

SYLLABUS FOR THE TRADE

OF

**MECHANIC (REFRIGERATION & AIR-CONDITIONER)
[Semester Pattern]**

**UNDER
CRAFTSMAN TRAINING SCHEME (CTS)**

Designed in- 2013

By

Government of India
CENTRAL STAFF TRAINING AND RESEARCH INSTITUTE
Directorate General of Employment & Training
Ministry of Labour & Employment
EN-81, Sector-V, Salt Lake City
Kolkata-700 091

**List of trade committee members approved the syllabus of semester system for the trade of "RAC"
held on 18th October 2011 at FTI, Bangalore**

| | | | |
|----|-------------------------------|---|------------------------------|
| 1. | Shri. B.S. Ravi Prasad | Joint Director, Director I/c, Foremen Training Institute, Bangalore, | Chairman |
| 2. | Shri. H. Madhava Rao | Joint Director, Apex Hitech Institute, Bangalore. | Member |
| 3. | Shri. B.V.S. Sessa chari | Deputy Director, Training I/c, Foremen Training Institute, Bangalore, | Member |
| 4. | Shri. Shri. P. Joji | Deputy Director, Foremen Training Institute, Bangalore, | Member |
| 5. | Shri. K.R. Ganapathy | Deputy Director, Foremen Training Institute, Bangalore, | Member |
| 6. | Shri. B.N. Sridhar | Deputy Director, Foremen Training Institute, Bangalore, | Member & Convener |
| 7. | Shri. Ketan Patel | Deputy Director, RDAT, Mumbai, | Member |
| 8. | Shri.C. Ramasubramanian | Deputy Director, Apex Hitech Institute, Bangalore, | Member |
| 9. | Shri. R.N. Dohare | Deputy Director, Apex Hitech Institute, Bangalore, | Member |
| 10 | Shri. M.N. Renukaradhya | Principal, Govt. ITI. Peenya, Bangalore | Member |
| 11 | Shri. B.L. Chandrashekar | Principal, Govt. ITI. Hosur Road, Bangalore | Member |
| 12 | Shri. D.M. Nagaraj | Principal, Govt. ITI. Bagur, Channarayapatna, Karnataka | Member |
| 13 | Shri. B. Paramashivaiah | Asst. Director (Retd), DET, Karnataka | Member |
| 14 | Shri. T.K. Bhattacharya | Training Officer, Advanced Training Institute, Hyderabad | Core Member |
| 15 | Smt. R. Malathi | Training Officer, RVTI, Trivandrum, Kerala | Member |
| 16 | Shri. T.C. Shantilal | Vocational Instructor, MITI, Calicut, Kerala | Core Member |
| 17 | Shri. Suresha | JTO, Govt. ITI, Peenya, Bangalore | Core Member |
| 18 | Shri. V. Venugopala | JTO, Govt. ITI, Hosur Road, Bangalore | Member |
| 19 | Shri. N. Dharmachar | JTO (Retd), Govt. ITI, Peenya, Bangalore | Member |
| 20 | Shri. B.N. Shreedhar | Chief Engineer, Karnataka power corporation ltd, Bangalore | Member |
| 21 | Shri.G.A. Narayanaswamy | Executive Engineer (Retd), Karnataka Electricity Board. | Member |
| 22 | Shri. Champaka Rao | Chief- Human Resourse, HMT M/c tools Ltd, Bangalore | Member |
| 23 | Shri. C. Subbanna | Senior Manager, Kirloskar Electric Co. Ltd, Bangalore | Member |
| 24 | Shri. S. Biswas | Asst. General Manager, EDN, BHEL, Bangalore | Member |
| 25 | Shri. L. R. Venugopal | Asst. General Manager, HMT M/c tools Ltd, Bangalore | Member |
| 26 | Shri. Nagabhushana Rao | Manager, Training & Development, Bosch Ltd, Bangalore | Member |
| 27 | Shri. M.V. Srinivasaiah | Deputy Manager, Quality control, KAVIKA, Bangalore | Member |
| 28 | Shri. A. Srirama | Engineer, Hindustan Aeronautics Ltd, Bangalore | Member |

List of members attended the Workshop to finalize the syllabi of existing CTS into Semester Pattern held from 6th to 10th May'2013 at CSTARI, Kolkata.

| Sl. No. | Name & Designation | Organisation | Remarks |
|---------|---|--|----------|
| 1. | R.N. Bandyopadhyaya, Director | CSTARI, Kolkata-91 | Chairman |
| 2. | K. L. Kuli, Joint Director of Training | CSTARI, Kolkata-91 | Member |
| 3. | K. Srinivasa Rao, Joint Director of Training | CSTARI, Kolkata-91 | Member |
| 4. | L.K. Mukherjee, Deputy Director of Training | CSTARI, Kolkata-91 | Member |
| 5. | Ashoke Rarhi, Deputy Director of Training | ATI-EPI, Dehradun | Member |
| 6. | N. Nath, Assistant Director of Training | CSTARI, Kolkata-91 | Member |
| 7. | S. Srinivasu, Assistant Director of Training | ATI-EPI, Hyderabad-13 | Member |
| 8. | Sharanappa, Assistant Director of Training | ATI-EPI, Hyderabad-13 | Member |
| 9. | Ramakrishne Gowda, Assistant Director of Training | FTI, Bangalore | Member |
| 10. | Goutam Das Modak, Assistant Director of Trg./Principal | RVTI, Kolkata-91 | Member |
| 11. | Venketesh. Ch. , Principal | Govt. ITI, Dollygunj, Andaman & Nicobar Island | Member |
| 12. | A.K. Ghate, Training Officer | ATI, Mumbai | Member |
| 13. | V.B. Zumbre, Training Officer | ATI, Mumbai | Member |
| 14. | P.M. Radhakrishna pillai, Training Officer | CTI, Chennai-32 | Member |
| 15. | A.Jayaraman, Training officer | CTI Chennai-32, | Member |
| 16. | S. Bandyopadhyay, Training Officer | ATI, Kanpur | Member |
| 17. | Suriya Kumari .K , Training Officer | RVTI, Kolkata-91 | Member |
| 18. | R.K. Bhattacharyya, Training Officer | RVTI, Trivandrum | Member |
| 19. | Vijay Kumar, Training Officer | ATI, Ludhiana | Member |
| 20. | Anil Kumar, Training Officer | ATI, Ludhiana | Member |
| 21. | Sunil M.K. Training Officer | ATI, Kolkata | Member |
| 22. | Devender, Training Officer | ATI, Kolkata | Member |
| 23. | R. N. Manna, Training Officer | CSTARI, Kolkata-91 | Member |
| 24. | Mrs. S. Das, Training Officer | CSTARI, Kolkata-91 | Member |
| 25. | Jyoti Balwani, Training Officer | RVTI, Kolkata-91 | Member |
| 26. | Pragna H. Ravat, Training Officer | RVTI, Kolkata-91 | Member |
| 27. | Sarbojit Neogi, Vocational Instructor | RVTI, Kolkata-91 | Member |
| 28. | Nilotpal Saha, Vocational Instructor | I.T.I., Berhampore, Murshidabad, (W.B.) | Member |
| 29. | Vijay Kumar, Data Entry Operator | RVTI, Kolkata-91 | Member |

GENERAL INFORMATION

1. Name of the Trade : **Mechanic(Refrigeration and Air-Conditioner)**
2. N.C.O. Code No. :
3. Duration of Craftsmen Training : 2 Years (4 Semesters)
4. Power Norms : 6.82 KW
5. Space Norms : 80 sq. meters.
6. Entry Qualification : Passed 10th class examination under 10+2 system of education with Science and Mathematics or its equivalent.
7. Unit strength : 16
8. Instructors Qualification : a) Degree in Mechanical/ Electrical Engineering from recognized engg. college/university with one year experience in the relevant field
OR
Diploma in Mechanical/Electrical Engg From recognized board of technical education with two years experience in the relevant field
OR
10th Passed + NTC/NAC in the Trade of “**Refrigeration & Air-Conditioning**)” with 3 years post qualification experience in the relevant field

b)Preference will be given to a candidate with Crafts Instructor Certificate (CIC)

* **Note:** At least one Instructor must have Degree/Diploma in Mechanical/Electrical Engineering. when applied for 02 units.

TRADE: Mechanic(Refrigeration and Air-Conditioner)

FIRST SEMESTER

Semester Code: **MRC;SEM-I**

| Week No. | Practical | Theory | E.drg. | W/shop cal. & Science |
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| 1 | 2 | 3 | 4 | 5 |
| 1. | Introduction about training scheme, workshop safety precautions and first Aid | Trade/course introduction, Applications and History of Refrigeration and Air conditioning. | ---- | 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 |
| 2. | FITTING Use of hand tools, instruments, Bench vices and simple marking and measuring tools. Marking/Layout practice as per Blue Pint. Chipping with flat chisel and hammer. Rough and finishing operations. Grinding of chisel to correct wedge angle. Hack sawing to a line. | Study of Fitting hand tools, precision measuring tools & their use. Chisel, hacksaw frame & blade, types, specification & their use. Vernier caliper and micrometer. | Introduction to Engineering. Drawing and Drawing instruments. | Metric system of weight and measurement unit and conversion factors, problems. |
| 3. | Filing flat, square & curved surfaces. Slots, grooves angular profile, Drilling clear and blind hole, Tapping, Counter sinking, counter boring, drill bit grinding and reaming. Use of Hand and Power drills. | Files and drills, Types, specifications, Uses, care and safety aspects, Drilling speed, feed & Coolants. | -do- | General simplifications. Fractions, Types of fractions, common fractions, Decimal fractions with examples Addition, subtraction, multiplication and division of fraction |
| 4. | SHEET METAL Use of sheet metal tools and equipment, care and safety. Sheet metal working basics comprising shearing / cutting, bending at the | Sheet metal tools and equipment type specification, care and safety. Types of sheet metal joints and their use. Rivet & riveting- their types | Use of different type of line and symbol for drawing. | Addition, subtraction, multiplication and division of fraction Reduction of common fraction to decimal. |

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| | edges to form flanges and hemmed locks, Embossing, forming. Use of sheet metal screws for joining, using rivets for joining. Introduction to rectangular duct fabrication. | and use. Calculation of Blank sizes from component drawing. | | |
| 5. | ELECTRICAL: Use of electrical hand tools Instruments. Joints on single and stranded conductors and soldering. | Electrical hand tools & measuring instruments, types, specifications, use, care and safety. Common terms used in the trade. Conductors and insulators. Selected letters symbols and sign as per I. S. I. Rules for medium voltage. | -do- | Square & Square root Square root of perfect square, Square of whole number and decimal. |
| 6. | Measurement of current, voltage, power and energy by voltmeter, Ammeter, wattmeter & energy meter. Measurement of resistance with Ohm meters | Introduction to Electricity, Safety precaution and first aid. Molecule, Atom, and how Electricity is Produced, Electric current, voltage, Resistance and their units. Ohm's law & Kirchhoff's law. | Lettering of alphabets. And numbers. Single stroke (vertical and inclined) | Symbol of Root, Cube root, Methods of finding the square roots. Division method Factorization method, Log tables using method. |
| 7. | Formation of simple electrical circuit, series circuit and parallel circuit, measuring insulation resistance & earth resistance. Verification of Ohm's law in D.C Circuit, Fixing and connecting electrical switches, holders fuses, plug sockets on T. W. Board and testing. | Simple electrical circuit, essential requirement of electrical circuit, series and parallel circuit. Different types of resistances. Earthing and fuses. Types, grades and sizes of insulated wire and cables – their selection and use. List of material for wiring. Switches, Sockets, Fuse, Etc.. | -do- | Finding cube root of Perfect cube. |
| 8. | Care & maintenance and running of A. C. Single and poly phase motor, starters and transformer. Single | A.C. Motor, starters and transformer. Their working principles, specification & use. | Dimensioning, Aligned and unidirectional system, Arrangement of dimensions, | Applications of Pythagoras theorem and related Problems. |

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| | phase motor starting methods like RSIR, PSC, CSIR & CSCR and the use of Current and Potential relays. | Care & safety. Run/start capacitors and PTCs. Motor Protection devices. Temperature rise of windings | | |
| 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. | Introduction to Electronics. Basic Principles of semiconductors, Principles and application of Diodes, | -do- | Percentage & its application |
| 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. | -do- | Introduction, use of Electricity, Molecule, Atom, and How Electricity is Produced, Electric current, voltage, Resistance and their units. Ohm's law. |
| 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. | Scales, full scale and Half scale | Relation between V.I.R & Problems. |
| 12. | COMPUTER AWARENESS: Switching ON/ OFF of PC, Safety Precautions, Installation of O/S & Application Soft wares -Identification of Computer Parts, Connecting ,Installing & Using them. -Identifying and using Windows Parts, Components- Like Files, Folders, Editing, Saving, Windows | Block diagram of computer, main parts inside the system unit, ports & connectors of PC parts &peripherals associated with PC like- keyboard, Mouse, Printers, Scanners, Camera, Modem, External Storage Devices & UPS . -Features of Operating System | Free hand sketching of simple solid cube, rectangular block, cylinder etc., | Series & Parallel circuits & Problems |

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| | Explorer, Notepad, Paint, Calculator. | like M.S. Windows, Components of Windows- Calculator, Notepad, Paint, Windows Explorer. | | |
| 13. | OFFICE PACKAGE & INTERNET: -Using / Practicing WORD, EXCEL, POWER POINT for documentation. -Internet Practicing- Browsing / Creating Email, Downloading, Communication. | -Features of Office Package Like-Word, Excel, Power Point -INTERNET: Websites, Browsing, Downloading, Creating and Using E-Mail ID's, Using it for Communications | -do- | Electrical Power and energy & their units, related calculations. |
| 14. | WELDING Identification of gas welding, equipments & accessories, setting up of a)AIR-LPG, b)O ₂ -LPG c) O ₂ -C ₂ H ₂ . Familiarization with the practice of 1)Oxy Acetylene Gas welding, brazing and cutting on thin sheet metal. 2) Safety in handling of Oxy Acetylene Cylinders, Regulators etc., | Introduction to basic principles of commonly used Welding processes, Arc welding, oxy fuel gas welding / cutting, brazing & soldering. | -do- | Magnetic Induction, Self & Mutual Inductance, EMF generation. |
| 15. | 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 torches, Nozzles, Types of flames and fluxes, Practice on Oxy Acetylene/LPG and Air LPG. | 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 applications. Use of Oxy Acetylene, Oxy LPG and Air LPG for brazing/soldering. | Geometrical constructions. Lines, angles, triangle, quadrilaterals, polygons, Ellipse and types etc.. | METALS: Properties and use of cast iron, wrought iron Plain carbon steel, Alloy steel. Effect of Alloying elements and properties of metals |

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| 16. | BASIC REFRIGERATION. Familiarization & use of general and special tools used in refrigeration work practice. | Fundamentals of Refrigeration, units and measurements, & Pressure & its Measurements. | -do- | Laws of indices or exponents with examples. |
| 17. | Identification of various Refrigeration equipments & components of vapor compression system like , compressor, condenser, expansion valve and evaporator etc | Heat and Temperature, Different temperature scales, Thermometers, Units of heat sensible heat, latent heat, super heating and sub-cooling, saturation temperature , Ton of Refrigeration. | -do- | Properties and uses of copper, zinc, lead tin, aluminum etc., Properties and uses of Brass, Bronze as bearing material. |
| 18. | Working on soft copper tubing like, cutting, bending, flaring, swaging, pinching process & preparing flare joints. | Types of Refrigeration systems, Study the construction and working of vapor compression cycle, low side & high side components of vapor compression system like , compressor, condenser, expansion valve and evaporator, functions and applications of above components. | -do- | Meaning of tenacity, elasticity, malleability brittleness, hardness, ductility. |
| 19. | Brazing of tube joints (Cu to Cu, Cu to Steel, Cu to Brass) using (i) Air-LPG (ii) O2-LPG (iii) O2-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, fundamental operations involved in vapor compression and Vapor absorption systems . And study of three fluid system. | Introduction to Isometric views of simple objects such as cubes, rectangular block, prism, pyramid etc.. | Meaning of tenacity, elasticity, malleability brittleness, hardness, ductility. |
| 20. | REFRIGERATOR. Direct cooled Domestic Refrigerator stripping accessories & cleaning / inspection and installing refrigerator, testing of components, Checking Door | Study the types of Refrigerator construction, & components like compressor, Condenser, Capillaries & evaporators, suction | -do- | Heat and Temperature, Measurement of Temperature, Boiling and melting points. |

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| | alignment & replacing of gaskets. Tracing the electrical and mechanical components of sealed refrigerator. & Testing Thermostats & semi automatic defrost system, Testing of compressor, Identification of CSR Terminals, Starting of compressor without relay, & starting Relay & overload functions, Electric safety, checking. Reassembly & Testing performance. | Heat exchanger, door, gaskets, PUF Insulation, Electrical components & wiring drawings, | | |
| 21. | Cleaning, Flushing, replacing capillary and drier, fault rectification, evacuation, leak testing, gas charging in Refrigerator. | Importance of flushing evaporator and condenser, necessity of replacing capillary and drier. Evacuation, leak testing, gas charging method in refrigerator, Refrigerants used in Refrigerators. | Introduction to orthographic views of simple objects such as cubes, rectangular block, prism, pyramid etc.. In 1 st angle projection. | Different Temperature scales. Types of Thermometers and Properties of Mercury. Mutual Conversions. Absolute Temperature. |
| 22. | 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. Re assembly and testing operation. | Study the construction 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. | -do- | Quantity of Heat and its different units and their mutual relations. Related problems. Specific heat sensible Heat, Latent heat, super heat Total Heat, Enthalpy. Latent heat of Evaporation & Fusion. |

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| 23. | Trouble shooting in refrigerator. Rectifying faults of a) less cooling b) more cooling c) high current d) water leakage e) excess frost f) short cycling g) Noise | Study the faults, Causes and their remedies of Refrigerator. | -do- | Interchange of heat, (Principle of calorimetry) Co-efficient of linear expansion, Related problems |
| 24. | | | | Vapors and gases. Saturated and superheated vapors, Critical pressures and temperatures. Heat transfer conduction, Convection, Radiation. Thermal conductivity and Insulations. |
| 25. | Project works / Industrial visit (optional) | | | |
| 26. | Examination | | | |

TRADE: Mechanic(Refrigeration and Air-Conditioner)

SECOND SEMESTER

Semester Code: MRC;SEM-II

| Week No. | Practical | Theory | Engg. Drg. | W/Shop cal. & Science |
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| 1 | 2 | 3 | 4 | 5 |
| 1. | COMPRESSOR Dismantling of Hermetic compressors, Identification of components, Servicing, cutting gaskets, lapping and assembling, Add oil , check efficiency (pumping) compressors used in refrigerators, window & split A.C. types like, rotary wobble, swash plate, scroll, compressors. | COMPRESSOR Types & working principle of compressor like, Reciprocating, rotary , scroll, wobble, swash plate, lubrication method, Compressor efficiency factors, wet compression, | Simple isometric views of solid & hollow object. | Ratio & Proportions, Introduction, Examples Types of Proportions, direct proportion |
| 2. | -do- | -do- | -do- | Indirect proportions compound (Combined) proportions. |
| 3. | MOTORS Starting of compressor motor by RSIR, CSIR, PSC & CSR method. Check and test relay, capacitors & OLP's. | MOTORS Motors used in refrigeration And Air conditioning system, types, construction, & their starting methods. Function of Starting relay, Capacitors, OLP's. | -do- | ALGEBRA Algebraic symbol, addition, subtraction, multiplication, and division |
| 4. | CONDENSER Familiarization with condensers used in Refrigerators, Bottle coolers, visible coolers, Deep freezer, window and Split A.C, Cleaning, Flushing and servicing of air cooled condenser, leak testing of condenser. | CONDENSER Function of condenser, types, Construction of air cooled condenser, calculating Capacity of air cooled Condenser. Effect of choked condenser. | Simple orthographic views of solid & hollow object in 3 rd angle projection. | ALGEBRA Algebraic symbol, addition, subtraction, multiplication, and division. |

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| 5. | EXPANSION VALVE AND DRIER Replacing drier, capillary tube, in refrigerator and window AC. | EXPANSION VALVE AND DRIER Function of drier & Expansion valve used in domestic refrigeration and air conditioning systems. Capillaries, Automatic and Thermostatic Ex. Valves. | -do- | Simple equations |
| 6. | EVAPORATOR Servicing of evaporators in refrigerators, bottle cooler, water coolers, window and split A.C, Installation, Leak test, Flushing, Defrosting. | EVAPORATOR Working principle, Function, types of evaporators used in refrigerator, water coolers, bottle coolers, window and split A.C, Super heating in evaporators, Function of accumulator and types. Methods of defrosting. | -do- | Standard formulas, simple simultaneous equations with two unknown quantities. |
| 7. | REFRIGERANT Identification of refrigerant cylinders, Identification of unknown refrigerants, Recovery & Transfer of refrigerant, safe handling Cylinders and Valves, Leak testing, Evacuation, Charging refrigerants in Refrigerator. | REFRIGERANT Classification of refrigerants, Properties, Chemical name and formulas, HFC, CFC. Ozone rule, substitute of CFC, Montreal protocol & India's CFC/HCFC phase out schedules. Ozone rules 2000. Substitute refrigerants in lieu of CFC'S their properties & comparison with CFCs, HFCs and HCs. | -do- | Simple algebraic problems. Factorization Quadratic equations, Related problems. |
| 8. | -do- | -do- | Isometric views of Machining object. | Pressure Atmospheric, Absolute barometric and gauge pressures and vacuum pressure, Bourdon gauges, compound and vacuum gauges. |

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| 9. | RETROFITTING Retrofitting of a CFC filled Domestic Refrigerator with Hydrocarbons (HC) using sealed components. | RETROFITTING Changes of components & practices while retrofitting CFC appliances with HC refrigerants. Properties of HCs | -do- | Evaporation Boiling condensation Freezing Effect of pressure on these. Study of Tables & Charts. |
| 10. | Retrofitting of a CFC filled Domestic Refrigerator with HFC & change of components. | Changes of components & practices while retrofitting CFC appliances with HFCs, changes in compressor, lubricating oil, need of filter. | -do- | Gas Laws Perfect and real gases, Boyle's law Charles's law Dalton's law. Pascal's law Joule's law |
| 11. | 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. | -do- | Chemistry of common elements, like carbon, oxygen, Hydrogen & halogens. |
| 12. | REFRIGERATOR Familiarization of electrical and mechanical components. Check and replace electrical components, leak test, evacuation ,gas charging in system, wiring of refrigerator, installation of refrigerator. | REFRIGERATOR Function, construction ,working of single door refrigerator, trouble shooting, care and maintenance | Orthographic views of Machining object. In 3 rd angle projection. | -do- |
| 13. | -do- | -do- | -do- | Chemistry of Ammonia, Carbon Dioxide, CFCs, HCFCs, HFCs and HCs. |
| 14. | FROST FREE REFRIGERATOR (Double door) Identify faults, rectify defects, installation method, study wiring circuit ,evacuation, leak testing & gas charging, | Study the construction and working , testing methods, trouble shooting, timer function, defrost heater, PTC Relay Function etc.. | -do- | Work , power, Energy, Definitions and Their units, related problems. |
| 15. | Stripping of components. Tracing | Study the construction and working of 2 and 3 | -do- | Horse power of engines- IHP, |

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| | electric circuit, Installation, testing, evacuation, leak testing, gas charging. | door , testing methods, trouble shooting, timer function, defrost heater | | BHP, Mechanical Efficiency- and Related problems |
| 16. | THREE DOOR REFRIGERATOR Identify three and four door no frost refrigerators, testing, fault finding, rectifications, evacuation and gas charging. | THREE DOOR REFRIGERATOR Study the construction and its working. Care and maintenance, installation method. | Drawing of different types of <i>Screw</i> threads, locking devices, keys & cutters. | Uses and Sources of Energy. Kinetic and Potential Energy. Their applications & related problems |
| 17. | WINDOW/ROOM A.C Identify the electrical and mechanical components, servicing and maintenance, trouble shooting, installation, tracing wiring circuit, evacuation, leak testing, gas charging. | Introduction of Domestic Air conditioning. Their types, applications. Construction and other Details. | | Transmission of Motion & Power transmission By belt drive, gear drive, |
| 18. | Identify the electrical and mechanical components, servicing and maintenance, trouble shooting, installation, tracing wiring circuit, evacuation , leak testing ,gas charging. | WINDOW/ROOM A.C Study the construction and working of window A.C, Care and Routine maintenance, installation procedure. | -do- | Problems related to belt drives. Slack side, light side. $D_1N_1 = D_2N_2$ |
| 19. | Trouble shooting in window AC. Rectifying faults of a) less cooling b) more cooling c) high current d) water leakage e) short cycling f) Noise | Study the faults, Causes and their remedies of Window AC. | -do- | Problems related to gear drives. $T_1N_1 = T_2N_2$ |
| 20. | SPLIT A.C Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting. | SPLIT A.C Construction and working principle, types, trouble shooting & care and maintenance. | Trade Related symbols Electrical, Electronics and Mechanical | Compound gears and simple problems, |

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| 21. | SPLIT A.C (Wall Mounted) Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting. | SPLIT A.C (Wall mounted) Construction and working principle, types, trouble shooting. | -do- | Speed & Velocity Definition & Units. And Related calculations. |
| 22. | SPLIT A.C (Floor & Ceiling Mounted) Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting. | SPLIT A.C (floor & Ceiling mounted) Construction and working principle, types, trouble shooting. | Free hand sketches of trade related tools, instruments. | Rest & Motion, Scalars and Vector quantities, displacement, speed, velocity, acceleration & Retardation |
| 23. & 24. | CASSETTE AIR CONDITIONING Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting. | CASSETTE AIR CONDITIONING Construction and working principle, types, trouble shooting. | -do- | Equations of motion of a body. Motion under the force of gravity. |
| 25. | Project Works / Industrial visit (optional) | | | |
| 26. | Examination | | | |

TRADE: Mechanic(Refrigeration and Air-Conditioner)

THIRD SEMESTER

Semester Code: **MRC;SEM-III**

| Week No. | Practical | Theory | Engg. Drg. | W/Shop Calculation & Science |
|-----------------|--|---|---|---|
| 1 | 2 | 3 | 5 | 6 |
| 1. | WATER COOLER Identify parts, Controls & accessories Specification of Instantaneous and storage type water cooler. electric circuit. Soldering of Cu tube on Stainless steel ,trouble shooting of commonly faced problems like condenser fan failure, corrosion etc. Charging Refrigerant. Servicing & maintenance of water cooler. | WATER COOLER Study of water coolers, types, construction, Capacity & applications. Refrigeration cycle. Electrical & control system. Insulation, Knowledge about Retro fitting with HFC 134a or HCs. | Sectional Blocks and views and types of sections, (full, Half, Offset Sectioning) | Mensuration Geometric properties. Line, angle, triangle and circle. |
| 2. | VISIBLE COOLER AND BOTTLE COOLER Checking & servicing of Visible cooler & Bottle cooler preventive maintenance & trouble shooting Retrofitting with Hydrocarbons or HFC-134a | VISIBLE COOLER AND BOTTLE COOLER Visible cooler & bottle coolers. Description, Construction & function, Substituting R-12 with R-134a or Hydrocarbon. | -do- | -do- |
| 3. | DEEP FREEZER Deep freezer Checking & servicing , preventive maintenance & trouble shooting Retrofitting with Hydrocarbons or HFC-134a | DEEP FREEZER Deep freezer Description, Construction & function, Substituting R-12 with R-134a or Hydrocarbon | -do- | -do- |
| 4 | ICE CUBER Checking & servicing of ice cuber, preventive maintenance & trouble shooting. Trace the Electrical Circuit diagram. Dismantle the wiring & reconnect. Servicing the unit involving Evacuation, leak testing & charging. Checking defrosting cycle. | ICE CUBER Ice cuber Description, Construction, Components used working principle reverse cycle functioning & Circuit diagram , function, | -do- | Mensuration area of square, triangle, circle and ellipse. |

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| 5. | WALK IN COOLER & REACH IN CABINET Identify parts, Controls & accessories Specification of Walk in cooler & Reach in cabinet preventive maintenance & trouble shooting Servicing of attach components, wiring circuit. Servicing , leak testing, Evacuation, charging. | Walk in cooler & Reach in cabinet Details about components, their functioning, working principle, Circuit diagram, capacity & types of compressor used, | Drawing of rivet & riveted joints. | -do- |
| 6. | ICE CANDY PLANT Identify parts, Controls & accessories Specification, Checking ice candy plant temperature maintaining. Function of agitator, preparing Brine solution, trouble shooting, servicing, Retrofitting with HFC-134a. | ICE CANDY PLANT Function, construction, working principle, Circuit diagram, capacity & types of compressor used. Brine composition to maintain required temperature. | -do- | Calculation of area of triangle, polygon etc., Volume & weight of simple solid bodies. |
| 7. | ICE CREAM PLANT Identify parts, Controls & Specification of Ice cream plant temperature maintaining,, trouble shooting, servicing, Retrofitting with HFC-134a | ICE CREAM PLANT Details about components of Ice cream plant their functioning, working principle, Circuit diagram, capacity & types of compressor used, temperature maintaining. | -do- | Volume & weight of regular cone sphere. Volumes & weight of simple hollow bodies |
| 8. | COLD STORAGE Identify parts, Controls & accessories Specification, Servicing of Cold storage plant. involving Electrical controls, cooling system, components & controls | 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. | Drawing of different types, nuts & bolts, Studs, machine screws, Washers, foundation Bolts. Set screw and Grab Screw. | Logarithms introduction, |
| 9. | Installing compressor. Use of vibration eliminator and shock absorber, electrical wiring of the | Cold storage- type construction, capacity and specification. Method of installing compressor vibration eliminator and | -do- | Logarithmic reading from table, determination of characteristic & |

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| | compressor and checking the wiring system of the plant. | shock absorber there type and application. Study of lay out and electric wiring of the storage plant .Mobile refrigeration and air conditioning in transport vehicles | | antilogarithm. |
| 10. | Cold storage pressure testing, evacuation ,charging & performance& efficiency testing of the unit. Cold storage plant operation its maintenance. | 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. | -do- | Applications of logarithms. Finding cube roots, square roots. Etc.. using log. |
| 11. | COMMERCIAL COMPRESSOR Dismantling of Commercial type reciprocating compressor , checking of components & accessories. Checking & servicing valve plate and piston assembly, lapping valve plate etc. Fitting and testing | COMMERCIAL COMPRESSOR Types, Construction & applications of Open type compressor And working, Performance of reciprocating compressor volumetric efficiency, Capacity control, factor influencing volumetric efficiency. | -do- | Solution of complex problems using logarithms. Relation between log and antilog. |
| 12. | -do- | -do- | Drawing different types of clutches, coupling, bearing and lubrication systems. | Simple machines Effort & Load, mechanical advantage, velocity ratio, efficiency of machines |
| 13. | Checking lubricating system, servicing oil pump,[Fitting and testing] Checking and servicing of capacity control of the compressor. | Selection of lubricant, Function and characteristic of lubricant Types of lubrication methods such as splash , forced feed., | -do- | Relationship between mechanical advantage, velocity ratio, efficiency of machines. |
| 14. | checking and servicing of bearing, shaft seal etc. Fitting and testing , cutting gasket, assembling of compressor testing efficiency, | Construction and working principle of Centrifugal and Screw compressor. | -do- | Simple machines such as Pulley block, inclined plane, simple wheel and axle, differential wheel and axle ,simple screw jack, |

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| 15. | WATER COOLED CONDENSER Servicing of water cooled condenser & receiver. Checking, leakage, Repairing and testing De Scaling of condenser. | WATER COOLED CONDENSER Condenser its type and capacity, water cooled condenser their types construction and application. | -do- | Stress, strain, Introduction & their units. Types of stress, |
| 16. | Servicing evaporative condenser, checking, repairing and testing | Evaporative condenser- their function, construction and application. | Drawing of pulley and pulley drive gear and gearing | Modulus of Elasticity, Ultimate strength. Yield point, Ultimate stress, & working stress. |
| 17. | COOLING TOWER Servicing of cooling tower & its, care and maintenance | COOLING TOWER cooling tower types, Construction, capacity, advantage & disadvantages of different types of cooling tower. efficiency, Wet bulb approach and Cooling tower range. | -do- | Stress- Strain graph. Modulus of Rigidity. Poisson's Ratio, Bulk modulus, Related problems. |
| 18. | Servicing of ,water circulating pumps ,dismantling, repairing and assembling .Water softening and Ion removing plant- its care and maintenance. Water piping. | WATER TREATMENT Water treatment necessary, Causes of water contamination control of scale deposit, corrosion, Slime and algae, Water softening and De-scaling method, pump and fan used, | Trade related Drawing of engine compressor and pump parts such as piston, connecting rod, crankshaft valve etc., | Archimedes principle. Law of floatation, and use of Hydrometer. |
| 19. | EVAPORATOR Servicing of extended surface forced air cooled evaporators. servicing of Water/ brine chillers, check De-Frost system. | EVAPORATOR Plate & Tube forced air DX evaporators. Types of Defrost system .Water/ Brine chillers. Types of brine used as secondary refrigerant | -do- | Examples of floatation |
| 20. | Servicing of suction-liquid Heat- exchanger | suction-liquid Heat-exchanger, their function, construction, application & advantages | Trade related Drawing involving Circuit Diagram. | Study of weight, gravitation and centre of gravity. |
| 21. | EXPANSION VALVE Installation of thermostatic Ex. Valve. Internal & external equalizer connection, super heat adjustment in TXV. | EXPANSION VALVE Expansion valve types and function, construction, working principle, & their advantage & disadvantages..TXV, AXV Float valves, fixed and modulating orifice controls & electronic Ex. Valves. | -do- | Methods of finding centre of gravity figures, & centre of gravity of certain geometrical figures. |

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| 22. | Automatic EX valve fitting & checking, High side, Low side float valves checking and fixing. | Selection of Ex. valves, and capillaries for various Refrigeration and Air Conditioning applications. | Development of surface of simple object. | Study of Matter, mass. Volume, |
| 23. | Testing Solenoid valve on load and testing safety devices like HP, LP & OP Cut out. | Types of solenoid valve, safety controls used like HP, LP & OP Cut out, PRV's AFTS, & water flow switch & their working principle. | -do- | Density & specific gravity. Related Problems, |
| 24. | REVISION | | | General laws of Thermodynamics 1 st & 2 nd laws, Mechanical equivalent of heat. |
| 25. | Project Work / Industrial Visit(optional) | | | |
| 26. | Examination | | | |

TRADE: Mechanic(Refrigeration and Air-Conditioner)

FOURTH SEMESTER

Semester Code: **MRC;SEM-IV**

| Week No. | Practical | Theory | Engg. Drg. | W/Shop cal. & Science |
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| 1 | 2 | 3 | 4 | 5 |
| 1. | PSYCHROMETRY. Find DBT, WBT, RH & other properties by using psychrometric chart. Use of psychrometer. | Central Air Conditioning fundamentals, requirements of comfort A.C, study of psychrometric terms, DBT, WBT, RH, enthalpy, dew point, specific humidity. | Curves of Interpenetration | Graph-object & use of graph, Rules of plotting, graph interpolation |
| 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, | -do- | The plotting of coordinates, Representation of simple equation. |
| 3. | Servicing of Fans & blowers, motors, used in Air conditioning system. | Description of blowers& fans, function and types, static and velocity pressure measurements. | Isometric and Orthographic Views of complicated objects. | Estimating and costing Applied problems. |
| 4. | DUCT Installation of ducts, construction of ducts, understanding Duct lay out drawings, selection of ducts, insulation in ducts. Longitudinal and transverse joints. | DUCT Function, types, materials, duct designing, air distribution methods, air flow, | -do- | Trigonometry, definition & Trigonometric functions- |
| 5. | AIR FILTERS Servicing and maintenance of different filters, Installation of filter | AIR FILTERS Function of air filters, types, construction, maintenance, effect of choked Air filter. | -do- | Standard formulae. |
| 6. | SPLIT A.C (Ductable) Identifying various components, electrical circuits, testing components ,fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting. | SPLIT A.C (Ductable) Study of the Ductable split AC, its Construction and working principle, types, trouble shooting. | -do- | Relationship between Trignometrical ratios. |

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| 7. | 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 of Multi Split A C, its Construction and working principle, types, trouble shooting. | Conversion of simple orthographic views to Isometric views. | Measurement of angles. |
| 8. | PACKAGE A.C Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Installation, Trouble shooting. | PACKAGE A.C Package AC types, construction and working principle, trouble shooting. | -do- | Use of trigonometric table, applied problems. |
| 9. | -do- | Care and maintenance, installation method, application, capacity calculation. | -do- | Use of Logarithmic trigonometrical tables, applied problems. |
| 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, trouble shooting | Blue print Reading. | Trigonometrically values of certain degrees, Trigonometrical values for any angle. |
| 11. | CENTRALISED/INDUSTRIAL AIRCONDITIONING. Identifying various components, electrical circuits, testing components, fault detection, leak testing, evacuation, gas charging, Trouble shooting. | CENTRALISED/INDUSTRIAL AIRCONDITIONING. Construction and working principle, types, maintenance of Industrial Air-conditioning plant. | -do- | Area of triangle using Trigonometry, |
| 12. | 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. | -do- | Solution of triangles using sine rule and Cosine rule. |

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| | Installation, Trouble shooting. Operation & Maintenance of Central AC plant. | | | |
| 13. | INDIRECT/CHILLER SYSTEM Identifying various components, electrical circuits, testing components, fault detection, 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. | Trade related wiring circuit of window, Split, package and central Air conditioning. | Heights and Distances. Angle of elevation, Angle of Depression. And Applied problems. |
| 14. | 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. | -do- | Hygrometry, properties of Air relative and absolute humidity and other Properties. |
| 15. | 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. | Prepare charts related to trade. Like, Refrigerator, water coolers, freezers, Vapour compression cycle, vapour absorption cycle, all types of compressor & Expansion valves working cycle sketches. | Heat load calculations of Air Conditioning plant. Calculation of volume of room, various heat loads, A.C Tonnage calculation. |
| 16. | Controls used in Packaged AC systems, trouble shooting. | Controls used in AC system, Electromechanical, pneumatic and electronic. | -do- | Heat Treatment, Function of heat treatment, Critical temperature, |
| 17. | 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 | -do- | Different processes of heat treatment. Annealing, Normalising, Hardening, Tempering, Case hardening. |

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| 18. | AUTOMOBILE AC(car) Repair and maintenance of Car AC system, servicing, testing magnetic clutch operation, 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, free wheeling | -do- | Corrosion, corrosive. Action due to electrolytic and galvanic corrosion. Corrosion protection FORCE Definition, Units. Resultant force, Space and vector diagrams, |
| 19. | Repair and maintenance of car AC system, servicing, testing magnetic clutch, leak testing, evacuation, gas charging, | Construction, working of car AC, Magnetic clutch operation, frees wheeling. Effects of speed of engine. | -do- | Representation of force, Parallel force, couple, Law of Parallelogram forces, Law of triangular forces, kinds of equilibrium with some examples. |
| 20. to 24. | Studying / Execution of Repair and Preventive maintenance of different Commercial units at site | Planning for Preventive maintenance and scheduling of maintenance activities in large AC and Refrigeration plant | -do- | Lamia's Theorem. Resolution of forces, Applied problems,- |
| 25. | Revision | | | |
| 26. | Examination | | | |

Trade: Mech. Mechanic(Refrigeration and Air-Conditioner)

LIST OF TOOLS & EQUIPMENT

A. TRAINEES TOOL KIT FOR 16 TRAINEES +1 INSTRUCTOR

| SL.NO | Name of tools | Broad specifications | Quantity |
|-------|---|----------------------|-------------|
| 1. | File flat rough double cut | 200mm | 17 nos. |
| 2. | File, half round, fine double cut, | length 150mm | 17 nos. |
| 3. | File, round, fine double cut | length 150mm | 17 nos. |
| 4. | File flat, fine double cut, | length 150mm | 17 nos. |
| 5. | File square, fine double cut, | length 150mm | 17 nos. |
| 6. | File triangular fine double cut | length 150mm | 17 nos. |
| 7. | Scriber | 150mm length | 17 nos. |
| 8. | Centre punch | length 100mm | 17 nos. |
| 9. | Try square | 150 mm | 17 nos. |
| 10. | Divider spring joint | length 150mm | 17 nos. |
| 11. | Caliper spring joint in side | length 150mm | 17 nos. |
| 12. | Caliper, odd leg, spring joint | length 150mm | 17 nos. |
| 13. | Hammer ball pain | 220 gms | 17 nos. |
| 14. | Cold Chisel flat and cross cut | length 150mm | 17 nos. |
| 15. | Engineers rule | 300mm long | 17 nos. |
| 16. | Tape measuring | 10m graduation in mm | 17 nos. |
| 17. | Pliers combination insulated | length 200mm | 17 nos. |
| 18. | Pliers long nose | 200 mm | 17 nos. |
| 19. | Pliers flat nose | 150mm | 17 nos. |
| 20. | Line tester | 500 v heavy duty | 17 nos. |
| 21. | End cutting nipper | 15cm | 17 nos. |
| 22. | Tweezers | 10 cm | 17 nos. |
| 23. | Gloves for welding[Treated as consumable] | | 16+1 nos. |
| 24. | Leather Apron [Treated as consumable] | | 16+1 nos. |
| 25. | Surface plate | 45 x45 cms | 1no. |
| 26. | Oil can | 500 ml | 5 nos. |
| 27. | Surface Gauge universal | 150 mm | 5 nos. |
| 28. | Bench vice | 300mm jaw | 10 nos. |
| 29. | Hack saw tubular metal frame adjustable | 300mm | 10 nos. |
| 30. | Snip sheet metal straight nose | 200 mm | 10 nos. |
| 31. | Snip sheet metal curved nose | 200 mm | 10 nos. |
| 32. | Anvil | 100X200mm | 1no. |
| 33. | Stakes [different Types] | 100mm | 1 no each |
| 34. | Tin smith | 400mm | 1 No. |
| 35. | Wooden mallet /Nylon mallet | 500 gm good finish | 5 Nos. |
| 36. | Round Punch | 3mm,4mm,6mm | 5 Nos. each |
| 37. | Grover set | 4mm forming | 1 set |
| 38. | Electrical drill portable drill with chuck and key, | capacity 6.4mm | 5 nos. |
| 39. | Tape measuring graduation in mm | 2 m | 5nos. |
| 40. | Screw driver, plastic handle, | 6mm TIP length 100mm | 6nos. |

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| | | to 150mm | |
| 41. | Screw driver, plastic handle, Flat tip | 10mm TIP length 200mm & 250mm | 6 nos. each |
| 42. | Philips screw driver – | complete set in leather case | 5 nos. |
| 43. | Screw driver, plastic handle, Flat tip | handle 3mm TIP length 100mm to 150mm insulated | 5 nos. |
| 44. | Soldering iron exchangeable copper tip | 65 watts | 10 nos. |
| 45. | Knife folded stainless steel – | 150mm | 10 nos. |
| 46. | Tong tester (clamp on multimeter) | 0-10-30 amps 0-500 v | 5 nos. |
| 47. | Voltmeter, AC/DC portable precision grade Digital Panel board type | 0 to 500 volt | 5nos. |
| 48. | Ammeter, AC/DC portable precision grade Digital Panel board type | belt 0 to 5 amp | 5nos. |
| 49. | Ammeter, AC/DC portable precision grade Digital Panel board type | 0 to 30 amp | 5nos. |
| 50. | Megger | 1000v | 5nos. |
| 51. | Wattmeter multi-range up to | 1 KW | 1no. |
| 52. | Multimeter digital type | | 5nos. |
| 53. | Tenon saw | 250 mm | 5nos. |
| 54. | Firmer chisel | 6,12,25mm | 2 nos. |
| 55. | Rawal plug tool | 6 mm | 2 nos. |
| 56. | K.W. meter | 0 -1 K w | 4 no. |
| 57. | Fire extinguisher | ABC dry powder type2 kg capacity | 1 no. |
| 58. | Fire buckets | 10 Litre | 1 no. |
| 59. | D.E spanner | 6-32 mm | 5 set |
| 60. | Ring spanner | 6 -32 mm | 5 set |
| 61. | Diagonal cutter | 15 cm | 5 nos. |
| 62. | Service Oscillator | | 1 no. |
| 63. | C.R.O Single beam | 5 MHZ | 2 nos. |
| 64. | C.R.O Dual trace/ Double beam | 60 MHZ | 2 nos. |
| 65. | A.F.O Oscillators | | 2 nos. |
| 66. | Tong, Close mouth and pick up | | 1 no. |
| 67. | Welding table for gas/Arc | 1200x760 | 1each |
| 68. | Flaring tool set, single type for tube. | 4.7mm to 16mm O.D | 5 nos. |
| 69. | Swaging tool, punch type, set of size for tube. | 4.7mm to 16mm O.D | 5sets |
| 70. | Swaging tool, screw type with adaptor set of size for tube | 4.7mm to 16mm O.D. | 5sets |
| 71. | Bending spring external type, for copper tube | 3mm to 16mm DIA | 5sets |
| 72. | Pipe cutter miniature for copper tube | 3mm to 16mm DIA | 5sets |
| 73. | Pinch of tool, for copper tube, | 6mm to 18mm DIA | 5sets |
| 74. | Ratchet spanner of | 6.4 sq.mm reversible | 5sets |

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| 75. | Capillary plug gauge | | 5sets |
| 76. | Pinch of pliers/crimping pliers tool | 6mm – 18mm DIA | 5sets |
| 77. | Piercing pliers & reversing valve with access fitting | 6-18mm | 5sets |
| 78. | Spanner double ended | 4.7mm to 16mm | 5sets |
| 79. | Ring spanner off set | 4.7mm to 16mm | 5sets |
| 80. | Wrench adjustable | length 150mm | 5sets |
| 81. | Wrench adjustable | length 200mm | 5sets |
| 82. | Wrench adjustable | length 250mm | 5sets |
| 83. | Valve key handle[Treated as consumable] | – 4.7mm & 6.4mm sq. | 5sets |
| 84. | Pressure gauge Digital type | diameter 63mm with recalibration set | 5sets |
| 85. | Compound gauge, Digital type | diameter 63mm, with recalibration set screw, scale vacuum 76mm. Pressure 15 Kg/sq.cm | 5sets |
| 86. | Service man thermometer in metal case | – 30 C to +30 C | 5sets |
| 87. | Scissor, gasket cutting stainless steel | length 25mm | 5sets |
| 88. | L-Allen key | set size 1.5mm to 6.4mm | 5 sets |
| 89. | T-Allen key set | size 5/32” to 1/8” | 5sets |
| 90. | Pipe cutter with built in reamer and space cutter, for copper tube | 3mm to 32mm | 5nos. |
| 91. | Pipe /Tube bender lever type | 3-16 mm | 1 no each |
| 92. | Spanner double ended | 19mm to 31.8 mm | 5nos. |
| 93. | Pipe wrench | size 50mm to 150mm | 5nos. |
| 94. | Gas leak detector for halogen gas | | 5nos. |
| 95. | Sling psychro meter mounted on aluminium back, | scale 50 C to +50 C | 5nos. |
| 96. | Lapping plate | 250mm x 200mm | 2nos. |
| 97. | Hammer ball peen | 450 gms | 5nos. |
| 98. | Puller 3 legged with flexible arm | 300mm | 5nos. |
| 99. | Hand blower portable complete | 1/10 HP | 2nos. |
| 100. | Spirit level precision metallic | 200mm | 2nos. |
| 101. | Stop watch | | 2nos. |
| 102. | Tap set with matching drills | 3 mm to 16mm | 3nos. |
| 103. | Tap set with matching drills | ¼” to 5/8” | 3nos. |
| 104. | Refrigerant cylinder | 2.5 Kg | 3nos. |
| 105. | Vernier caliper | length 250mm | 2nos. |
| 106. | Micrometer outside measurement | 0 to 25mm | 2nos. |
| 107. | Heating kit with infrared bulb | (200 w capacity) | 2nos. |
| 108. | Plumbing hammer weight | 200 gm | 2nos. |
| 109. | Multimeter analogue type | | 5nos. |
| 110. | Tachometer digital, multi range | 0 r m p to 3000 r m p. Portable small size in leather case | 2nos. |
| 111. | Micron vacuum gauge | capable of reading upto 20 microns | 2nos. |
| 112. | Sensor thermometer (digital) | -50 degree Celsius to 150 degree Celsius | 2nos. |

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| 113. | Fin straightened/fin comb. | With strong steel wire based combing on wood | 3nos. |
| 114. | Filler gauge | 0.05 mm – 1 mm | 3nos. |
| 115. | Wire gauge metric and with worth | Steel plate embossing converse of British & Metric | 2nos. |
| 116. | Dial thermometer remote control, armored capillary dial | 75mm – 50C to +50 C | 3nos. |
| 117. | Anemometer Digital type | | 1no. |
| 118. | Compressors testers for small hermetic compressors | Fixed with electrical input/ output indicating facilities | 2nos. |
| 119. | Electrical accessories [Treated as consumable] | current and potential relays, start & run capacitors, PTCs overload protectors', relays contactors | As required |
| 120. | Engineers square | 150mm with 5' tolerance | 5nos. |
| 121. | Digital thermometer [Treated as consumable] | Graduated disc analogy type | 1no. |
| 122. | Temperature & Humidity recorder | Capacity to record 24 hrs record | 1no. |
| 123. | Electronic leak detector Digital type | Capable to detect of R134a, HC, R-22 | 2nos. |
| 124. | Instrumentation screw driver set | 100mm | 5nos. |
| 125. | Digital weighing machine | 100 kg | 1no. |
| 126. | Recycling unit | | 1 no. |
| 127. | Quick couplers/Self sealing coupler [Treated as consumable] | 1/4 - 3/8" | 2 pairs for each |
| 128. | Schrader valve [Treated as consumable] | | 1 each |
| 129. | Cylinder 134 a | 5 kg | 1 no. |

B. General Machinery Shop Outfit

| Sl.No | Name of Equipment | Broad specifications | Quantity |
|--------------|------------------------------------|---|-----------------|
| 1. | Split phase induction motor | ¼ hp, 230 V | 1 no. |
| 2. | Capacitor start induction motor | ½ Hp, 230 V | 1 no. |
| 3. | AC 3 Phase motor, 400/50 Hz | 2 Hp | 1 no. |
| 4. | Star delta starter | 2 hp | 1 no. |
| 5. | Auto Transformer starter | 3 hp | 1 no. |
| 6. | D.O.L Starter | 2 hp | 1 no. |
| 7. | Portable air – LPC brazing kit | 2 kg. LPC cylinder, torches, houses, stand make | 1 no. |
| 8. | Oxy-acetylene welding set complete | cylinders, regulators welding torches with difference nozzles | 1 no. |
| 9. | Refrigerator | 165L carrying with HFC-134a, & HC | 2 Each |

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| 10. | Frost free refrigerator | 200L carrying with HC blend | 2 nos. |
| 11. | Three/four door refrigerator | 300L carrying with HC R-600a | 2 nos. |
| 12. | Bench Drilling machine | 20 mm capacity,200-2500rpm | 1 no. |
| 13. | Grinding Machine | 200mm,3000rpm,Double ended 1/2 hp | 1 no. |
| 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. |
| 15. | Two stage rotary vacuum pump | capacity approx. 60 – 10rpm capable of evacuating to 50 microns of Hg and fitted with gas ballast, anti such back valve and single phase motor | 1 no. |
| 16. | Air compressor, | two stage for oil – less dry air, with rush proof tank assembly, heater and controls max. pr. 10 kgs /sq.m Capacity 45 ltr. Motor 1 hp. | 1 no. |
| 17. | Reciprocating compressor | provision of capacity control etc. for demonstration. Capacity 9000Kcal/hr. semi hermetic open type. | 1 no. |
| 18. | Dry N2 in cylinder | 2 stage regular or commercial N 2 in cylinder with drier unit and 2 stage regular 7meter cube | 1 no. |

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| 19. | Window A.C | 1 Ton with R-22 or HFC Blend reciprocating compressor | 2 nos. |
| 20. | Split A.C | 1.5 Ton with R134a or R-22 reciprocating compressor | 2 nos. |
| 21. | Duct able split A.C 1.5 ton | 1.5 Ton with R134a or R-22 reciprocating compressor | 1 no. |
| 22. | Recovery unit with cylinders | CFC & 134 a | 1 each |
| 23. | Heat pump | 3000 Kcal/hr | 1 no. |
| 24. | Cassette Air conditioner | 4500 kcal/hr with R-404 . | 1 no. |
| 25. | De scaling pump set | with stainless steel impeller and housing complete with motor 1/2 hp and accessories | 1 no. |
| 26. | Small capacity shell and tube condenser | 5 Ton with Cu tubing only | 1 no. |
| 27. | Fan coil unit | with water valves (2 & 3 way) | 1 no. |
| 28. | Shell and tube, DX chillers (small) | 5 Ton with Cu tubing only | 1 no. |
| 29. | Circulating water pump (small) | 0.5 H.P with stainless steel tank capacity 20 litres with in let/ outlet provision. | 1 no. |
| 30. | Shell and tube type condenser | 5 Ton | 1 no. |
| 31. | Rotary hermetic compressor | 2 Ton | 1 no. |
| 32. | Screw compressor | 5Ton | 1 no. |
| 33. | scroll compressor | 1Ton | 1 |
| 34. | Bottle cooler visible | 200 L carrying with HFC-134a& reciprocating compressor | 1 no. |
| 35. | Deep freezer | 200 L carrying with HFC-134a& reciprocating compressor | 1 no. |
| 36. | Water cooler storage type | 200 L carrying with HFC-134a& reciprocating compressor | 1 no. |
| 37. | 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. |
| 38. | Walk in cooler | 3 Ton cap. with open type compressor, water cooled condenser, providing with PUF insulated room sealed proof size 8X8X10Ft maintain 0 - 5 degree centigrade. | 1 no. |

| | | | |
|-----|--|--|-------|
| 39. | Air-conditioning, direct and indirect water chiller. | Complete with all controls including humidity control capacity 15000Kcal/hr | 1 no. |
| 40. | Package A/C | 7.5 ton capacity, Water cooled type with open type compressor reciprocating type | 1 no. |
| 41. | 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 |
| 42. | 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 provision with open rack. Frame square conduit of 1". top ½" sun mica ply board | 10 nos. |
| 2. | Work bench | 2000 x 1000 x 700 mm with 2" pipe frame. top with teak slab and fixing with ¾" good quality rubber sheet. | 10 nos. |
| 3. | Almirah | 195 x 90 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 | 4 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" | 4 no. |
| 13. | LCD PROJECTOR / LED / LCD TV | Big Size | 1 no. |
| 14. | Laptop | Latest version | 1 no. |
| 15. | UPS | 650 VA | 5 sets |
| 16. | Stool | | As required |
| 17. | Book Self with glass panel | | 1 No. |
| 18. | Storage rack | | As required |
| 19. | Storage shelf | | As required |