SunRise University

Approved by Govt. of Rajasthan vide Sunrise University Act, 2011
Recognized by UGC Act, 1956 u/s 2 (f)

STUDY, EVALUATION SCHEME & SYLLABUS

of Diploma COURSE

(Refrigeration & Air Conditioning)

SunRise University, Alwar

Evaluation Scheme
Refrigeration and Air conditioning

SEMESTER I											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				MS-I	MS-II		Total	TE	PE		
1	1DRC01	Basics of Refrigeration	30	20	20		40	60		100	2
2	1DRC02	Basics of Air Conditioning	30	20	20		40	60		100	2
3	1DRC03	Engineering Material	30	20	20		40	60		100	2
4	1DRC04	Soldering & De Soldering of Components & Emergency actions	30	20	20		40	60		100	2
5	1DRC05	Metrology and Measuring Instruments Lab	30				60		40	100	1
6	1DRC06	Heat Transfer lab.	30				60		40	100	1
7	1DRC07	Language Lab	30				60		40	100	2
8	1DRC08	Field Technician AC (ELE/Q 3102)						Any one Training 400 hrs/ 8 weeks		300	12
	1DRC09	Field Technician Refrigeration (ELE/Q 3103)									
	1DRC10	Field Engineer RACW (ELE/Q3105)									
Total			610							1000	24

SEMESTER II											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				MS-I	MS-II		Total	TE	PE		
1	2DRC01	Industrial Management	30	20	20		40	60		100	2
2	2DRC02	Total Quality Management	30	20	20		40	60		100	2
3	2DRC03	Entrepreneurship	30	20	20		40	60		100	2
4	2DRC04	Refrigeration & Air Conditioning Applications	30	20	20		40	60		100	2
5	2DRC05	Project 1	30				50		50	100	1
6	2DRC06	Basic Electrical and Electronics Lab	30				60		40	100	1
7	2DRC07	IT Tools Lab	30				60		40	100	2
8	2DRC08	Field Technician AC (ELE/Q 3102)						Any one Training (other than 1st sem) 400 hrs/ 8 weeks		300	12
	2DRC09	Field Technician Refrigeration (ELE/Q 3103)									
	2DRC10	Field Engineer RACW (ELE/Q3105)									

Total	**610**							**1000**	**24**

SEMESTER III											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				MS-I	MS-II		Total	TE	PE		
1	3DRC01	RAC Piping Systems – I	30	20	20		40	60		100	2
2	3DRC02	Refrigeration & Air-conditioning Material – I	30	20	20		40	60		100	2
3	3DRC03	Refrigerants	30	20	20		40	60		100	2
4	3DRC04	RAC Standards	30	20	20		40	60		100	2
5	3DRC05	Uni. Human Values & Ethics	30	20	20		40	60		100	2
6	3DRC06	RAC Material Lab	30				60		40	100	1
7	3DRC07	RAC Systems Installation and its Maintenance Lab. – I	30				60		40	100	1
8	3DRC08	Safety Tester – RACWO (ELE/Q3605)					Any one Training 400 hrs/ 8 weeks			300	12
	3DRC09	Field Engineer – RACW (ELE/Q3105)									
	3DRC10	Cold Storage Technician (FIC/Q7004)									
Total			610							1000	24

SEMESTER IV											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				MS-I	MS-II		Total	TE	PE		
1	4DRC01	RAC Piping Systems – II	30	20	20		40	60		100	2
2	4DRC02	Refrigeration & Air conditioning Material – II	30	20	20		40	60		100	2
3	4DRC03	RAC Maintenance – I	30	20	20		40	60		100	2
4	4DRC04	RAC Installation Techniques – I	30	20	20		40	60		100	2
5	4DRC05	Environment and Ecology	30	20	20		40	60		100	2
6	4DRC06	RAC Systems Installation and its Maintenance Lab. – II	30				60		40	100	1
7	4DRC07	RAC Piping Systems Lab	30				60		40	100	1
8	4DRC08	Safety Tester – RACWO (ELE/Q3605)					Any one Training (other than 3rd sem) 400 hrs/ 8 weeks			300	12
	4DRC09	Field Engineer – RACW (ELE/Q3105)									
	4DRC10	Cold Storage Technician (FIC/Q7004)									
Total			610							1000	24

SEMESTER V											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				MS-I	MS-II		Total	TE	PE		
1	5DRC01	RAC Maintenance ‐II	30	20	20		40	60		100	2
2	5DRC02	RAC Installation Techniques ‐II	30	20	20		40	60		100	2
3	5DRC03	Automobile Air conditioning	30	20	20		40	60		100	2
4	5DRC04	Non‐conventional Refrigerating System	30	20	20		40	60		100	2
5	5DRC05	Constitution of India, Law and Engineering	30	20	20		40	60		100	2
6	5DRC06	RAC Maintenance ‐II	30				60		40	100	1
7	5DRC07	RAC Installation Techniques ‐II	30				60		40	100	1
8	5DRC08	AC Specialist – Automobile (ASC/Q 1416)					Any one Training 400 hrs/ 8 weeks			300	12
	5DRC09	Assembly Operator (ELE/ Q 3501)									
Total			610							1000	24

SEMESTER VI											
S. No.	Subject Code	Subject	Total Teaching/ Training Hours	Evaluation Scheme				End Semester		Total	Credit
				MS-I	MS-II		Total	TE	PE		
1	6DRC01	RAC Safety	45	20	20		40	60		100	2
2	6DRC02	Process Planning and Cost Estimation	45	20	20		40	60		100	2
3	6DRC03	Indian Tradition, Culture and Society	30	20	20		40	60		100	2
4	6DRC04	Major Project	180						300	300	6
5	6DRC05	AC Specialist – Automobile (ASC/Q 1416)					Any one Training (other than 5th sem) 400 hrs/ 8 weeks			400	12
	6DRC06	Assembly Operator (ELE/ Q 3501)									
Total			610							1000	24

(Semester 1)

Bridge Course

Steam Generators: Types of steam generators - Fire tube, water tube boilers, boiler mountings and accessories, Equivalent evaporation, boiler efficiency, elements of power plant.

Reciprocating Steam Engines: Working principles, classification, a brief idea and concept only.

Steam Turbines: Classification, principle of operation of Impulse reaction steam turbines.

Steam Condensers: Principle of operation, classification, a brief concept, condenser details, applications

Air Compressors: Definition and their use, Difference between reciprocating and rotary compressors, their types and working, Inter cooling in two stage compression volumetric efficiency, Compressor lubrication. Simple numerical problems.

Basic Thermodynamics: Definition, concept of thermodynamic system and surroundings, closed system, open system, isolated system thermodynamics, definition of work, Zeroth law of thermodynamics, First law of thermodynamics for cyclic and noncyclical processes, Idea of internal energy and enthalpy, Applicability of first law on various thermodynamics processes, simple numerical problems.

Steady state flow process, its equation and its applications: Second law of thermodynamics, Thermodynamics concept of perpetual motion machine of first order and that of second order, Concept of heat engine, heat pump and refrigerator, Carnot cycle efficiency for heat engine and C.O.P for refrigerator and heat pump, Entropy: Its physical concept and significance.

1DRC01: Basics of Refrigeration

Unit 1

INTRODUCTION: Its meaning and application, unit of refrigeration; Various methods of refrigeration.

Unit 2

REFRIGERATION SYSTEMS: Refrigeration Cycles: Refrigeration, carnot cycle of refrigeration (ideal cycle), Bell- Coleman cycle of refrigeration, their COP and Conditions for its highest value, Temperature limitations. Representation of these cycles, in P-V, T-S and P-H diagrams and also their flow diagrams, Simple numerical problems .

Unit 3

Vapour compression system: Standard vapour compression cycle, wet and dry compression, Effect of sub cooling and super heating, Effect of temperature and pressure on COP of the cycle. Simple numerical problems with the help of P-H diagram. Concept of house hold refrigerator working on vapour compression cycle.

Unit 4

Vapour Absorption System: Cycle of operation, Construction and working of refrigerator based on this system. Simple numerical problems (Simple line diagram)

Unit 5

REFRIGERANTS: Definition, classification & properties of few important refrigerants such as Ammonia, Sulphur- Di- Oxide (SO2) Carbon Di Oxide (CO2) Freon- 12 (F- 12) F- 11. Qualities of good refrigerants, secondary refrigerant .

Suggested Reading:

Refrigeration and Air Conditioning: A Sarao

Refrigeration and Air Conditioning: RS Khurmi

1DRC02: Basics of Air Conditioning

Unit 1

INTRODUCTION: Its meaning and general application. Psychrometry: Definition, Composition of air, Daltons law of partial pressure, Gas and Vapour mixture, Dry and Wet bulb temperature, Wet bulb depression, Dew point, Dew point depression, Saturated air,

Unit 2

Specific humidity, Degree of saturation, Relative humidity, Absolute humidity, Humid specific volume and humid specific heat, Enthalpy of moist air,

Unit 3

Use of psychometric charts and tables, Sensible heating and cooling, Humidification and dehumidification and their methods, Simple numerical problems concerning above

Unit 4

HEAT LOAD: Brief idea of various types of heat loads, Sensible and latent heat loads. Sensible hat factor

Unit 5

ROOM AIR CONDITIONING: Brief idea of room air conditioning, Window types packaged air conditioner. Central air conditioning system, Round the year air conditioning

Suggested Reading:

Refrigeration and Air Conditioning: A Sarao
Refrigeration and Air Conditioning: RS Khurmi

1DRC03: Engineering Material

UNIT 1

ELECTRICAL ENGINEERING MATERIALS

Conducting Materials: Properties of good conducting materials, Brief idea about conductivity & Resistivity

UNIT 2

(a) Insulating Materials: (a) Plastic insulating materials- definition and classification, thermo setting and thermoplastic materials, their applications and commercial names & uses in industry. (b) Various insulating materials-mica asbestos, ceramic materials, glass, cotton, silk, jute, paper their properties and applications

(B) Semiconductor Materials: Characteristics and applications of semiconductor materials

UNIT 3

(A) Non-Metallic Materials-Timber. Preservation of timber, Defects of timber, Surface treatment, Plywood, Hard Board, Batten Board, Veneer board, units of purchase

(B) Miscellaneous Materials: Important properties, characteristics and use of the following materials: Abrasives, Asbestos, Celluloid, Cork, Mica, Refractory

UNIT 4:Mechanical Engineering Materials

Non-Ferrous Metals: Aluminium, Zinc, Copper, Tin, Silver, Lead-Trade names; Physical, mechanical, and electrical properties and use

(ii) Base metal with principal alloying elements- Aluminium Alloys, Copper Alloys, Nickel Alloys, Bearing Metals- Lead base alloys, Tin base alloys, (White metals or babbitt metals), Copper base alloys.

UNIT 5: Civil Engineering Materials

General idea of raw materials, properties and uses of Bricks, lime, cement

Foundation: (i) Bearing capacity of soil and its importance, need of foundation for machines (ii) Foundations for heavy, light and vibrating machines (iii) Concrete proportion, mixing w/c ratio, workability RCC and its use.

Suggested Reading:

Engineering Materials: DhanpatRai& Sons

Electrical Engineering Materials: Madan Publishers

1DRC04: Soldering & De soldering components & Emergency actions

1. Soldering & De Soldering of Basic Components
   - Soldering Tools
   - Different types of Soldering Guns related to Temperature and wattages, types of tips
   - Solder materials and their grading
   - Soldering and De Soldering Stations and their Specifications
   - Preparing Component for Soldering
   - PCB Applications
   - Types of PCB
   - Soldering Basic Components on PCB
   - De soldering Basic Components
   - Safety precautions while Soldering & De soldering
   - Check for cold continuity of PCB
   - Identification of loose/dry solder, broken tracks on printed wire assemblies & discrete components mounted circuit boards
   - Join the broken PCB track and test
   - De soldering using Pump and wick
   - Introduction of SMD Components

2. Introduction to SMD Components
   - Identification of 2, 3, 4 terminal SMD components
   - Soldering the SMD components on the PCB
   - Make the necessary settings on SMD soldering station to solder various ICs of different packages by choosing proper clamping tools
   - Identify various connections and the setup required for SMD soldering station
   - De solder the SMD components from the given PCB
   - Make the necessary settings on SMD soldering station to de solder various ICs of different packages by choosing proper clamping tools
   - Make a panel board using different types of switches for a given application
   - Identification of crimping tools for various IC packages
   - Reliable Soldering Practices

3. Emergency actions
   - Minimum Requirements

1DRC05: Metrology and Measuring Instruments lab.

1. Measurement of angle with the help of sine bar/ Vernier Bevel protractor.
2. Study and sketch of various types of optical projectors.
3. Study and sketch of various types of comparators and use them for comparing length of given piece.
4. To measure the diameter of a hole with the help of precision balls.
5. To measure external and internal taper with the help of taper gauges, precision rollers.
6. To test the squareness of a component with auto-collimeter.
7. To measure the pitch, angle and form of thread of a screw.
8. To measure the geometry of a gear having involute profile.
9. To measure the straightness of the edge of a component with the help of auto-collimeter.
10. To measure the length, breadth, thickness, depth, height with micrometer.
11. To measure the length, breadth, thickness, depth, height, with height gauge and Vernier calipers.
12. Calibration of Vernier calipers/micrometers.
13. Calibration of height gauge/depth gauge.
14. Study of a tool maker's microscope.
15. Checking of accuracy of snap gauge with slop gauge.
16. Checking of accuracy of a plug gauge with micrometer.
17. Measurement of areas by polar planimeter.
18. Use of feeler, wire, radius and fillet gauges measurement of standard parameters

1DRC06: Heat Transfer Lab.

Experiments on Conduction

1. Determination of Thermal conductivity of insulation powder
2. Determination of overall heat transfer coefficient of Composite Wall
3. Determination of overall heat transfer coefficient of Lagged Pipe
4. Determination of Thermal Conductivity of given Metal Rod

Experiments on Convection

5. Determination of heat transfer coefficient of Pin-Fin (Natural and Forced Convection)
6. Determination of heat transfer coefficient of Natural Convection
7. Determination of heat transfer coefficient of Forced Convection.

Experiments on Radiation

8. Determination of Stefan Boltzman Constant
9. Determination of Emissivity of test plate

Experiments on Applications of heat transfer and heat transfer with phase change

10. Determination of effectiveness and overall heat transfer coefficient using Parallel and Counter flow Heat Exchanger
11. Determination of heat transfer coefficient in drop and film wise condensation
12. Determination of Critical Heat flux
13. Study of heat pipe and its demonstration

(Semester II)

2DRC01: Industrial Management

Unit -1. Introduction:

Growth of industry, The management of men, materials and machines, the art of management, Sources of capital- industrial individual enterprise, private partnership and private Ltd. Co., Joint Stock Co. shares, debentures, financial agencies and their role in promoting industries. Break even analysis.

Unit-2. Private sector and public sector:

Public sector enterprise, merits and demerits of public sector industry and private sector industry, Line, staff and functional organizations, reasons for the choice of various types of organization, functions of different departments, viz. stores, purchase and sales departments relationship between individual departments.

Unit-3. Wages & incentives:

Definition of wages, real wage and nominal wage, systems of wage payment, incentives, financial and non financial incentives, Essentials of a good wage plan, essentials of a good incentive scheme. Introduction to elements of cost & indirect expenses, Material cost, labour cost, fixed and variable overheads, components of cost, selling price, Factory expenses, administrative expenses, selling & distribution expenses, depreciation, obsolescence, interest on capital, Idleness, Repair and maintenance.

Unit-4.Labour, industrial & tax laws:

Evolution of industrial law, factory act, workmen compensation act, payment of wages act, employee's state insurance act, Industrial dispute act. Role of technician in industry: Position of technician in various engineering departments, Role of a supervisor in industry, Foremanship, duties and qualities of a good foreman.

Unit-5. Material management:

Introduction, Scope of Material Management selective control techniques-ABC analysis, Material handling, inventory control, Essential steps in inventory control, quality standards

2DRC02: Total Quality Management

Unit-1. Introduction, Basic concepts

of total quality management

Introduction to Quality, Dimensions of Quality, Quality Planning, Concept and definition of quality cost, Determinants of Quality, Optimum cost of performance, Principles of TQM, Pillars of TQM, Introduction to leadership and Leadership roles, Quality council and Quality statement, Strategic Planning Process, Deming philosophy

Unit-2. Continuous process improvement

Input /output process Model, Juran trilogy, PDCA Cycle, 5 -'S' Housekeeping principle, Kaizen Seven tools of Quality (Q- 7 tools), Check Sheet, Histogram, Cause and effect diagram, Pereto diagram, Stratification analysis, Scatter diagram, Control charts, Control chart for variables & process capability, Control chart for attributes.

Unit-3. Management planning tools & Bench marking

Affinity diagram, Relationship diagram, Tree diagram, Matrix diagram, Matrix data analysis, Arrow Diagram, Process decision programme chart (PDPC), Concept of bench marking, Reason to bench marking, Bench marking process, Types of bench marking, Benefits of bench marking

Unit-4. Just in time (JIT)

JIT philosophy, Three elements of JIT, Principles of JIT Manufacturing, JIT Manufacturing building blocks, JIT benefits, Kanban& 2 Bin Systems

Unit-5. Total productive maintenance (TPM)

Concept of Total Productive Maintenance, Types of maintenance, OEE (Overall Equipment Efficiency), Stages in TPM implementation, Pillars of TPM, Difficulties faced in TPM implementation.

2DRC03: Entrepreneurship

Unit 1. Entrepreneurship

and entrepreneur:

Need of Employment and Opportunities, Essential Characteristics of a good Entrepreneur, Industrial Policy, Classification of industries- Micro, small scale , Medium scale, Large scale, Type of industries- Production, Job based & Service

Unit 2. Entrepreneurial Development:

Product identification/ selection, Site selection, Plant layout, Institutional support needed, Pre - market survey.

Unit 3. Entrepreneurship Support System and Start -ups:
Introduction to start-up's, Role of District Industries Centre in setting up industry, Function of NSIC, SISI, NISIET, NRDC, SSIC, SIDO, NMTC, KVIC, RSMML, Role of state finance corporation, state electricity corporations, pollution control board, BIS, I.S.O. etc.

Unit 4. Introduction to Tax System, Insurance and Acts:
Idea of income tax, sales tax, excise duty and custom duty, Industrial and fire insurance, procedure for industrial insurance, Introduction to Industrial acts, factory act, Workmen's compensation act 1923, Apprentices act 1961, Environmental protection act 1986.

Unit 5. Project Report Preparation:
Procedure of preparing a project report, Format of project report, Preparation of project report, Introduction to ISO: 9000 Series of Quality System

2DRC04: Refrigeration & Air Conditioning Applications

Unit I: Food Preservation

Introduction, factors contributing to food spoilage, causes of food spoilage, methods of food preservation, freezing method of food preservation, preservation of food with direct contact of liquid N2, freeze drying, preservation of different products, cold storage and commercial cabinets.

Unit II: Commercial Applications

Introduction, air- conditioning of houses, offices, hotels and restaurants, air -conditioning ofdepartmental stores, air- conditioning of theatres and auditoriums, hospitals and medical applications

Unit III: Ice-Manufacturing

Introduction, principles of ice production, different methods of ice manufacturing, treatment of water for making ice, brines, freezing tanks, ice cans, quality of ice

Unit IV: Industrial Applications

Introduction, importance of RH in different industries, ice -cream manufacturing, refrigeration for breweries, selection of refrigerant for breweries, use of liquid N2 for fabric, quality, air conditioning in textile and photographic industries

Unit V: Transport Air Conditioning

Introduction, automobile air conditioning, railway air-conditioning, marine air conditioning, aircraft air conditioning

Recommended books:

1. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
2. course in Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpatrai and sons, Delhi

Reference books:

1. Refrigeration and Air Conditioning by C.P.Arora, McGraw Hill education (India) (P) limited, New Delhi
2. Principles of Refrigeration by Roy J. Dossat, Pearson education, New Delhi

2DRC05 Project 1

On the basis of learning and skill acquired in the academic year, a project to be taken up by the student strengthening his/ her skills

2DRC06: Basic Electrical and Electronics Lab

Basic Electrical – Practicals

Verify that resistance of conductor is directly proportional to resistivity and length and inversely proportional to cross-sectional area of the conductor.

2. Verification of Ohm's Law.
3. Verification of temperature co-efficient of resistance:
(i) Positive for Tungsten and Nichrome and
(ii) Negative for carbon.
4. Study of series resistive circuits.
5. Study of parallel resistive circuits.
6. Study of series and parallel connection of cells in circuits.
7. Preparation of Electrolyte for lead acid battery and its charging and measurement of Specific gravity with the help of hydrometer.
8. To find heat efficiency of an electric kettle.
9. Charging and Discharging of a capacitor.
10. Verification of magnetic field of a Solenoid with:
(i) Iron core and
(ii) Air core.
11. Verification of Faraday's Laws of electromagnetic induction.
12. Verification of Torque development in a current carrying coil in magnetic field.
13. Study of R.L. series circuit and measurement of power and power factor.
14. Study of R.C. series circuit and measurement of power and power factor.
15. Study of R.L.C. series circuit and measurement of power and power factor.
16. Study of R.L.C. series circuit for calculation of inductive reactance, capacitive reactance, impedance and Q-Factor.

Basic Electronics – Practicals

1. Study of current and voltage measurement using Ammeter and Voltmeter.
2. Study of current and voltage measurement using Galvanometer.
3. Study of current, voltage and resistance measurement using of Multi-meter
4. Study of Power and Energy measurement using Wattmeter and Energy meter.
5. Study of working principle of Signal Generator and measurement of amplitude, time period and frequency of signal using Oscilloscope.
6. Study of V-I Characteristic of Diode.
7. Study of V-I Characteristic of Zener Diode. And use of Zener Diode as voltage regulator.
8. Study of Half wave rectifier with and without filter circuit.
9. Study of Full wave rectifier with and without filter circuit.
10. Study CE configuration for NPN and PNP transistors and measurement of voltage and current gain.
11. Study CB configuration for NPN and PNP transistors and measurement of voltage and current gain.
12. Study CC configuration for NPN and PNP transistors and measurement of voltage and current gain.
13. Study of working of single layer PCB manufacturing
14. Study of working of double layer PCB manufacturing.
15. Design of 7 segment display using LED and bread board.

Instruments Required (Electrical)

- Trainer kit for verifying ohm's law,
- Trainer kit for measuring TCR
- Lead acid battery,
- Hydrometer,
- Electric kettle
- Trainer kit for measuring power and power factor in RLC circuits

Instruments Required (Electronics)

- Ammeter
- Voltmeter,
- Multi-meter,
- Galvanometer,
- Energy Meter,
- CRO,
- Diode Trainer kit
- Zener diode Trainer kit
- Rectifier trainer kit
- Transistor characteristics trainer kit,
- PCB manufacturing Lab
- Bread board trainer kit to design 7 segment displays.

(Semester III)

3DRC01: RAC Piping

Systems – I

Bridge Course
Basic understanding Engineering Drawing

Unit I
Codes, Standards and Specifications: Piping codes, ASME codes and standards, ASTM Specifications,

Unit II
ASME Boiler, Pressure vessel codes, ASME B31-Code for pressure piping, mechanical strength, testing of piping system and valves, fabrications.

Unit III
Piping Components: Pipe-seamless, welded pipes, pipe sizes, dimensional specifications, material, specifications, pipe ends, pipe fittings, pipe support,

Unit IV
valves-gate valve, globe valve, check valve, ball valve, plug valve, butterfly valve, control valve, pressure relief valve, valve, codes and standard, valve size, pressure class rating.

Unit V
Viscosity, Reynolds number, friction factor, Darcy Weisback friction factor, friction factor for laminar and turbulent flows, equivalent pipe length, hydraulic radius, compressible, flow,

Recommended Books

1. Piping and Pipeline Calculations Manual by J. Phillip Ellenberger
2. The fundamentals of piping design by Peter Smith.

Reference Books:

1. Hand book of Air conditioning and refrigeration by Shan K Wang, McGraw-hill international edition, Singapore.
2. ASHRAE handbook, 2002

3DRC02:**Refrigeration & Air conditioning Material – I**

Unit I

Introduction, desired properties of ideal insulating material, factors effecting the thermal conductivity,

Unit II

types of insulating material., reflective insulating blinds, laprock – a thermal acoustic and fire insulation, natural insulator, new transparent heat insulator, heat transfer through insulation used for A.C,

Unit III

thickness of insulation, few insulated systems, low temperature insulations, importance of relative humidity for the selection of the insulations, air distribution for reducing heat lose.

Unit IV

Cables and Wiring: Cryocables, economics of cryocables, A.C. super conducting cables, liquid N2 cooled cables, Liquid H2 cooled cables, super magnet, electric generator, minimal insulated cables, installing cables

Unit V

Component Material: Refrigeration component material, duct material, material used in evaporator, material used in compressor, material used in condenser.

3DRC03:Refrigerants

Unit I

Introduction: Refrigerants, cooling media and liquid absorbents, azeotropic and zeotropic, numbering of refrigerants.

Unit II

Classification and Properties of Refrigerants: Requirement for refrigerant, classification based on working principle, safety and chemical composition, desirable properties of refrigerants - thermodynamic properties, safe working properties, physical properties etc

Unit III

Choice of Refrigerant: Important refrigerants, secondary refrigerant, anti-freeze solution, selection of refrigerant for required purpose,

Unit IV

Application of Refrigerants: refrigerant oils and applications, Properties and uses of commonly used refrigerant

Unit V

Greenhouse effect, Global warming, Future Refrigerants like Hydrofluoro -Olefines

Recommended books

1. A course in Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpatrai and sons, Delhi
2. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi

Reference books

1. Hand book of Air conditioning and refrigeration by Shan K Wang, McGraw -hill international edition, Singapore
2. Refrigeration and Air Conditioning by P.L.Ballaney, Khanna publishers, New Delhi

Modern Refrigeration and Air Conditioning by Andrew D. Althouse, Carl h. Turnquist and Alfred F. Bracciano, The goodheart- willcox company, INC

3DRC04: RAC Standards

Unit I

Introduction: Meaning of IS, need of IS, international classification of standards for refrigeration and air conditioning, various national and international standards for heating, ventilation and air conditioning

Unit II

Procedure of standard development, levels of standard, main standardization, organizations, i.e. ISO- international organization for standardization, IEC international electro technical commission and others international and national organizations

Unit III

Existing Standards: Main technical standards relevant to HCFC phase-out and low GWP (Global Warming Potential) alternatives, ISO, IEC, ECS (European Committee for Electrical Technical Standardization)

Unit IV

Adoption of International Standards at National Level: National standardization bodies, national ozone units, accreditation bodies, national RAC associations, the process of adoption

Unit V

Use of International Standards: In designing of refrigeration and air conditioning equipment, selection of materials related to refrigeration and air conditioning, safety issues related to refrigeration and air conditioning, industrial and field applications.

Recommended books

1. International Standards in Refrigeration and Air Conditioning , UNEP (United Nations Environment Program)
2. Refrigeration and Air Conditioning data book, New Age International Publication

Reference books

1. ISHRAE standard book for Refrigeration and Air Conditioning
2. ASHRE hand book for Refrigeration and Air Conditioning

3DRC05: Human Values & Ethics

3DRC06:RAC Materials Lab

Any eight of the following practical should be performed and recorded in laboratory book

1. Identification of types of copper tubes (dia. 3 mm, 6 mm, 12.5mm)
2. Identification of types of brazing road and its composition
3. Identification of oil and grease removals, fire hazard of the removals
4. Familiarization of joining material, gasket, pipe joint
5. Introduction of various insulating material, properties, fire hazard, etc.
6. Soldering and Brazing – types of brazing, preparation, purging. applying flux, applying heat.
7. Pipe Bending – Introduction to tools and different bends, pipe cutting.
8. Electrical requirement – introduction and familiarization with electrical symbols, circuit diagram of the RAC system
9. Introduction to gas welding set, simple gas welding, arc welding
10. Identification and testing of resistor, diodes and transistors
11. Identification of refrigerant cylinder by color coding and standing pressure – types of cylinder
12. Technique of glass wool filling method in conventional refrigerant.

3DRC07: RAC Systems Installation & Maintenance Lab. – I

1. Handling, use and familiarization with refrigeration tools and accessories such as: (a) Tube cutter (b) Tube bender [spring type] (c) Flaring tool (d) Swaging tool (e) Pinch off tools (f) Service valve wrench (g) Service valve (h) Adjustable wrench (i) Spanner set (j) Allen Key (k) Gauges (l) Blow lamp (m) Service cylinder (n) Gauge manifold (o) Wheel puller (p) Vacuum pump (q) Halide torch (r) Practicing of related operations.
2. Study of the following units: (a) Domestic refrigerator (b) Water cooler (c) Room Air conditioner (d) Evaporative cooler (e) Experimental ice plant.
3. Experimental ice plant.
4. Study of the following components and controls: (a) Compressor: open type and sealed types (b) Thermostatic expansion valve (c) Surface condenser (d) Different types of evaporators (e) Solenoid valve (f) Thermostat for refrigeration (g) H.P. and L.P. cut out (h) Gil safety switch (i) Strainers and driers.

(Semester4)

4DRC01: RAC Piping Systems – II

Unit I

Pipe Size Calculations: Pipe sizing, pipe sizing formulae, pipeline wall thickness calculation, elements of total dynamic head-static head, pressure head, velocity head, friction head, Pump power required, Cavitations in pumps, NPSH required and NPSH available for pumps.

Unit II

Pipe Stress Analysis: Objectives and definition of stress analysis, piping loads, piping stresses-primary, secondary, pipe span, calculations flexibility analysis-expansion loops and expansion joints, concept of thermal expansion, providing flexibility in piping

Unit III

Assembly and Erection: Fabrications materials for piping systems, fabrication drawings, fabrication processes, Assembly- alignment, flanged joints, threaded joints,

Unit IV

Piping System Testing: Examinations methods, visual examination, magnetic particle examination, Liquid penetrant examination, radiographic examination, ultrasonic examinations,

Unit V

Testing-leak, test, preparation for leak test, hydrostatic leak test, pneumatic leak test, sensitive leak test, examination of welds

Recommended Books

3. Piping and Pipeline Calculations Manual by J. Phillip Ellenberger
4. The fundamentals of piping design by Peter Smith.

Reference books:

2. Hand book of Air conditioning and refrigeration by Shan K Wang, McGraw -hill international edition, Singapore.
3. ASHRAE handbook, 2002

4DRC02: Refrigeration & Air conditioning Material – II

Unit I

Component Material: Material used in expansion valve, different type of valve material

Unit II

Material used in cooling towers, pipeline materials, drying materials, jointing, material, synthetic repair materials.

Unit III

Oils and Lubrication: Need of lubrication, types of lubrication, properties of lubrication oils, lubrication systems

Unit IV

Selection of refrigerant lubricant, compatibility of lubricant with refrigerant fluidrefrigeration oil with additives, the effect of refrigerant on lubricant density, solvent and cleaning.

Unit V

Tubing: Soft copper tubing, hard-drawn copper tubing, steel tubing, normal size copper tubing, Cutting tubing, bonding tubing, connecting tubing, flaring tubing.

Recommended books

1. A course in Refrigeration and Air Conditioning by S.C.Arora and S.Domkundwar, Dhanpatrai and sons, Delhi

Reference books

1. Modern Refrigeration and Air Conditioning by Andrew D. Althouse,Carl h. Turnquist and Alfred F. Bracciano, The goodheart- willcox company, INC

4DRC03: RAC Maintenance – I

Unit I

RAC Tools: Engineering hand tools: spanners, screwdrivers, pliers, hammers, brazing, welding, flaring tool, tube bender, hammer, wrenches, shock wrenches, files, hacksaws, wood saws, electrical hand drill, sheet metal snips, Allen keys pop riveter, chisels, pulley extractors, Center punch, wire brush, drill bits, oil can, knife, inspection lamp, bolt extractor

Unit II

Measuring equipment's - steel tape measure, feeler gauge, Caliper, micrometer, engineers levels, pocket type of thermometer, sling psychomotor, system analyzers, temperature analyzers, electronic leak detector, voltmeter, clamp on ammeter

Unit III

Specialist tools and accessories: flexible charging line, bending springs, pipe tube cutter, fin combs, soldering and brazing equipments, Vacuum pump, charging cylinders, electric test lamps, jumper lead, welding goggles

Unit IV

Pipe installation work, pumping down the system, purging the system, starting the plant

Unit V

Using a system analyzer, transferring and handling liquid refrigerant

Recommended books

1. A course in Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpatrai and sons, Delhi
2. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi
3. Electric controls for Refrigeration and Air Conditioning by B.C. Langley, D.B. Taraporevala sons and co. pvt.ltd., Bombay

Reference books

1. Hand book of Air conditioning and refrigeration by Shan K Wang, McGraw hill international edition, Singapore
2. Refrigeration and Air Conditioning by P.L.Ballaney, Khanna publishers, New Delhi
3. Modern Refrigeration and Air Conditioning by Andrew D. Althouse,Carl h. Turnquist and Alfred F. Bracciano, The goodheart willcox company, INC
4. Refrigeration and Air Conditioning Technology by William C. Whitman, William M. Johnson and John A. Tomczyk, Delmar Thomson learning, USA

4DRC04: RAC Installation Techniques I

Unit I

Introduction: Installation operation, adding oil, testing for leak detection

Unit II

Evacuation and dehydration, removing air, charging of the system, through suction valve, through discharge valve.

Unit III

Installation of Room Air-Conditioner: Selection of proper location, providing proper slope and provision for to drain water

Unit IV

Ventilation arrangement for window air conditioner, wiring diagram for installation for room air, conditioner

Unit V

Installation of split air conditioner, providing arrangement for pipes and pipe, pipe insulations

Recommended books

1. Air conditioning: procedures and installation by V. Paul Lang, CBS publishers &distributors, Delhi

2. Refrigeration Technicians pocket book by F.H. Meredith, Butterworths

4DRC05: Environment and Ecology

4DRC06: RAC System Installation & Maintenance Lab. – II

1. Leak detection in refrigeration system by different methods.
2. Air removal and charging of a refrigeration unit.
3. Testing of a refrigeration system to find out: (a) Refrigerating capacity (b) Power input c) C.O.P.
4. Determination of psychrometric properties of air with the help of a sling psychrometer and aspiration psychrometer.
5. Determination of bye pass factor of a cooling coil.
6. Determination of humidifying efficiency of a evaporative cooler.
7. Determination of cooling load for a specified situation.
8. Study of the following system by visit: (a) Ice Plant (b) Cold storage plant (c) Control air conditioning system.

SUGGESTED READING:

REFRIGERATION AND AIR CONDITIONING: A Sarao REFRIGERATION AND AIR CONDITIONING: RS Khurmi

4DRC07: RAC Piping Systems Lab.

List of Experiments
Any six of the following practical should be performed and recorded in laboratory book:

1. Study of piping codes, ASME codes and standards, ASTM Specifications
2. Study of Pipe-seamless, welded pipes, pipe sizes, dimensional specifications, material specifications, pipe ends
3. Study of pipe fittings-elbows, tees, flanges, butt welded end fittings, socket welded and threaded end fittings
4. valves-gate valve, globe valve, check valve, ball valve, plug valve, butterfly valve, control valve, pressure relief valve, valve codes and standard, valve size, pressure class rating.
5. Study of pipeline wall thickness calculation
6. Study of NPSH required and NPSH available for pumps
7. Study of piping load and piping stresses
8. Study of different leak detection methods
9. Checking the performance of air ducting system

(Semester 5)

5DRC01: RAC Maintenance II

Unit I

Checking the charge, electrical circuits (servicing), evacuation of the system, installation, and location of main components, leak detection methods

Unit II

Servicing Techniques: Piping and Joining Work, Burn out repair, capillary tube cleaning

Unit III

Charging the system, compressor work expansion valve (thermostatic), servicing, hermetic compressor motors (stating problems) repairing leaks, sealed system connections.

Unit IV

Electrical Fault Finding: Compressor motor fails to start, compressor motors tries to start but does not run, compressor motor starts but does not reach running speed, thermostat failure type, pressure cut-out failure, wiring and collection faults

Unit V

Mechanical Fault Finding: Fault analysis by temperature and pressure, methods of confirming the fault, finding the fault when the compressor is not running, abnormal noise problem, domestic system faults

5DRC02: RAC Installation Techniques – II

Unit I

Commercial Installations of Refrigeration Systems: Ice manufacturing plant, ice bank

Unit II

Commercial Installations of Refrigeration Systems: Cold storage plant, milk dairy plant

Unit III

Commercial Installation of Air Conditioning Systems: Office air conditioning, Hotel air conditioning

Unit IV

Central air conditioning, Designs, Factors of consideration for Central AC

Unit V

Automobile air conditioning: Need, Types, Selection of AC System, Ducts

5DRC03: Automobile Air Conditioning

Unit I

Introduction: Methods of refrigeration. Vapour compression refrigeration system, vapour absorption refrigeration system, applications of refrigeration & air conditioning, Automobile air conditioning, air conditioning for passengers, isolated vehicles, Refrigerated transport vehicles, applications related with very low temperatures, Study of Psychometric
charts: Psychometric properties, tables/charts, psychometric processes, comfort charts, factors affecting comfort, effective temperature, ventilation requirements.

Unit II

Refrigerants & AC Systems: Importance of Refrigerant- Classification, properties, selection criteria, commonly used refrigerants, alternative refrigerants, eco-friendly refrigerants; applications of refrigerants, refrigerants used in automobile air conditioning, Air Conditioning Systems- Classification, layouts, central / unitary air conditioning systems, System components, Switch and electrical wiring circuit.

Unit III

Design Automobile AC system: Load Calculations & Analysis- Design considerations for achieving desired inside/room conditions with respect to prevailing outside/environment conditions. Factors affecting/contributing towards the load on refrigeration & air conditioning systems, Cooling& heating load calculations, Load calculations for automobiles, Effect of air conditioning load on engine

Unit IV

Air Distribution: Air Distribution Systems- Distribution ducting, sizing, supply / return ducts, type of grills, diffusers, ventilation, air noise level, layout of duct systems for automobiles and their impact on load calculations
Electronic control : Air Routing & Temperature Control -Objectives of the dashboard re-circulating unit, automatic temperature control, controlling flow, control of air handling systems & air flow through evaporator care

UNIT V

AC Service & Control: Air Conditioning Service- Air conditioner maintenance & service - removing & replacing Components. Compressor service, Testing, Diagnosis & trouble shooting of air conditioning system, Refrigerant gas charging procedure &. Servicing of heater system, Air Conditioning Control - Common controls such as thermostats, humidistat, control dampers, pressure cut outs, relays.

5DRC04:-Non conventional Refrigerating System

1. Vapour Absorption Refrigeration System: Principle of absorption system, comparison between vapour compression system and vapor absorption system, theory of binary mixtures,
2. Aqua-ammonia vapour absorption system, theory of mixtures, temperature concentration diagram and enthalpy concentration diagram, processes used in aqua-ammonia absorption system, adiabatic mixing, separation, throttling process,
3. Vapour absorption system its components, working principle and mathematical analysis, b. Lithium-bromide- water absorption system its components, working principle, and mathematical analysis
4. Steam Jet Refrigeration System: Introduction, steam jet refrigeration system, components of steam jet refrigeration system, advantage and limitation of steam jet refrigeration system, performance of steam jet refrigeration system
5. Thermo-Electric Refrigeration System: Introduction, thermo-electric effects, Seebeck effect, Peltier effect, Thomson effect

Recommended books

1. A course in Refrigeration and Air Conditioning by S.C. Arora and S. Domkundwar, Dhanpatrai and sons, Delhi
2. Refrigeration and Air Conditioning by Manohar Prasad, New age international (P) limited, New Delhi

5DRC05: Constitution of India, Law and Engineering

5DRC06: Automobile AC Lab.

1. To study the load requirement of AC in the vehicle.
2. To design the AC System for the automobile according to the use.
3. To select the components for Automobile AC System
4. To install the AC System in automobile
5. To diagnose the fault in Automobile AC System
6. To conduct the mechanical repair in the Automobile AC System
7. To charge the Refrigerant in the Automobile AC System
8. To test the Automobile AC System.

5DRC07: AC Components and Assembly Laboratory

Any five of the following practical should be performed and recorded in laboratory book
1. To study hermetically sealed compressor, condensing units, performance, volumetric efficiency, performance of the ideal compressor and power requirement
2. To study different types of condensers and condenser design
3. To study different types of evaporators and evaporator performance, pressure drop in tubes, frost.
4. To study selection of expansion valves, and capillaries for various refrigeration and airconditioning

applications

5. Find out the heat rejection factor of condenser, condenser capacity, efficiency and effect of fouling factor

6. Capillary bore checking, performance test conducted by test rig (consisting of capillary tube and thermostatic expansion valve) for finding C.O.P.

7. Familiarization of capillary selection guide

(Semester 6)

6DRC01: RAC Safety

Unit I

Introduction to Industrial Safety: History and development of safety movement, need for safety, safety legislation: acts and rules, safety standards and codes, safety policy: safety organization and responsibilities and authorities of different levels, accident sequence theory, causes of accidents, accident prevention and control techniques, plant safety inspections, job safety analysis and investigation of accidents, first aid.

Unit II

Overview of Standard: ANSI/ASHRAE Standard, ANSI/ASME boiler and pressure vessel code, refrigeration, piping code, boiler and pressure vessel code, safety for refrigerant -containing components and accessories, nonelectrical, uniform mechanical code, basic national mechanical code

Unit III

Safety on the Job: Personal safety, protective clothing and equipment, harmful substances, safe work, practices, safety when working with electricity, refrigeration safety.

Unit IV

Safety for RAC Engineers: Types of accident, physical injuries from mechanical causes, use of tools and handling precautions, electrical injuries, electrical safety rules

Unit V

Injuries in RAC and Precaution: Refrigerant cylinder, corrosion, burn and other scalds, refrigerants and other gases Construction materials, fire fighting precautions, breathing, toxic gases, asphyxiation and precaution for the same.

Recommended books

1. "Air conditioning Systems principles, equipments and Services", Joseph Moravek, Prentice Hall

Reference books

1. "HVAC Handbook", Part I and II, ISHRAE
2. "Industrial refrigeration Hand Book", Wilbert F. Stoecker

6DRC02: Process Planning and Cost Estimation

1. Introduction to Process Planning:

Process Planning—Definition, Purpose of Process Planning, Concept of Process Planning, Objectives of Process Planning, Scope of Process Planning, and Information required to do Process Planning, Preparing Operation Planning Sheet

2. Process Planning activities:

Process Planning Procedure, Approaches of Process Planning, Manual Process Planning, Computer Aided Process Planning, Factors Affecting Selection Process, Machine Capacity,
Determination of Man, Machine and Material Requirements, Factors Influencing Choice of Machinery

3. Introduction to Cost Estimation:
Reasons for doing Estimates, Importance of Estimating, Objectives or Purpose of Estimating, Functions of Estimating, Cost Accounting of Costing, Importance of Costing, Aims of Cost Accounting, Difference Between Cost Estimating and Cost Accounting, Cost of Product (Ladder of Cost) Production Cost Estimation, Determination of Material Cost, Mensuration in Estimating

4. Assembly & Installation Time Calculation:
Time calculation: Study of RAC requirement, design of RAC System, Selection of RAC components & material, Fabrication of ducts and distribution system, installation of RAC System, Testing of RAC System.

6DRC03: Indian Tradition, Culture and Society

6DRC04: Major Project

On the basis of learning in the Diploma Programme, a project to be taken up by the student strengthening his/ her skills