AXV), Float valves, fixed and modulating orifice controls & electronic Expansion Valves, LMC (level master control).(09 hrs.)
		195. Identify automatic expansion valve.(03 hrs.) 196. Fitting and checking its efficiency.(10 hrs.) 197. Install and fitting of high side and low side float valves. (04 hrs.) 198. Checking its efficiency. (08 hrs.)	Selection of Expansion valves and capillaries for various Refrigeration and Air Conditioning applications. (09 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Perform servicing of evaporator & chillers.	199. Identify extended surface forced air-cooled evaporators.(03 hrs.) 200. Service air cooled evaporator by blower.(06 hrs.) 201. Service water cooled or brine cooled chiller.(05 hrs.) 202. Check de-frosting system and anti-freeze thermostat.(04 hrs.)	**EVAPORATOR** Function, types, Plate & Tube forced air DX evaporators. Types of Defrost system. Water/ Brine chillers. Types of brine used as secondary refrigerant. Accumulator, its function. (09 hrs.)

		203. Oil removing from coil.(07 hrs.)	
		204. **Servicing of liquid** - suction heat exchanger used in central plant.(07 hrs.) 205. Service suction liquid heat exchanged used in small machines. (06 hrs.) 206. Service accumulator and check its functionality.(06 hrs.) 207. Service oil separator and check its functionality.(06 hrs.)	**Liquid**-suction-liquid Heat-exchanger, their function, construction, application & advantages. Study of Accumulator and Oil separator. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Carry out Servicing and retrofit of Water cooler and dispenser.	208. Identify parts, control, electric circuit, accessories of storage type water coolerand Bubble type water dispenser.(03 hrs.) 209. Solder copper tube on stainless steel.(05 hrs.) 210. Trouble shoot of commonly faced problems like condenser fan motor failure, corrosion etc. (05 hrs.) 211. Install gauge manifold, Leak test and refrigerant charging after evacuation. (06 hrs.) 212. Installation, servicing and maintenance of water cooler and dispensers. (06 hrs.)	**WATER COOLER & WATER DISPENSER** Study the refrigeration cycle of water cooler and dispenser, types, construction & working, Capacity & applications. Study the electrical and mechanical components of storage type water cooler and Bubble type water dispenser. Insulation material used in water cooler and dispenser; refrigerant used in the system. UV and RO type water coolers and dispensers.(09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge	Service, retrofit of visible cooler and bottle cooler and test performance.	213. Checking and servicing of visible cooler and bottle cooler and its parts.(04 hrs.) 214. Preventive maintenance and	**VISIBLE COOLER ANDBOTTLE COOLER-** Visible cooler & bottle coolers. Description,

09 Hrs.		trouble shooting (05 hrs.) 215. Evacuation, flushing with dry nitrogen, Retrofit the machine with HFC 134a, R-600a, R-290.(06 hrs.) 216. Check wiring circuit, test components & replace.(05 hrs.) 217. Install and Test performance of the machine. (05 hrs.)	construction & working, with HFC-134a and hydrocarbons, safety especially for flammable refrigerants, maintenance, testing of mechanical and electrical components including sealed electrical components fitted in appliances using flammable refrigerants. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Conduct servicing of deep freezer and test performance.	218. Checking and servicing of horizontal and vertical deep freezer / display cabinet and their different parts. (04 hrs.) 219. Preventive maintenance and trouble shooting.(05 hrs.) 220. Check wiring circuit, test and replace defective components. (05 hrs.) 221. Install gauge manifold, evacuate and gas charge.(05 hrs.) 222. Installand test performance. (06 hrs.)	**DEEP FREEZER / DISPLAY CABINET-** Description, Construction,working, specifications, function, care and maintenance, faults and remedies. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Install, service, repair, gas charging and testing performance of Ice Cube machine.	223. Checking and servicing of ice cube machine and its different components. (04hrs.) 224. Check and service flow system of gases and preventive maintenance and trouble shooting. (07hrs.) 225. Check Electric circuit and four-way solenoid valve.	**ICE CUBE MACHINE-** Description, Construction, working, reverse cycle functioning & Circuit diagram, installation method. **SOFTY MACHINE -** Description, Construction and function. (09 hrs.)

		(05hrs.) 226. Test leakage, evacuation and charge gas. (06 hrs.) 227. Check defrosting system and overall performance. (03hrs.)	
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Repair, servicing & retrofit of ice candy plant.	228. Identify different parts, controls and accessories used in ice-candy plant. (05 hrs.) 229. Prepare brine solution, function of agitator and temperature maintained in brine. (06 hrs.) 230. Check wiring circuit, service, test, trouble shoot, and replace defective components. Retrofit R22 with R134a. (07 hrs.) 231. Install gauge manifold, leak test, evacuate and gas change. (04 hrs.) 232. Install and Test performance. (03 hrs.)	**ICE CANDY PLANT-** Function, construction, working principle, Circuit diagram, capacity& types of compressor used. Brine composition to maintain required temperature. Operation, maintenance, retrofit. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Perform servicing of Ice plant and evaporative condenser.	233. Identify parts, accessories and controls of ice plant.(04 hrs.) 234. Maintain temperature in brine and check function of agitator. (04 hrs.) 235. Check motor and wiring circuit, service and trouble shoot, Test component and replace defective parts. (08 hrs.) 236. Evacuate and charge gas. (04 hrs.)	**ICE PLANT-** Details about components of Ice plant their functioning, working principle, Circuit diagram, capacity & types of compressor used, agitator functioning, temperature maintaining.Properties and handling of ammonia and other flammable low-GWP refrigerants. (09 hrs.)

		237. Install and test performance. (05 hrs.)	
Professional Skill 75 Hrs.; Professional Knowledge 27 Hrs.	Perform Servicing and preventive maintenance of walk in cooler & cold storage.	238. Identify parts, accessories, controls and operation of walk in cooler and reach in cabinet.(04 hrs.) 239. Preventive maintenance, trouble shooting and servicing of components. (06 hrs.) 240. Service and trouble shoot, check wiring circuit, Test component and replace defective parts. (07 hrs.) 241. Install gauge manifold, leak test, evacuate and gas charge. (08 hrs.)	**WALK IN COOLER & REACH IN CABINET** Details about components, their functioning, working principle, Circuit diagram, capacity & types. Care and maintenance. (09 hrs.)
		242. Identify parts, controls and accessories of Cold storage plant. (04 hrs.) 243. Service and operation of cold storage plant. (06 hrs.) 244. Test electrical controls and cooling system. (03 hrs.) 245. Charge refrigerant and oil. (02 hrs.) 246. Test leak, evacuation and gas charging. (08 hrs.) 247. Periodic maintenance. (02 hrs.)	**COLD STORAGE** Study of cold storage plant, parts, Construction, applications, controls & electrical diagram used in cold storage plant. Food preservation spoiling agents-controlling of spoiling agents, preservation by refrigeration system, maintaining temperature in different places. Types of cold storage and its details.Properties of commonly used refrigerants like ammonia and its safe handling. (09 hrs.)

		248. Install ammonia compressor.(03hrs.) 249. Check Electrical wiring of the compressor and plant. (05 hrs.) 250. Check the refrigeration system of the plant.(03hrs.) 251. Perform cold storage servicing.(02hrs.) 252. Measure pressure and temperature.(02hrs.) 253. Evacuationby two stage rotary vacuum pumps. (03hrs.) 254. Gas charging and performance testing. (02hrs.) 255. Operate and maintain cold storage plant. (05 hrs.)	Cold storage- type construction, capacity and specification. Use of vibration eliminator and shock absorber, Study the lay out and electric wiring of the storage plant. Mobile refrigeration in transport vehicles. Method of pressure testing, evacuation & charging to the system and testing efficiency. Cold storage plant operation, its common trouble & remedies. Deep freezing, freezing tunnel, blast freezer its function and working, its application.(09 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Study psychrometric chart and measure psychrometric properties using psychrometric, anemometer i.e. DBT, WBT, RH, air flow etc.	256. Find out DBT, WBT, RH & other properties by using psychrometric chart. (15 hrs.) 257. Use psychrometer. (10 hrs.)	**HVAC (Plant) –** Introduction to HVAC, Fundamentals of Central Air Conditioning / HVAC plant, requirements of comfort A.C, study of psychometric terms, DBT, WBT, RH, enthalpy, dew point, and specific humidity. (09 hrs.)
		258. Use Anemometers for measuring air flow. (15 hrs.) 259. Use pitot tube for air flow measurement. (10 hrs.)	Types of Central air conditioning (Direct and indirect system) Construction, working, components, faults, care and maintenance. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge	Perform servicing of motor and blowers used in different air conditioning system.	260. Service of fans and blowers used in air-conditioning system. (15 hrs.) 261. Service of motors used in air-	Description of blowers& fans, function and types, static and velocity pressure

09 Hrs.		conditioning system. (10 hrs.)	measurements. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Construct, install, pack thermal and acoustic insulation of different air ducts. Perform servicing and maintenance of different types of air filters.	262. Install Ducts. (05 hrs.) 263. Construct Ducts as per duct layout drawing. (06 hrs.) 264. Insulate Ducts. (02hrs.) 265. Longitudinal and transverse joints. (07 hrs.) 266. Service and maintain different filters. (03 hrs.) 267. Placing of filters. (02 hrs.)	**DUCT** Function, types, materials, duct designing, duct insulation, properties of insulating materials 'K' factors, Acoustic insulation, air distribution methods, air flow, AHU, FCU, fan, blower. **AIR FILTERS** Function of air filters, types, construction, maintenance, effect of chocked Air filter, Hepa filters. (09 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Perform servicing, installation, fault diagnosis and remedial measures on Package AC with Air cooled condenser.	268. Identify various components of Package AC (with Air Cooled Condenser). (14 hrs.) 269. Identify Electrical circuit of Package AC (with Air Cooled Condensers). (14 hrs.) 270. Leak testing, evacuation, gas charging. (14 hrs.) 271. Commissioning and trouble shooting. (08 hrs.)	**PACKAGE AC (with Air Cooled Condenser)** Study the Package AC (with Air Cooled Condensers), its Construction and working principle, types, trouble shooting. (18hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Carry out servicing, installation, fault diagnosis and remedial measures in Package A.C. with water cooled condenser.	272. Identify various components of package AC, Water cooled condenser. (03hrs.) 273. Electrical circuit of package AC. (05hrs.) 274. Descale the Water cooled condenser. (05hrs.) 275. Leak testing, evacuation, gas charging. (07hrs.) 276. Trouble shooting. (05hrs.)	**PACKAGE A.C WITH WATER COOLED CONDENSER** Study Package AC, types, construction and working principle, trouble shooting, and various applications. Duct system, AHU.Care and maintenance, installation method. (09 hrs.)
		277. Identify various components of split package AC. (06 hrs.) 278. Electrical circuit of split	**SPLIT PACKAGE** Construction and working principle, types, Study

		package AC. (05 hrs.) 279. Testing components. (02 hrs.) 280. Leak testing, evacuation, gas charging. (10 hrs.) 281. Installation and trouble shooting. (02 hrs.)	various electrical and mechanical components, trouble shooting. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Identify various components of central AC, test electrical components and make wiring. Servicing of A.H.U, damper, check air flow, De-scaling of condenser and CT servicing.	282. Identify various components of central AC plant. (03 hrs.) 283. Electrical circuit of central AC plant. (03 hrs.) 284. Testing components, gas charging. (08 hrs.) 285. Servicing AHU including fire dampers. (04hrs.) 286. Checking airflow, damper, temperature and pressure. (03 hrs.) 287. De-scaling condenser and cooling tower. (04 hrs.)	**CENTRALISED/INDUSTRIAL AIRCONDITIONING.** Construction and working principle, types, maintenance of Industrial Air-conditioning plant. Humidification and dehumidification methods. AHU, description of FCU (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Pump down the system, top up oil and gas and check temperature and pressure.	288. Pump down gas from central AC plant. (05 hrs.) 289. Add oil to compressor. (02 hrs.) 290. Top up gas to the central AC system. (16 hrs.) 291. Check temperature and pressure control. (02 hrs.)	Temperature and pressure controls used in AC plant, its construction, working, safety devices, cooling towers, piping lines. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Identify components of DX system. Test components, make wiring of dx system. Test leak and evacuate, gas charge the system and check the performance. Maintenance, trouble shoot and operate the plant.	292. Identify various components of direct expansion type central AC plants. (05 hrs.) 293. Electrical circuit of direct expansion type central AC plants. (05 hrs.) 294. Testing components. (02 hrs.) 295. Leak testing, evacuation, gas charging. (05 hrs.) 296. Trouble shooting. (03 hrs.) 297. Operation & Maintenance of	**DIRECT EXPANSION SYSTEM** Study Direct expansion system. Operation & Preventive Maintenance Schedule of central AC plant. Maintain log book for daily operation. (09 hrs.)

		central AC plants. (05 hrs.)	
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Identify the different part of VRF/VRV system, check and service VRF/VRV system.	298. Identify VRF / VRV system. (05 hrs.) 299. Check and service VRF / VRV system. (10 hrs.) 300. Connect master unit and IDU.(10 hrs.) 301. Identify the location of ODU.(02 hrs.) 302. Identify the size of piping's and laying work. (10hrs.) 303. Check control system. (10 hrs.) 304. Identify error code. (03 hrs.)	VRF / VRV system – description and function of different parts. Details of piping have and controls system, Common reason for error code, types of ODU and IDU. (18hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Identify different part of indirect or chiller system. Check components and make wiring, leak test, evacuate and gas charge/ top up. Servicing the plant and trouble shoot.	305. Identify various components of indirect expansion type central AC plants. (05 hrs.) 306. Electrical circuit of indirect expansion type central AC plants. (10 hrs.) 307. Testing components. (03 hrs.) 308. Leak testing, evacuation, gas charging / top up gas. (05 hrs.) 309. Trouble shooting. (02 hrs.)	**INDIRECT/CHILLER SYSTEM** Study central station AHU and FCU, **Air washers** used in chilled water system, understanding lay out, modulating valves for temperature control. Expansion valves & other related control – description and function. (09 hrs.)
Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	Identify chilled water pipe line. Servicing of dampers, FCU and water control valves.	310. Insulate chilled water piping's. (08 hrs.) 311. Servicing of FCU and water control valves. (12 hrs.) 312. Mixing dampers. (03 hrs.) 313. Bypass dampers checking. (02 hrs.)	Study of Humidification & De-humidification. Humidifiers & De-humidifier's. Humidity control. Use of hygrometer. (09 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	Troubles shoot of both central A.C. plant Dx and indirect system. Check different control system, installation of	314. Servicing and troubleshooting of direct expansion AC plants. (07 hrs.) 315. Servicing and troubleshooting of indirect expansion AC plants. (10 hrs.)	Construction and study of commercial A.C plant, package chillers, screw chillers, reciprocating chillers. (09 hrs.)

	other major components, servicing of all parts including cooling tower and water treatment plant.	316. Erection of commercial type condensing unit. (05 hrs.) 317. Vibrating eliminator, water proofing insulation. (03 hrs.)	
		318. Check different controls used in central AC system. (07hrs.) 319. Trouble shooting of central AC. (06hrs.) 320. Install compressor and other components. (03hrs.) 321. Electrical wiring in central AC. (04hrs.) 322. Estimate the capacity of AHU, CFM of air andFind the tonnage of cooling & heating load effect in a duct-based AC. (05hrs.)	Controls used in AC system, Electromechanical, pneumatic and electronic. Detail study of heat load calculation for commercial and industrial buildings. (09 hrs.)
Professional Skill 50 Hrs.; Professional Knowledge 18 Hrs.	PerformServicing, fault diagnosis, repair and maintenance of mobile A.C. leak test, evacuation, gas charging, check magnetic clutch and make wiring. Test performance after start.	323. Repair and maintenance of bus AC system. (05 hrs.) 324. Servicing and testing magnetic clutch operation. (05 hrs.) 325. Compressor overhauling. (05 hrs.) 326. Leak testing, evacuation, gas charging, oil charging. (05 hrs.) 327. Testing wiring system. (05 hrs.)	**MOBILE AC (Bus, train)** Study the refrigeration cycle in automobile AC, its Construction, working of bus AC, Magnetic clutch operation, freewheeling (de engaging clutch). Refrigerants used HCFC-22, HFC-134a, HFOs, blends of HFCs and HFOs. (09 hrs.)
		328. Repair and maintenance of train AC system. (14 hrs.) 329. Leak testing, evacuation, gas charging. (05 hrs.) 330. Checking air flow. (02 hrs.) 331. Measure temperature and pressure. (02 hrs.) 332. Check solenoid valve. (02 hrs.)	Construction & working of train AC and its operation. Trouble shooting in train A.C. (09 hrs.)

Professional Skill 25 Hrs.; Professional Knowledge 09 Hrs.	PerformPreventive maintenance of different plants. Maintain log book based on daily operation.	333. Study/execute repair of different commercial units at site. (13 hrs.) 334. Study/execute preventive maintenance of different commercial units at site. (12 hrs.)	Planning for Preventive maintenance and scheduling of maintenance activities in large AC and Refrigeration plant. (09 hrs.)
Project Work/ Plant Visit: - **Broad area:** a) Central AC plant visit where direct chilling system available. b) Central AC plant visit where indirect chilling system available. c) Survey a heat load of a commercial/industrial building. d) Make a duct for central A.C			