SYLLABUS OF SEMESTER SYSTEM FOR THE TRADE OF

REFRIGERATION AND AIR CONDITIONING

Under

Craftsmen Training Scheme (CTS) (Two years/Four Semesters)

Redesigned in 2014

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By Government of India Ministry of Labour & Employment (DGE&T)

GENERAL INFORMATION

1. Name of the Trade	: REFRIGERATION AND AIR CONDITIONING
2. N.C.O. Code No.	: 845.706
3. Qualification pack	: ELE/Q3501
4. Duration of Craftsmen Training	ng : 4 Semesters (2 Years)
5. Entry Qualification	: Pass in 10 th Class under 10+2 system of Education
6. Unit strength	: 20
7. Space norms	: a) Workshop: 80 Sq. meters.b) Class room: 30 sq.meter.
8. Power norms	: 6.82 KW
9. Job role	:To repair and service in refrigerator, water cooler, bottle cooler, deep freezer, Visi Cooler, Walk in Cooler, Ice candy plant, Cold storage, Ice plant, Split Air Conditioner, Package Air Conditioner, Central Air Conditioner, Auto mobile Air Conditioner, Transport refrigeration, Air craft Air conditioning, Rail way Air conditioning, Ship Refrigeration and Air conditioning.
10. Instructors Qualification :	: NTC/NAC in Mechanic Refrigeration & Air-conditioning trade with 3 years' post qualification experience OR Degree in Mechanical Engineering from recognized engg. college/university with one year experience in the relevant field OR Diploma in Mechaical Engineering from recognized board of technical education with two years experience in the relevant field
11. Desirable qualification	: Preference will be given to a candidate with CITS. (If not done CITS must be trained with in 2 yrs of joining)

Syllabus for the Trade of "RAC" Under Craftsman Training Scheme

First Semester (Semester Code no. RAC- 01) Duration : Six Months

Syllabus for TT and TP

Week No	PRACTICAL	THEORY
1	Familiarization with workshop & machineries. Safety precautions. Familiarization of refrigeration tools, instruments & equipments. Care and maintenance of tool, instruments and equipments.	Introduction to trade, general safety precautions and first aids, history of Refrigeration and Air conditioning. Function, working, use, specifications of refrigeration tools, instruments and equipment.
2	<u>FITTING</u> Familiarization of tools, instruments and machines used in fitting. Marking/Layout practice as per Blue Print. Cutting, filling, drilling, grinding & Chipping by using hand tools and power tools.	<u>FITTING</u> Study the different types of Fitting hand tools, power tools, precision measuring instruments & their use. Equipments used in fittings like drilling machines, grinding machines, types, specifications and care and maintenance.
3	FITTING Filing flat, square & curved surfaces. Slots, grooves angular profile, Drilling clear and blind hole, Threading & Tapping, Counter sinking, counter boring, drill bit grinding and reaming. Use of Hand and Power drills.	FITTING Study the function, construction, working of fitting hand tools, precision measuring instruments & their use. Specification & their application.
4	SHEET METAL Familiarization of tools, instruments and machines used in sheet metal. Marking, measuring, cutting, bending, folding, riveting, joints, soldering in sheet metal.	SHEETMETAL Study the function, construction, working, use, and application, specification of Sheet metal tools, instruments and equipment. Care and maintenance of tools. Types of sheet metal joints and their use. Rivet & riveting- their types and use.
5	ELECTRICAL: Familiarization of Electrical tools. Wire joint	ELECTRICAL Electrical terms such as AC and DC

	practice, Soldering and Brazing practice. Verification of Ohm's law. Identification of phase and neutral of AC supply. Construction of a load circuit with single phase AC and DC supply. Measurement of Voltage, Current, Resistance, power, Frequency and energy consumed in an electrical circuit. Measurement of earth resistance. Insulation and continuity test.	supply, Voltage, Current, Resistance, Power, Energy, Frequency etc. Safety precautions to be observed while working on electricity. Conductors and Insulators, Materials used as conductors. 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
6	Construction of RL,RC and RLC circuits, measurement of electrical parameters and calculation of impedance and power factor. Construction of Star and Delta connection in three phase supply and measurement of Line voltage, Line current, Phase voltage and Phase current. Three phase power and power factor measurement.	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.
7	Familiarization with split phase AC motors and identification of the terminals. Identification of starting and running coil. Resistance measurements of windings. Familiarization with capacitor start induction runs motors and identification of the terminals. Identification of starting and running coil. Resistance measurements of windings. Familiarization of DOL starter and checking of its function. Starting of split phase motor through DOL starter, measurement of starting current and running current and changing of DOR. Starting of capacitor start induction run motor through DOL starter, measurement of starting current and running current and changing of DOR.	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.
8	Starting of capacitor start capacitor run	Capacitor starts capacitor run motor,

	motor through DOL starter, measurement of starting current and running current and changing of DOR. Starting of shaded pole motor through DOL starter, measurement of starting current and running current and changing of DOR. Fault rectifications. Insulation test on windings, continuity test, open circuit test and short circuit test.	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.
9	ELECTRONICS Identification of Electronic components and tools & instruments, colour coding of resistors, verification of ohms law, use of voltmeter, ammeter, multi meter, Practice of soldering & de soldering.	ELECTRONICS Introduction to Electronics. Basic Principles of semiconductors, Principles and application of Diodes
10	Identification of transistors, resistors, capacitors, diodes, S.C.R, U.J.T, I.Cs. used in refrigeration & AC, Full wave and bridge rectifier circuit, voltage regulators. Construction of low voltage Power Supply. Construction of transistor amplifier circuit.	Rectification, Zener diode as voltage regulator – transistors parameters- CB, CE, CC, configuration, amplification. SCR
11	Multi-vibrator circuits and RC wave shaping circuits. Wiring of SCR, UJT for power control circuits, applications of OP –AMP, Applications of photo transistor.	Photo diodes, photo transistors, multi – vibrator, CR & LR circuit. SCRs, UJTs, ICs.
12	WELDINGIdentification of gas welding equipments& accessories, setting up of a)AIR-LPG,b)O2-LPGc) O2-C2H2. Familiarization with thepractice of1) Oxy Acetylene Gas welding, brazing andcutting on thin sheet metal.2) Safety in handling of Oxy AcetyleneCylinders, Regulators etc.,	WELDING Introduction to basic principles of commonly used Welding processes, Arc welding, oxy fuel gas welding / cutting, brazing & soldering
13	Welding tools and equipment care and safety. Setting oxy-acetylene plant, lighting and adjustment of flame-simple joint on M.S. Preparing close fitting lap joints for both soldering/ brazing cu to cu, cu to MS. Importance of wetting and capillary action. Use of appropriate	Welding tools and equipment type specification and use. Safety method in welding. Method of gas welding, gas used and flames adjustment. Difference between soldering and Brazing in terms of temperatures, filler materials, joint strengths and

	torches, Nozzles, Types of flames and fluxes, Practice on Oxy Acetyl	applications. Use of Oxy Acetylene, Oxy LPG and Air LPG for brazing/soldering
14	BASIC REFRIGERATION. Familiarization & use of general and special tools used in refrigeration work practice.	BASIC REFRIGERATION Study the function, working, use, specifications of refrigeration tools, instruments and equipment. Fundamentals of Refrigeration, units and measurements, Pressure & its Measurements. Thermodynamics law.
15	Identification of various Refrigeration equipments, components of vapour compression system like compressor, condenser, expansion valve and evaporator etc	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.
16	Working on soft copper tubing like, cutting, bending, flaring, swaging, pinching, brazing.	Types of Refrigeration systems, Ton of Refrigeration, Study the construction and working of vapor compression cycle, low side & high side of vapour compression system. Applications of vapour compression cycle.
17	Brazing of tube joints (Cu to Cu, Cu to Steel, Cu to Brass) using (i)Air-LPG (ii) 02-LPG (iii) 02-C2 H2 set up & use of the above gases with the right torches, Brazing Filler Rods. Distinguishing good joints from bad joints.	Construction and working of V.C Cycle, fundamental operations, sub cooling and super heating.
18	REFRIGERATOR (Single Door)Familiarization of electricaland mechanical components ofrefrigerator.Check and replace electrical components,leak test, evacuation ,gas charging inrefrigerator, wiring circuit of refrigerator,installation of refrigerator, faults andremedies in refrigerator.	REFRIGERATOR (Single Door) Function, construction ,working of single door refrigerator, specifications, trouble shooting, care and maintenance
19	REFRIGERATOR. (SINGLE DOOR) Familiarization of electrical and mechanical components of single door refrigerator. Trouble shooting , Stripping accessories & cleaning / inspection and installing refrigerator, testing of components, Checking Door	REFRIGERATOR (SINGLE DOOR) Study the construction & working of single door Refrigerator. Study the electrical components of refrigerator. Study the mechanical components of refrigerator and their types. Study the

	alignment & replacing of gaskets. Tracing the electrical and mechanical components of sealed refrigerator. Check and test relay, OLP, capacitor, windings, thermostat.	heat exchanger, door gaskets, Heat Insulation materials. Care and maintenance of refrigerator.
20	Testing of compressor, Identification of motor terminals, Starting of compressor without relay & starting with Relay, testing OLP and other electric safety devices. Reassembly the components & Test performance. Cleaning, Flushing, replacing capillary and drier, fault rectification, install gauge manifold in the system, evacuation, leak testing, gas charging in Refrigerator. Check electrical wiring of refrigerator.	Importance of flushing in evaporator and condenser, necessity of replacing capillary and drier. Evacuation, leak testing, gas charging method in refrigerator, Refrigerants used in Refrigerators and its properties.
21	FROST FREE REFRIGERATOR: Tracing Electrical circuit, checking and testing of electrical accessories like, thermostat, Timer, Defrost Heaters, Bi- metal etc., checking air distribution system, servicing of refrigerator, testing of components. Test the performance of refrigerator.	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, the automatic defrost system. Study of Electrical accessories & their functions (Timer, Heater, Bi- Metal, Relay, OLP, T/S etc,.) Refrigerator cabinet volume calculation.
22	Identify three and four door no frost refrigerators, Stripping of components. Tracing electric circuit, Installation, testing components, evacuation, leak testing, gas charging, testing, fault finding, rectifications, evacuation and gas charging.	Study the construction and its working of two and three door frost free refrigerator. Care and maintenance, installation method.
23	Project work	Project work
24	Revision	Revision
25	Revision	Revision
26	EXAM	EXAM

Trade : MECHANIC REFRIGERATION AND AIRCONDITIONING

Semester : II

Week	Trade Practical	Trade Theory
No	COMPRESSOR	COMPRESSOR
1	COMPRESSOR Dismantling of Hermetic compressors, Identification of components, Servicing, cutting gaskets, lapping and assembling of compressors used in refrigerators, window & split A.C, and assembling.	COMPRESSOR Function, construction, working ,application of compressor like, Reciprocating, rotary , scroll type.
2	Dismantling & assembling of Hermetic compressors like, reciprocating, rotary, wobble, swash plate & scroll type compressors. Identify the parts and rectify the defects	Study the construction & working of centrifugal compressor, wobble & swash plate compressor. Compressor efficiency factors, wet compression, oil, properties, lubrication methods.
3	MOTORS Starting of compressor motor by RSIR, CSIR, PSC & CSR method. Check and test relay, capacitors & OLP's, Faults and rectification, installation.	MOTORS Motors used in refrigeration And Air conditioning system, types, construction, working & their starting methods. Function of Starting relay, Capacitors, OLP's.
4	Familiarization with Squirrel cage induction motor and identification of terminals. Phase sequence test of SCIM. Starting of SCIM through DOL starter, measurement of starting current and running current and changing of DOR Starting of SCIM with Star – Delta starter and Auto Transformer starter. Familiarization with Slip ring induction motor and identification of terminals. Starting of SRIM through Rotor resistance starter, measurement of starting current and running current and changing of	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

	DOR. Fault rectifications.	
	Insulation test on windings,	
	continuity test, open circuit test and	
	short circuit test.	
5	CONDENSER	CONDENSER
	Familiarization with condensers	Function of condenser, types, Construction of
	used in Refrigerators, Bottle	air cooled condenser. Effect of chocked
	coolers, visible coolers, Deep	condenser. Advantages, de scaling of air
	freezer, window and	cooled condenser.
	Split A.C, Cleaning, Flushing and	
	servicing of air cooled condenser,	
	leak testing of condenser	
6	De scaling of air cooled	Types of air cooled condenser, application,
	condenser.	and advantages. Liquid receiver, pump down,
		application, types, function and working.
7	DRIER	DRIER
	Replacing drier & capillary tube,	Function of drier, types, application and its
-	in refrigerator and window AC.	advantage.
8	EXPANSION VALVE	EXPANSION VALVE
	Install capillary tube, Test and	Expansion valve used in domestic
	adjust expansion valves.	refrigeration and air conditioning systems.
		Capillaries, Automatic and Thermostatic Ex.
9	EVAPORATOR	Valves. EVAPORATOR
	Servicing of evaporators in	Working principle, Function, types of
	refrigerators, bottle cooler, water	evaporators used in refrigerator, water
	coolers, window and split A.C,	coolers, bottle coolers, window and split A.C,
	Installation, Leak test, remove oil	Super heating in evaporators, Function of
	from evaporator, Flushing,	accumulator and types. Methods of defrosting,
	Defrosting.	heat exchanger.
10	REFRIGERANT	REFRIGERANT
	Identification of refrigerant	Classification of refrigerants, Properties,
	cylinders, Identification of	Chemical name and formulas, HFC, CFC. Ozone
	unknown refrigerants, Recovery	rule, substitute of CFC, Montreal protocol
	& Transfer of refrigerant,	&India's CFC/HCFC phase out schedules.
		Ozone rules 2000.
11	Safe handling Cylinders and	Refrigerant leak detection methods,
	Valves, Leak testing, Evacuation,	Substitute refrigerants in lieu of CFC ARE
	Charging refrigerants in	their properties & comparison with CFCs,
L	Refrigerator.	HFCs and HCs.
12	RETROFITTING	RETROFITTING
	Retrofitting of a CFC filled	Changes of components & practices while
	Domestic Refrigerator with	retrofitting CFC appliances with HC

	Hydrocarbons (HC) using sealed	refrigerants. Properties of HCs
13	components. THERMAL INSULATION Filling insulation materials in refrigeration systems.	THERMAL INSULATION Function, types, thermodynamic properties of heat insulation materials used in refrigeration and Air Conditioning systems.
14	WINDOW AIR CONDITIONERIdentify the electrical and mechanical components, servicing and maintenance, trouble shooting, installation, tracing wiring circuit, evacuation, leak testing, and gas charging in window Air conditioner.	WINDOW Air conditioner. Their types, applications. Construction and working, care and maintenance,
15	WINDOW AIR CONDITIONERIdentify the electrical and mechanical components, servicing and maintenance, trouble shooting, installation, tracing wiring circuit, install gauge manifold in the system, evacuation, leak testing, gas 	WINDOW AIR CONDITIONER Study the construction and working of window A.C, Care and Routine maintenance, installation procedure.
16	SPLIT A.C Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting in split A.C.	SPLIT A.C Construction and working principle, types, trouble shooting & care and maintenance.
17	SPLIT A.C (Wall Mounted) Identifying various components, electrical circuits, testing components, fault detection, install gauge manifold in the system, leak testing, evacuation, gas charging, Installation, trouble shooting.	SPLIT A.C (Wall mounted) Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit .
18	SPLIT A.C (Floor & Ceiling Mounted) Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging,	SPLIT A.C (floor & Ceiling mounted) Construction and working principle, types, trouble shooting. Description of electrical components used in split A.C. Study the wiring circuit .

	Installation, trouble shooting.	
19	SPLIT A.C (Duct) Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting.	SPLIT A.C (Duct) 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 .
20	MULTI SPLIT A.C Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting.	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.
21	CAR AIR CONDITIONING Identifying various components, electrical circuits, testing components, fault detection, install gauge manifold in the system, leak testing, evacuation, gas charging, Installation, trouble shooting, testing magnetic clutch, regular maintenance, compressor overhauling, condenser de scaling, add refrigerant.	CAR AIR CONDITIONING Study various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting, Magnetic clutch operation, free wheeling
22	CAR AIR CONDITIONING Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting, testing magnetic clutch, regular maintenance.	CAR AIR CONDITIONING Study various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, trouble shooting, Magnetic clutch operation, freewheeling, care and maintenance.
23	Project works	Project works
24	Project works	Project works
25	Project works	Project works

Trade: Mechanic Refrigeration and Air conditioning

Semester: III

Week no	Trade Practical	Trade Theory
1	COMMERCIAL COMPRESSOR	COMMERCIAL COMPRESSOR
	Dismantling of Commercial type	Function, types, Construction & working,
	reciprocating compressor,	applications of compressors used in
	centrifugal compressor,	commercial refrigeration.
	checking of components &	Volumetric efficiency, Capacity control, factor
	accessories. Checking &	influencing volumetric efficiency.
	servicing valve plate and piston	
	assembly, lapping valve plate	
	etc. Preparing gasket, check belt	
	tension and replacing.	
2	Checking lubricating	Compressor oil, types, properties, types of
	system, servicing oil pump,	lubrication methods such as splash, forced
	Checking and servicing of	feed.
	capacity control of the	
-	compressor	
3	Checking and servicing of	Study the Construction and working
	bearing, shaft seal etc. Fitting	principle of Centrifugal and Screw
	and testing, cutting gasket,	compressor.
	assembling of compressor,	
	testing efficiency of	
4	compressor. WATER COOLED CONDENSER	WATER COOLED CONDENSER
4		
	Servicing of water cooled condenser & receiver. Checking	Study the water cooled Condenser, its type and capacity, construction and working, de
	leakage, Repairing and testing,	scaling, application.
	De Scaling of condenser.	scame, appreation.
5	Servicing evaporative type	Evaporative condenser- their function,
	condenser, checking, repairing	construction and application. Liquid receiver,
	and testing, Pump down of gas.	function. Drier, types and application.
6	COOLING TOWER	COOLING TOWER
	Servicing of cooling tower & its,	Cooling tower, types, Construction, capacity,
	care and maintenance	advantage & disadvantages of different types
		of cooling tower. Efficiency, approach and
		Cooling tower range.
7	Servicing of water circulating	WATER TREATMENT
	pumps, dismantling, repairing	Water treatment necessary, Causes of water
	and assembling.	contamination control of scale deposit,
		corrosion, Slime and algae, Water softening

		and De-scaling method, pump and fan used,
8	EXPANSION VALVE	EXPANSION VALVE
	Testing & Installation of	Expansion valve types and function,
	thermostatic Ex. Valve. Internal	construction, working principle, & their
	& external equalizer	advantage & disadvantagesTXV, AXV, Float
	connection, super heat	valves, fixed and modulating orifice controls &
	adjustment in TXV.	electronic Ex. Valves.
9	Automatic EX valve fitting	Selection of Ex. valves, and capillaries for
	& checking, High side, Low side	various Refrigeration and Air Conditioning
	float valves checking and fixing.	applications.
10	EVAPORATOR	EVAPORATOR
	Servicing of extended surface	Function, types, Plate & Tube forced air DX
	forced air cooled evaporators.	evaporators. Types of Defrost system .Water/
	Servicing of Water/ brine	Brine chillers. Types of brine used as
	chillers, check De- Frost system,	secondary refrigerant. Accumulator, its
	Oil removing.	function.
11	Servicing of suction-liquid Heat-	suction-liquid Heat-exchanger, their function,
	exchanger	construction, application & advantages
12	WATER COOLER	WATER COOLER
	Identify parts, Controls &	Study the refrigeration cycle of water cooler,
	accessories, electric circuit.	types, construction & working, Capacity &
	Soldering of Cu tube on	applications. Study the electrical and
	Stainless steel, trouble shooting	mechanical components of storage type
	of commonly faced problems	water cooler. Insulation material used in
	like condenser fan failure,	water cooler, refrigerant used in the system.
	corrosion etc. install gauge	
	manifold in the system, Leak	
	testing, evacuation, Charging	
	Refrigerant. Installation,	
	Servicing & maintenance of	
	water cooler.	
13	VISIBLE COOLER AND	VISIBLE COOLER AND
	BOTTLE COOLER	BOTTLE COOLER
	Checking & servicing of Visible	Visible cooler & bottle coolers. Description,
	cooler & Bottle cooler	Construction & working, Substituting R-12
	preventive maintenance &	with R-134a or Hydrocarbon, care and
	trouble shooting Retrofitting	maintenance, testing electric components.
	with Hydrocarbons or HFC- 134a, Checking wiring circuit,	
	test components, replacing	
	components, evacuation, gas	
	charging, Installation, testing	
	performance.	
14	DEEP FREEZER	DEEP FREEZER
	Deep freezer Checking &	Deep freezer description, Construction,
	200p n color oncoming a	

	servicing, preventive	working, specifications, function, care and
	maintenance & trouble shooting	maintenance, faults and remedies.
	Checking wiring circuit, test	
	components, replacing	
	components, install gauge	
	manifold in the system,	
	evacuation, gas charging,	
	Installation, testing	
	performance.	
15	ICE CUBE MACHINE	ICE CUBE MACHINE
	Checking & servicing of ice cube	Ice cube machine description, Construction,
	machine, preventive	working, reverse cycle functioning & Circuit
	maintenance & trouble	diagram, installation method.
		ulagrani, instanation methou.
	shooting. Trace the Electrical	
	Circuit diagram. Dismantle the	
	wiring & reconnect. Servicing	
	the unit involving Evacuation,	
	leak testing & charging.	
	Checking defrosting system.	
16	ICE CANDY PLANT	ICE CANDY PLANT
	Identify parts, Controls &	Function, construction, working principle,
	accessories Specification,	Circuit diagram, capacity & types of
	Checking ice candy plant	compressor used. Brine composition to
	temperature maintaining.	maintain required temperature. Operation,
	Function of agitator, preparing	maintenance.
	Brine solution, trouble	
	shooting, servicing, Checking	
	wiring circuit, test & replace	
	components, install gauge	
	manifold in the system, leak	
	-	
	testing, evacuation, gas	
	charging, Installation, testing	
17	performance.	
17	ICE PLANT	ICE CREAM PLANT
	Identify parts, Controls &	Details about components of Ice plant
	Specification of Ice plant	their functioning, working principle, Circuit
	temperature maintaining.,	diagram, capacity & types of compressor
	trouble shooting, servicing,	used, temperature maintaining.
	Checking wiring circuit, test	
	components, replacing	
	components, evacuation, gas	
	charging, Installation, testing	
	performance, plant operation.	
18	WALK IN COOLER & REACH IN	WALK IN COOLER & REACH IN CABINET
	CABINET	Details about components, their functioning,
		2 chans about componentes, then randtoning,

	Identify parts, Controls &	working principle, Circuit diagram, capacity
	accessories Specification of	& types. Care and maintenance.
	Walk in cooler & Reach in	
	cabinet preventive maintenance	
	& trouble shooting, Servicing of	
	components, wiring circuit.	
	Install gauge manifold in the	
	system, leak testing,	
	Evacuation, gas charging.	
19	COLD STORAGE	COLD STORAGE
	Identify parts, Controls &	Study of cold storage plant, parts,
	accessories Specification,	Construction, applications, controls &
	Servicing of Cold storage plant.	electrical diagram used in cold storage plant.
	Operation of cold storage.	Food preservation spoiling agents- controlling
	Testing electrical controls,	of spoiling agents, preservation by
	cooling system, mechanical	refrigeration system, maintaining
	components, add oil, add	temperature in different places. Types of cold
	refrigerant, test leak,	storage and its details.
	evacuation, gas charging,	
	periodic maintenance.	
20	Installing compressor.	
	Electrical wiring of the	Cold storage- type construction, capacity and
	compressor and checking the	specification. Use of vibration eliminator and
	wiring system of the plant.	shock absorber, Study the lay out and electric
		wiring of the storage plant .Mobile
24		refrigeration in transport vehicles.
21	Cold storage pressure testing,	Method of pressure testing, evacuation &
	evacuation, charging &	charging to the system and testing efficiency.
	performance testing of the unit.	Cold storage plant operation, its common
	Cold storage plant operation	trouble & remedies. Deep freezing, freezing
	and its maintenance.	tunnel, blast freezer its function and working,
22	Drojost work	its application.
22	Project work	Project work
23	In plant Training	In plant Training
	In plant training	In plant Training
25	Revision	Revision
26	Exam	Exam

TRADE: MECHANIC REFRIGERATION AND AIRCONDITIONING

SEMESTER: IV

Week No.	Trade Practical	Trade Theory
1	2	3
1.	PSYCHROMETRY. Find DBT, WBT, RH & other properties by using psychometric chart. Use of psycho meter.	Fundamentals of Central Air Conditioning, requirements of comfort A.C, study of psychometric terms, DBT, WBT, RH, enthalpy, dew point, and specific humidity.
2.	Use of Anemometers for measuring Air flow, use of monometers, measuring air flow, pivot tube for air flow measurement.	Types of Central air conditioning (Direct and indirect system) Construction, working, components, faults, care and maintenance,
3.	Servicing of Fans & blowers, motors, used in Air conditioning system.	Description of blowers& fans, function and types, static and velocity pressure measurements.
4.	DUCT Installation of ducts, construction of ducts, understanding Duct lay out drawings, selection of ducts, and insulation in ducts. Longitudinal and transverse joints.	DUCT Function, types, materials, duct designing, duct insulation, air distribution methods, air flow, AHU, fan, blower.
5.	AIR FILTERS Servicing and maintenance of different filters, Installation of filter	AIR FILTERS Function of air filters, types, construction, maintenance, effect of chocked Air filter.
6.	SPLIT A.C (Duct) Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting.	SPLIT A.C (Duct) Study the Duct able split AC, its Construction and working principle, types, trouble shooting.
7.	MULTI SPLIT A.C (Duct) Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting.	MULTI SPLIT A.C (Duct) Study various mechanical and electrical components construction and working,, electrical circuits, testing components, fault detection, trouble shooting.

8.	PACKAGE A.C Identifying various components, electrical circuits, testing components, fault detection, install gauge manifold in the system, leak testing, evacuation, gas charging, Installation, Trouble shooting.	PACKAGE A.C Study Package AC, types, construction and working principle, trouble shooting, and various applications. Duct system, AHU.
9.	Identifying various components, electrical circuits, testing components, fault detection, install gauge manifold in the system, leak testing, evacuation, gas charging, Installation, Trouble shooting.	Care and maintenance, installation method, capacity calculation.
10.	SPLIT PACKAGE Identifying various components, electrical circuits, testing components ,fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting.	SPLIT PACKAGE Construction and working principle, types, Study various electrical and mechanical components, trouble shooting.
11.	CENTRALISED/INDUSTRIAL AIRCONDITIONING. Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Trouble shooting, Servicing AHU. Check air flow, Check temperature & pressure, operation of plant, Decaling condenser and cooling tower.	CENTRALISED/INDUSTRIAL AIRCONDITIONING. Construction and working principle, types, maintenance of Industrial Air- conditioning plant. Humidification and dehumidification methods. AHU.
12.	Pump down of gas, add oil to compressor, add gas in the system, trouble shoot and repair air conditioner. Check temperature and pressure controls.	Temperature and pressure controls used in AC plant, its construction, working, safety devices, cooling towers, chilled piping lines,
13.	DIRECT EX.SYSTEM Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging,	DIRECT EX.SYSTEM Understanding Direct expansion system. Operation & Preventive Maintenance Schedule of central AC plant.

	Installation, Trouble shooting. Operation &Maintenance of Central AC plant.	
14.	Check and test VRF system.	Details of VRF system.
15.	INDIRECT/CHILLER SYSTEM Identifying various components, electrical circuits, testing components, fault detection, install gauge manifold in the system, leak testing, evacuation, gas charging, Installation, Trouble shooting	INDIRECT/CHILLER SYSTEM Understanding central station AHU and FCU, Air washers used in chilled water system, understanding lay out, modulating valves for temperature control. Expansion tanks.
16.	Chilled water piping and insulation. Servicing of FCU and water controls valves. Mixing dampers, bypass dampers checking.	Study of Humidification & De-humidification. And Humidifier's & De-humidifier's.
17.	Servicing and trouble shooting of direct, indirect A.C Plant, erection of commercial type condensing unit, vibration eliminator, water proofing insulation.	Construction and study of commercial A.C plant, package chiller, screw chiller, reciprocating chiller.
18.	Check controls used in Packaged AC systems, trouble shooting.	Controls used in AC system, Electromechanical, pneumatic and electronic.
19.	Installing compressor and other components, electrical wiring in central AC and checking HVAC	Introduction to heat load calculation in AC building. Sensible & latent heat load. Basic of HVAC and its applications
20.	AUTOMOBILE AC (car) Repair and maintenance of Car AC system, servicing, testing magnetic clutch operation, compressor overhauling, leak testing, evacuation, gas charging, oil charging. Testing wiring system.	AUTOMOBILE AC Study the refrigeration cycle in automobile AC, its Construction, working of car AC, Magnetic clutch operation, freewheeling.
21	Repair and maintenance of car AC system, servicing, testing magnetic clutch, leak testing, evacuation, gas charging, check air flow, measure temperature and pressure. Check solenoid valve.	Construction & working of car AC, Magnetic clutch operation, frees wheeling. Effects of speed of engine. Trouble shooting in car A.C.
22	Studying / Execution of Repair and	Planning for Preventive maintenance

	Preventive maintenance of different Commercial units at site	and scheduling of maintenance activities in large AC and Refrigeration
		plant
23	INPLANT TRAINING	INPLANT TRAINING
24	INPLANT TRAINING	INPLANT TRAINING
25	REVISION	REVISION
26	EXAM	EXAM

Trade: Mechanic (Refrigeration and Air-Conditioning)

LIST OF TOOLS & EQUIPMENT

SL.NO	Name of tools	Broad specifications	Quantity	Life
				span
1.	File flat rough double cut	200mm	17 nos.	10 Years
2.	File, half round, fine double cut,	length 150mm	17 nos.	10
3.	File, round, fine double cut	length 150mm	17 nos.	10
4.	File flat, fine double cut,	length 150mm	17 nos.	10
5.	File square, fine double cut,	length 150mm	17 nos.	10
6.	File triangular fine double cut	length 150mm	17 nos.	10
7.	Scriber	150mm length	17 nos.	10
8.	Centre punch	length 100mm	17 nos.	10
9.	Try square	150 mm	17 nos.	10
10.	Divider spring joint	length 150mm	17 nos.	10
11.	Caliper spring joint in side	length 150mm	17 nos.	10
12.	Caliper, odd leg, spring joint	length 150mm	17 nos.	10
13.	Hammer ball pain	220 gms	17 nos.	10
14.	Cold Chisel flat and cross cut	length 150mm	17 nos.	10
15.	Engineers rule	300mm long	17 nos.	10
16.	Tape measuring	10m graduation in mm	17 nos.	5
17.	Pliers combination insulated	length 200mm	17 nos.	10
18.	Pliers long nose	200 mm	17 nos.	10
19.	Pliers flat nose	150mm	17 nos.	10
20.	Line tester	500 v heavy duty	17 nos.	5
21.	Tweezers	10 cm	17 nos.	10

A. TRAINEES TOOL KIT FOR 16 TRAINEES +1 INSTRUCTOR

22.	Surface plate	45 x45 cms	1no.	15
23.	Oil can	500 ml	5 nos.	5
24.	Surface Gauge universal	150 mm	5 nos.	10
25.	Bench vice	300mm jaw	10 nos.	10
26.	Hack saw tubular metal frame adjustable	300mm	10 nos.	5
27.	Snip sheet metal straight nose	200 mm	10 nos.	5
28.	Snip sheet metal curved nose	200 mm	10 nos.	5
29.	Anvil	100X200mm	1no.	5
30.	Stakes [different Types]	100mm	1 no each	5
31.	Tin smith	400mm	1 No.	5
32.	Wooden mallet /Nylon mallet	500 gm good finish	5 Nos.	5
33.	Round Punch	3mm,4mm,6mm	5 Nos. each	10
34.	Grover set	4mm forming	1 set	5
35.	Electrical drill portable drill with chuck and key,	capacity 6.4mm	5 nos.	5
36.	Tape measuring graduation in mm	2 m	5nos.	5
37.	Screw driver, plastic handle,	6mm TIP length 100mm to 150mm	6nos.	5
38.	Screw driver, plastic handle, Flat tip	10mm TIP length 200mm & 250mm	6 nos. each	5
39.	Philips screw driver –	complete set in leather case	5 nos.	5
40.	Screw driver, plastic handle, Flat tip	handle 3mm TIP length 100mm to 150mm insulated	5 nos.	5
41.	Soldering iron exchangeable copper tip	65 watts	10 nos.	5
42.	Knife folded stainless steel –	150mm	10 nos.	5
43.	Tong tester (clamp on multi meter)	0-10-30 amps 0-500 v	5 nos.	5
44.	Voltmeter, AC/DC portable precision grade Digital Panel board type	0 to 500 volt	5nos.	5
45.	Ammeter, AC/DC portable precision grade Digital Panel board type	0 to 30 amp	5nos.	5
46.	Megger	1000v	5nos.	5
47.	Wattmeter multi-range up	1 KW	1no.	5

	to			
48.	Multi meter digital type		5nos.	5
49.	Tenon saw	250 mm	5nos.	5
50.	Firmer chisel	6,12,25mm	2 nos.	5
51.	Rawal plug tool	6 mm	2 nos.	5
52.	K.W. meter	0 -1 K w	4 no.	1
53.	Fire extinguisher	ABC dry powder		
		type2 kg capacity	1 no.	1
54.	Fire buckets	10 Litre	1 no.	5
55.	D.E spanner	6-32 mm	5 set	5
56.	Ring spanner	6 -32 mm	5 set	10
57.	Diagonal cutter	15 cm	5 nos.	10
58.	Service Oscillator		1 no.	5
59.	C.R.O Single beam	5 MHZ	2 nos.	5
60.	C.R.O Dual trace/ Double	60 MHZ		
00.	beam	0011112	2 nos.	5
61.	A.F.O Oscillators		2 nos.	5
62.	Tong, Close mouth and pick			
02.	up		1 no.	5
63.	Welding table for gas/Arc	1200x760	1each	15
64.	Flaring tool set, single type	4.7mm to 16mm 0.D		
0 11	for tube.		5 nos.	10
65.	Swaging tool, punch type,	4.7mm to 16mm 0.D		10
	set of size for tube.		5sets	10
66.	Swaging tool, screw type	4.7mm to 16mm 0.D.		
	with adaptor set of size for		5sets	10
	tube			
67.	Bending spring external	3mm to 16mm DIA	C	10
	type, for copper tube		5sets	10
68.	Pipe cutter miniature for	3mm to 16mm DIA	Fasta	10
	copper tube		5sets	10
69.	Pinch of tool, for copper	6mm to 18mm DIA	5sets	10
	tube,		SSELS	10
70.	Ratchet spanner of	6.4 sq.mm reversible	5sets	10
71.	Capillary plug gauge		5sets	10
72.	Piercing pliers & reversing	6-18mm	Faota	10
	valve with access fitting		5sets	10
73.	Spanner double ended	4.7mm to 16mm	5sets	10
74.	Ring spanner off set	4.7mm to 16mm	5sets	10
75.	Wrench adjustable	length 150mm	5sets	10
76.	Wrench adjustable	length 200mm	5sets	10
77.	Wrench adjustable	length 250mm	5sets	10
78.	Valve key handle[Treated as	– 4.7mm & 6.4mm sq.	Facto	10
	consumable]	`	5sets	10

79.	Pressure gauge Digital type	diameter 63mm with recalibration set	5sets	3
80.	Compound gauge, Digital type	diameter 63mm, with recalibration set screw, scale vacuum 76mm. Pressure 15 Kg/sq.cm	5sets	3
81.	Service man thermometer in metal case	– 30 C to +30 C	5sets	2
82.	Scissor, gasket cutting stainless steel	length 25mm	5sets	10
83.	L-Allen key	set size 1.5mm to 6.4mm	5 sets	10
84.	T-Allen key set	size 5/32" to 1/8"	5sets	10
85.	Pipe cutter with built in reamer and space cutter, for copper tube	3mm to 32mm	5nos.	10
86.	Pipe /Tube bender lever type	3-16 mm	1 no each	10
87.	Spanner double ended	19mm to 31.8 mm	5nos.	10
88.	Pipe wrench	size 50mm to 150mm	5nos.	10
89.	Gas leak detector for halogen gas		5nos.	5
90.	Sling psychro meter mounted on aluminum back,	scale 50 C to +50 C	5nos.	10
91.	Lapping plate	250mm x 200mm	2nos.	10
92.	Hammer ball peen	450 gms	5nos.	10
93.	Puller 3 legged with flexible arm	300mm	5nos.	10
94.	Hand blower portable complete	1/10 HP	2nos.	10
95.	Spirit level precision metallic	200mm	2nos.	10
96.	Stop watch		2nos.	10
97.	Tap set with matching drills	3 mm to 16mm	3nos.	5
98.	Tap set with matching drills	¹ ⁄4" to 5/8"	3nos.	5
99.	Refrigerant cylinder	2.5 Kg	3nos.	10
100.	Vernier caliper	length 250mm	2nos.	10
101.	Micrometer outside measurement	0 to 25mm	2nos.	10
102.	Heating kit with infrared bulb	(200 w capacity)	2nos.	5
103.	Plumbing hammer weight	200 gm	2nos.	10
104.	Multi meter analogue type		5nos.	5
105.	Tachometer digital, multi	0 r m p to 3000 r m p.	2nos.	10

	range	Portable small size in leather case		
106.	Micron vacuum gauge	capable of reading up to 20 microns	2nos.	5
107.	Sensor thermometer (digital)	-50 degree Celsius to150 degree 23Celsius	2nos.	5
108.	Fin straightened/fin comb.	With strong steel wire based combing on wood	3nos.	10
109.	Filler gauge	0.05 mm – 1 mm	3nos.	10
110.	Wire gauge metric and with worth	Steel plate embossing converse of British & Metric	2nos.	10
111.	Dial thermometer remote control, armored capillary dial	75mm – 50C to +50 C	3nos.	
112.	Anemometer	Digital type	1no.	10
113.	Compressors testers for small hermetic compressors	Fixed with electrical input/ output indicating facilities	2nos.	5
114.	Engineers square	150mm with 5' tolerance	5nos.	10
115.	Digital thermometer [Treated as consumable]	Graduated disc analogy type	1no.	5
116.	Temperature &Humidity recorder	Capacity to record 24 hrs record	1no.	5
117.	Instrumentation screw driver set	100mm	5nos.	5
118.	Digital weighing machine	100 kg	1no.	5
121.	Cylinder 134 a	5 kg	1 no.	5

B. General Machinery Shop Outfit

Sl. No	Name of Equipment	Broad specifications	Quantity	Life span
1.	Split phase induction motor	¼ hp, 230 V	1 no.	5
2.	Capacitor start induction motor	½ Hp, 230 V	1 no.	5
3.	AC 3 Phase motor, 400/50 Hz	2 Hp	1 no.	5
4.	Star delta starter	2 hp	1 no.	5

5.	Auto Transformer starter	3 hp	1 no.	5
6.	D.O.L Starter	2 hp	1 no.	5
7.	Portable air – LPC brazing kit	2 kg. LPC cylinder, torches, houses, stand make	1 no.	5
8.	Oxy-acetylene welding set complete	cylinders, regulators welding torches with difference nozzles	1 no.	5
9.	Refrigerator	165L carrying with HFC- 134a, & HC	2 Each	7
10.	Frost free refrigerator	200L carrying with HC blend	2 nos.	7
11.	Three/four door refrigerator	300L carrying with HC R-600a	2 nos.	7
12.	Bench Drilling machine	20 mm capacity,200- 2500rpm	1 no.	10
13.	Grinding Machine	200mm,3000rpm,Double ended1/2 hp	1 no.	10
14.	Evacuating and refrigerant charging station, consist of a)Rotary two stage vacuum pump and motor (with gas ballast and anti such back) b) manifold with gauges and valves and capable of pulling vacuum up to 50 microns of Hg and with provision of connecting to a microns level vacuum gauge b)Graduated charging cylinder with provision for temperature correction and all necessary isolating valves II) Evacuating and charging station as above but fitted with weighing scale	(CAP. 2 kg. In lieu of (b) above and with accuracy of +/-1 g for charging hydrocarbons)	1 no. 1 no.	10
15.	Two stage rotary vacuum	capacity approx. 60 –	1 no.	10

	pump	10rmp capable of		
		evacuating to 50 microns		
		of Hg and fitted with gas ballast, anti such back		
		valve and single phase		
		motor		
16.	Air compressor,	two stage for oil – less	1 no.	10
10.	in compressor,	dry air, with rush proof	1 1101	10
		tank assembly, heater		
		and controls max. pr. 10		
		kgs /sq.m Capacity 45		
		ltr. Motor 1 hp.		
17.	Reciprocating	provision of capacity	1 no.	10
	compressor	control etc. for		
		demonstration. Capacity		
		2 ton open type.		
18.	Dry N2 in cylinder	2 stage regular or	1 no.	10
		commercial N 2 in		
		cylinder with drier unit		
		and 2 stage regular		
		7meter cube		
19.	Window A.C	1 Ton with R-22 or HFC	2 nos.	10
		Blend reciprocating		
		compressor		
20.	Split A.C	1.5 Ton with R134a or R-	2 nos.	10
		22 reciprocating		
01		compressor	1	10
21.	Duct able split A.C 1.5 ton	1.5 Ton with R134a or R-	1 no.	10
		22 reciprocating		
22.	Bacawary unit with	compressor CFC & 134 a	1 each	10
۷۷.	Recovery unit with cylinders	CFC & 154 a	1 each	10
23.	Cassette Air conditioner	4500 kcal/hr	1 no.	10
23.	Casselle All conditioner	4500 Keal/III	1 110.	10
24.	De scaling pump set	with stainless steel	1 no.	10
21.	20 Seams pamp Sec	impeller and housing	1 110.	10
		complete with motor 1/2		
		hp and accessories		
25.	Fan coil unit	with water valves (2 & 3	1 no.	10
		way)		
26.	Shell and tube, DX	5 Ton with Cu tubing	1 no.	10
	chillers (small)	only		
27.	Circulating water pump	0.5 H.P with stainless	1 no.	10
	(small)	steel tank capacity 20		
		liters within let/ outlet		

		provision.		
28.	Shell and tube type condenser	5 Ton	1 no.	10
29.	Rotary hermetic compressor	2 Ton	1 no.	10
30.	Screw compressor	5Ton	1 no.	
31.	Bottle cooler visible	200 L carrying with HFC- 134a& reciprocating compressor	1 no.	10
32.	Deep freezer	200 L carrying with HFC- 134a& reciprocating compressor	1 no.	10
33.	Water cooler storage type	200 L carrying with HFC- 134a& reciprocating compressor	1 no.	10
34.	Ice candy plant	2 ton with capacity to make 32 ice candy at a time with Forma tray, stainless steel tank on trolley	1 no.	10
35.	Air-conditioning, direct and indirect system.	Complete with all controls including humidity control capacity 15000Kcal/hr	1 no.	10
36.	Package A/C	5 ton capacity, Air cooled type with open type compressor reciprocating type	1 no.	10
37.	Car A.C components(full kit) a) Wobble plate compressor with mounting brackets. b) Serpentine Evaporator c) Parallel Flow Condenser d) Hoses, tubes, Receiver, Ex. valve. e) Electrical components & wiring Harness		1 Set	10
38.	CAR AC tutorial model		1 set	

C. WORKSHOP FURNITURE

SL.	Name of Furniture	Broad specifications	Quantity
1.	Class room table	One table for each trainee size of 2.5 provisions with open rack. Frame square conduit of1".top ½" sun mica ply board	10 nos.
2.	Work bench	2000 x1000 x 700 mm with 2" pipe frame. Top with teak slab and fixing with3/4" good quality rubber sheet.	6 nos.
3.	Almirah	195 x90 x 48 cm outer sheet 20 SWG inner partition with four selves of 22Swg	4 nos.
4.	Lockers	195 x 90 x 48 set six locker in one structure	2 nos.
5.	Glass board portable	2.5'X4' with stand	2 nos.
6.	Instructor table	4'X2'X2.5' with steel tubular frame & sun mica top	1 no.
7.	Instructor chair	Standard revolving with wheel	1 no.
8.	Computer table	Standard with drawers & self to accommodate UPS&CPU	1 no.
9.	Computer chair	Revolving type metal based & metal wheel standard one	1 no.
10.	White board	4'X3' ferrous base sheet to hold magnetic duster with white finish surface.	1 no.
11.	Chart stand	6'X3' providing with hanging clip top & bottom plate	1 no.
12.	Computer latest version with printer	Ddr-3 -1333Mega Hz, GB - 6,hard disc - 1terabite,processor-I5 second generation, laser get ,LED monitor 32"	1 no.
13	LCD PROJECTOR / LED / LCD TV	Big Size	1 no.
14	Laptop	Latest version	1 no.
15	UPS	650 VA	1 sets

16	Stool	2' x 1.5'	10 nos
17.	Book Self with glass panel	6' x 3'	1 No.
18	Storage rack	6' x 3'	2 nos
19	Storage shelf	6' x 3'	2 nos

D. LIST OF CONSUMABLES.

SL.	Name of consumables	Broad specifications
1.	Copper tube	1/4",5/16",3/8",7/16",1/2",5/
		8"
2.	Capillary tube	0.026 to 0.64"
3.	Flare nut	1/4",5/16",3/8",7/16",1/2",5/
		8"
4.	Straight union	¹ / ₄ ",5/16",3/8",7/16",1/2",5/
		8"
5.	Half union	¹ / ₄ ",5/16",3/8",7/16",1/2",5/
		8"
6.	Elbow	¹ / ₄ ",5/16",3/8",7/16",1/2",5/
		8"
7.	Tee	¹ ⁄ ₄ ",5/16",3/8",7/16",1/2",5/
0	Droging rod	8" Cu to Cu
<u>8.</u> 9.	Brazing rod Brazing flux	Borax
	Kerosene	DUIAX
	Diesel	
	Cotton waste	
	Baniyan waste	
	Nitrogen	
	L p g brazing kit	
	Lapping paste	Hard and Soft
	Refrigeration oil	Capilla – D- Oil
-	Charging line	500 psi
	Carbide	
20.	Door switch	5 amps
21.	Refrigerator Bulb	15 watts
22.	Box type relay	1/6, 1/8 Нр
23.	Open type relay	1/6, 1/8 Hp
24.	Thermal relay	1/6, 1/8 Hp
25.	O L P	1/6, 1/8 Нр
26.	Thermostat	-15degree Centigrade

27.	Door Gasket	15 mm
28.	Drier	D N 50, 150
29.	De frost heater	· · · · · · · · · · · · · · · · · · ·
30.	Defrost timer	4 -6 Hr
31.	Bimetal thermo	
32.	Wiring leg	5 mm
33.	Hand shut off valve	1/4 "
34.	Solenoid valve	230 V, ¼ "
35.	L P Cut out	40 psi
36.	H P Cut out	240 psi
37.	Oil pressure cut out	40 psi
38.	Tread seal	10 mm
39.	Starting capacitor	60-80 Mfd
40.	Running capacitor	40 Mfd
41.	Fan Capacitor	4 mfd
42.	Flexible Wire	1.5 mm
43.	Freon gas	12
	Freon gas	22
45.	HFC	134 a
46.	Match box	
	Washing soap	
	Incandescent lamp	500 W
	Cell	12 V
	L.M.S relay	¹ ⁄ ₄ , 1/6, 1/8 HP
	Sand paper	
	Stove pin	
	Epoxy compound/ M seal	
54.	Gloves for welding[Treated as	
	consumable]	
55.	Leather Apron [Treated as	
	consumable]	

Note:- 1, Consumables may procure according to skills requirements.

2, Specification may change depends upon availability of market.

3, Quantity depends up on number of trainees.

Week No	Workshop sc. and calculation	
1	General simplifications. Fractions, Types of fractions, common fractions, Decimal fractions with examples Addition, subtraction, multiplication and division of fraction	
2	Addition, subtraction, multiplication and division of fraction Reduction of common fraction to decimal.	
3	Square & Square root Square root of perfect square, Square of whole number and decimal.	
4	Methods of finding the square roots. Division method Factorization method, Log tables using method.	
5	Problems using log for finding cube, fourth, fifth root	
6	Applications of Pythagoras theorem and related Problems.	
7	Percentage & its application	
8	Unit & Measurements Introduction, Definition, classification of System of units, Fundamental & derived units. C.G.S, M.K.S,. F.P.S, & S.I System of units	
9	Metric system of weight and measurement unit and conversion factors, problems.	
10	Laws of indices or exponents with examples.	
11	Introduction, use of Electricity, Molecule, Atom, and How Electricity is Produced, Electric current, voltage, Resistance and their units. Ohm's law.	
12	Relation between V.I.R & Problems.	
13	Series & Parallel circuits & Problems	
14	Electrical Power and energy & their units & calculation	
15	Magnetic Induction, Self & Mutual Inductance, EMF generation.	

16	METALS: Properties and use of cast iron, wrought iron Plain carbon steel, Alloy steel. Effect of Alloying elements and properties of metals
17	Properties and uses of copper, zinc, lead tin, aluminum etc., Properties and uses of Brass, Bronze as bearing material.
18	Meaning of tenacity, elasticity, malleability brittleness, hardness, ductility
19	Meaning of tenacity, elasticity, malleability brittleness, hardness, ductility.
20	Heat and Temperature, Measurement of Temperature, Boiling and melting points.
21	Interchange of heat, (Principle of calorimetry) Co-efficient of linear expansion, Related problems
22	Vapors and gases. Saturated and superheated vapors, Critical pressures and temperatures. Heat transfer conduction, Convection, Radiation. Thermal conductivity and Insulations.
23	Revision
24	Revision
25	Revision
26	Exam

Week No	Workshop sc. and calculation
1	Ratio & Proportions, Introduction, Examples Types of Proportions, direct proportion
2	Indirect proportions compound (Combined) proportions.
3	ALGEBRA

	Algebraic symbol, addition, subtraction
4	ALGEBRA Multiplication and division.
5	Simple equations
6	Standard formulas, simple simultaneous equations with two and three unknown quantities.
7	Simple algebraic problems. Factorization Quadratic equations, Related problems.
8	Pressure Atmospheric, Absolute barometric and gauge pressures and vacuum pressure, Bourdon gauges, compound and vacuum gauges.
9	Evaporation Boiling condensation Freezing Effect of pressure on these. Study of Tables & Charts.
10	Gas Laws Perfect and real gases, Boyle's law Charles's law Dolton's law. Pascal's law Joule's law
11	Chemistry of common elements, like carbon, oxygen, Hydrogen & halogens.
12	Chemistry of common elements Hydrogen & halogens.
13	Chemistry of Ammonia, Co2, CFCs, HCFCs, HFCs and HCs.
14	Work, power, Energy, Definitions and Their units, related problems.
15	Horse power of engines- IHP, BHP, Mechanical Efficiency- and Related problems
16	Uses and Sources of Energy. Kinetic and Potential Energy. Their applications & related problems
17	Transmission of Motion & Power transmission By belt drive, gear drive,
18	Problems related to belt drives. Slack side, light side. $D_1N_1 = D_2N_2$
19	Problems related to gear drives. $T_1N_1 = T_2N_2$
20	Compound gears and simple problems,

21	Speed & Velocity Definition & Units. And Related calculations.
22	Rest & Motion, Scalars and Vector quantities, displacement, speed, velocity, acceleration & Retardation Equations of motion of a body. Motion under the force of gravity.
23	Revision
24	Revision
25	Revision
26	Exam

Week No	Workshop sc. and calculation
1	Mensuration
	Geometric properties. Line, angle, triangle and circle.
2	Mensuration Area of square, triangle
3	Mensuration Area of circle and ellipse
4	Calculation of area of triangle, polygon etc

5	Calculation of Volume & weight of simple solid bodies.
6	Volume & weight of regular cone sphere.
7	Volumes & weight of simple hollow bodies
8	Logarithms introduction,
9	Logarithmic reading from table, determination of characteristic & antilogarithm.
10	Applications of logarithms. Finding cube roots, square roots. Etc Using log.
11	Solution of complex problems using logarithms.
12	Simple machines Effort & Load, mechanical advantage, velocity ratio, efficiency of machines
13	Relationship between mechanical advantage, velocity ratio, efficiency of machines.
14	Simple machines such as Pulley block, inclined plane, simple wheel and axle, differential wheel and axle ,simple screw jack,
15	Stress, strain, Introduction & their units. Types of stress,
16	Modulus of Elasticity, Ultimate strength. Yield point, Ultimate stress, & working stress.
17	Stress- Strain graph. Modulus of Rigidity. Poisson's Ratio, Bulk modulus, Related problems.
18	Archimedes principle. Law of floatation, and use of Hydrometer.
19	Examples of floatation Study of weight, gravitation and centre of gravity.
20	Methods of finding centre of gravity figures, & centre of gravity of certain geometrical figures.
21	Study of Matter, mass. Volume Density & specific gravity. Related Problems,
22	General laws of Thermodynamics 1 st & 2 nd laws, Mechanical equivalent of heat.
23	Revision
24	Revision

25	Revision
26	Exam

Week No	Workshop sc. and calculation
1	Graph- object & use of graph, Rules of plotting, graph interpolation
2	The plotting of coordinates, Representation of simple equation.
3	Estimating and costing Applied problems.

4	Trigonometry, definition & Trigonometric functions-
5	Standard formulae.
6	Relationship between Trigonometrically ratios.
7	Problems
8	Measurement of angles.
9	Use of natural trigonometric table
10	Problems using natural trigonometrically table
11	Use of Logarithmic trignometrical tables
12	Problems using Logarithmic trignometrical tables
13	Trigonometrically values of certain degrees, Trignometrical values for any angle.
14	Area of triangle using Trigonometry,
15	Solution of triangles using sine rule and Cosine rule.
16	Heights and Distances. Angle of elevation, Angle of Depression.
17	Height and distanceApplied problems
18	Hygrometry, properties of Air relative and absolute humidity and other Properties.
19	Heat load calculations of Air Conditioning plant. Calculation of volume of room, various heat loads, A.C Tonnage calculation.
20	Heat Treatment, Function of heat treatment, Critical temperature, Different processes of heat treatment. Annealing, Normalizing, Hardening, Tempering, Case hardening.
21	Corrosion, corrosive. Action due to electrolytic and galvanic corrosion. Corrosion protection FORCE Definition, Units. Resultant force, Space and vector diagrams,
	Representation of force, Parallel force, couple, Law of Parallelogram forces, Law of triangular forces, kinds of equilibrium with some examples. Lamia's Theorem. Resolution of forces, Applied problems,-

22	
23	Revision
24	Revision
25	Revision
26	Exam

Week No	Engineering Drawing
1	Introduction to Engineering Drawing and Drawing instruments.
2 to 3	Sheet lay out, line, types, dimensioning, types and symbol for drawing.
4 to 5	Lettering of alphabets and numbers. Single stroke (vertical and inclined)
5 to 6	Dimensioning, Aligned and unidirectional system, Arrangement of dimensions.
6	Scales, full scale and Half scale
7 to 9	Free hand sketching of simple solid cube, rectangular block, cylinder etc.,
10 to 12	Geometrical constructions. Lines, angles, triangle, quadrilaterals, polygons, Ellipse and types etc
12 to 15	Introduction to Isometric views of simple objects such as cubes, rectangular block, prism, pyramid etc
16 to 21	Introduction to orthographic views of simple objects such as cubes, rectangular block, prism, pyramid etc In 1 st angle projection.
22	REVISION
23	REVISION
24	REVISION
25	REVISION

26	EXAM

Week No	Engineering Drawing
1 to 3	Simple isometric views of solid & hollow object.
4 to 7	Simple orthographic views of solid & hollow object in 3 rd angle projection.
8 to 11	Isometric views of Machining object.
12 to 15	Orthographic views of Machining object. In 3 rd angle projection.
16 to 18	Drawing of different types of <i>Screw</i> threads, locking devices, keys & cutters.
19	
	Trade Related symbols Electrical, Electronic and Mechanical
20 to 21	Free hand sketches of trade related tools, instruments & machines.
22	REVISION
23	REVISION
24	REVISION
25	REVISION
26	EXAM

Week No	Engineering Drawing
1 to 4	Sectional Blocks and views and types of sections, (full, Half, Offset Sectioning)
5 to 7	Drawing of rivet & riveted joints.
8 to 11	Drawing of different types of nuts & bolts, Studs, machine screws, Washers, foundation Bolts, Set screw and Grab Screw.
12 to 15	Drawing different types of clutches, coupling, bearing and lubrication systems.
16 to 17	Drawing of pulley and pulley drive gear and gearing
18 to 19	Trade related Drawing of compressor and pump parts such as piston, connecting rod, crankshaft valve etc.,
20 to 21	Trade related Drawing involving electrical Circuit Diagram.
22	Development of surface of simple object.
23	REVISION
24	REVISION
25	REVISION
26	EXAM

Week No	Engineering Drawing
1 to 2	Curves of Interpenetration
3 to 6	Isometric and Orthographic Views of complicated objects.
7 to 9	Conversion of simple orthographic views to Isometric views.
10 to 12	Blue print Reading.
13 to 14	Trade related wiring circuit of window, Split, package and central Air conditioning.
15 to 19	Prepare charts related to trade like Refrigerator, water coolers, freezers, Vapour compression cycle, vapour absorption cycle and all types of compressor & Expansion valves, working cycle sketches.
20 to 21	Computer aided drafting.
22	REVISION
23	REVISION
24	REVISION
25	REVISION
26	EXAM

Trade Testing and Certification

Same as for other similar Engineering Trades.

Further Learning options

After successful completion of CTS Course in the trade of RAC, the trainees have the option to continue their further studies by joining the CITS Course in the same trade, which is of two semester's duration. (Or) The trainees can apply 3 year Diploma course in polytechnic.