

GOVERNMENT OF RAJASTHAN
BOARD OF TECHNICAL EDUCATION, RAJASTHAN, JODHPUR
 TEACHING AND EXAMINATION SCHEME FOR
Diploma III Year MECHANICAL(R.A.C) Engg.
SCHEME SESSION 2012 -2013 & ONWARDS

| Code No. | Subjects | Distribution of Time | | | | Distribution of Max. Marks/ Duration | | | | | | | | Total Marks |
|----------------------|---------------------------------|----------------------|----------|-----------|-----------|--------------------------------------|------|------------|------|------------|------------|-------|-------------|-------------|
| | | Hours per week | | | | Board's Exam. | | | | Sessionals | | | | |
| | | L | T | P | Tot | TH | Hrs. | PR | Hrs. | CT | TU | PR(S) | | |
| MR301 | Advance Refrigeration | 2 | -- | 2 | 4 | 70 | 3 | 50 | 3 | 30 | -- | 50 | 200 | |
| MR302 | Advance Air Conditioning | 2 | -- | 2 | 4 | 70 | 3 | 50 | 3 | 30 | --- | 50 | 200 | |
| MR303 | SystemControl & Instrumentation | 2 | -- | 2 | 4 | 70 | 3 | 50 | 3 | 30 | -- | 50 | 200 | |
| MR304 | Modern R.A.C. Practices | 2 | -- | 2 | 4 | 70 | 3 | 50 | 3 | 30 | -- | 50 | 200 | |
| MR305 | Refrigeration Application | 2 | -- | 2 | 4 | 70 | 3 | -- | -- | 30 | -- | 50 | 150 | |
| MR306 | Air Conditioning Application | 2 | -- | 2 | 4 | 70 | 3 | -- | -- | 30 | -- | 50 | 150 | |
| MR307 | A/C Design & Drawing | 1 | -- | 2 | 3 | 70 | 3 | -- | -- | 30 | -- | 50 | 150 | |
| MR308 | Refrigeration Design & Drawing | 1 | -- | 2 | 3 | 70 | 3 | -- | -- | 30 | -- | 50 | 150 | |
| MR309 | Fire Prevention & Protection | 2 | 1 | -- | 3 | 70 | 3 | -- | -- | 30 | 50 | -- | 150 | |
| MR310 | Industrial Management | 2 | 1 | -- | 3 | 70 | 3 | -- | -- | 30 | 50 | -- | 150 | |
| | Project | -- | -- | -- | -- | -- | -- | 100 | -- | -- | -- | -- | 100 | |
| | Total | 18 | 2 | 16 | 36 | 700 | | 200 | | 300 | 100 | | 1800 | |
| Grand Total : | | | | | | | | | | | | | 1800 | |

- | | |
|------------------------------------------------|------------------------------------------------------|
| 1. L : Lecture | 5. PR : Marks for Board's Examination for Practicals |
| 2. T : Tutorial | 6. CT : Marks for Class Tests |
| 3. P : Practical | 7. TU : Marks for Tutorials |
| 4. TH : Marks for Board Examination for Theory | 8. PR(S) : Marks for Practical and Viva |

ADVANCE REFRIGERATION

CODE MR 301

| L | T | P |
|---|----|---|
| 2 | -- | 2 |

RATIONALE

Looking to the increasing use of Refrigeration in day-to-day life, in depth knowledge of components used in this field is essential. This subject mainly deals with reciprocating compressors and other basic components of Refrigeration systems. Contents of this subject will provide detailed knowledge of various types of condensers, cooling towers, expansion devices and evaporators.

CONTENTS**1. Compressors:**

- 1.1 Rotary compressor
 - 1.1.1 Types
 - 1.1.2 Construction, working principle and performance
- 1.2 Centrifugal compressor
 - 1.2.1 Types
 - 1.2.2 Construction, working principle and performance
- 1.3 Screw compressor
 - 1.3.1 Construction, working principle and performance
- 1.4 Scroll compressor
 - 1.4.1 Construction, working principle and performance
- 1.5 Reciprocating Compressor
 - 1.5.1 Types, Construction, working principle and performance
 - 1.5.2 Compression cycle, Total volumetric efficiency
 - 1.5.3 Wire drawing, Piston and valve leakage
 - 1.5.4 Water jacketing, Wet compression, Mechanical efficiency
 - 1.5.5 Effect of suction, superheat and sub cooling on compressor Performance, Lubricating oil

2. Condensers :

- 2.1 Types
- 2.2 Condenser load
- 2.3 Condenser capacity
- 2.4 Quantity and temperature rise of condensing medium
- 2.5 Condenser applications
- 2.6 Air cooled condensers
 - 2.6.1 Types
 - 2.6.2 Air quantity and velocity
 - 2.6.3 Rating and selection
- 2.7 Water cooled condensers
 - 2.7.1 Types
 - 2.7.2 Rating and selection

- 2.8 Water cooled condensing system
 - 2.8.1 Waste water system
 - 2.8.2 Recirculated water system
- 2.9 Fouling rates
- 2.10 Evaporative condensers
- 2.11 Water regulating valve
- 2.12 Condenser controls

3. Cooling Towers :

- 3.1 Types
 - 3.1.1 Natural draft
 - 3.1.2 Mechanical draft
 - 3.1.3 Spray filled
 - 3.1.4 Deck filled
 - 3.1.5 Forced and induced draft
 - 3.1.6 Counter and cross flow
- 3.2 Cooling tower calculations
 - 3.2.1 Efficiency
 - 3.2.2 Amount of water evaporated
- 3.3 Amount of air to be handled
- 3.4 Tower rating and selection

4. Expansion Devices :

- 4.1 Types
 - 4.1.1 Capillary tube
 - 4.1.2 Automatic expansion valve
 - 4.1.3 Thermostatic expansion valve-internally and externally equalised
 - 4.1.4 Float valve-low and high side
- 4.2 Suitability of expansion device
- 4.3 Rating and selection

5. Evaporators :

- 5.1 Types
 - 5.1.1 Flooded
 - 5.1.2 Dry expansion
- 5.2 Types of construction
 - 5.2.1 Bare tube
 - 5.2.2 Finned tube
 - 5.2.3 Plate surface
- 5.3 Evaporator capacity
- 5.4 Advantage of fins
- 5.5 Log mean temperature difference
- 5.6 Effect of air quantity on evaporator capacity
- 5.7 Surface area
- 5.8 Evaporator circuiting

- 5.9 Evaporator T.D.
- 5.10 Effect of coil T.D. on space humidity
- 5.11 Effect of air circulation on product condition
- 5.12 Natural convection evaporators-rating and selection
- 5.13 Forced convection evaporators-rating and selection
- 5.14 Various types of liquid chilling evaporators

6. Defrosting:

- 6.1 Necessity
- 6.2 Defrosting interval
- 6.3 Methods of defrosting
 - 6.3.1 Water defrosting
 - 6.3.2 Electric defrosting
 - 6.3.3 Hot gas defrosting
 - 6.3.4 Reverse cycle defrosting
 - 6.3.5 Vapour defrosting
 - 6.3.6 Heat bank defrosting

7. System Equilibrium:

- 7.1 System balancing
- 7.2 Graphical analysis of system equilibrium
- 7.3 Effect of decreasing or increasing evaporator capacity
- 7.4 Effect of decreasing or increasing condensing unit capacity

PRACTICALS

- 1. To determine bypass factor of an evaporator.
- 2. To determine effectiveness of a cooling tower.
- 3. To calculate friction losses and pressure drop through different expansion devices.
- 4. To calculate the capacity and efficiency of different types of condensers.
- 5. To calculate the capacity and efficiency of different types of evaporators.
- 6. Study of open type reciprocating compressor.
- 7. Study of semi sealed type reciprocating compressor.
- 8. Study of hermetically sealed type reciprocating compressor.
- 9. Study the constructional details of rotary compressor.
- 10. Study the constructional details of centrifugal compressor.
- 11. Study the constructional details of screw compressor.
- 12. Study the constructional details of scroll compressor.

REFERENCE BOOKS:

- 1. A Course in Refrigeration & Air Conditioning Domkundwar & Arora
- 2. Principles of Refrigeration Roy J.Dossat (S.I. Edition)
- 3. Refrigeration & Air Conditioning C.P.Arora

ADVANCE AIR CONDITIONING

CODE MR 302

L T P
2 -- 2**RATIONALE**

This subject deals with modern systems and system components used in Air Conditioning practice. An important topic evaporative cooling, which is very useful in hot and dry climate of Rajasthan, is also included. Quality of air inside the conditioned space is now a day becoming very important, therefore proper emphasis is given on subject matter.

CONTENTS**1. Ventilation:**

- 1.1 Necessity of ventilation
- 1.2 Quantities of ventilating air required
- 1.3 System of ventilation
 - 1.3.1 Central ventilation systems
 - 1.3.2 Unit ventilators
- 1.4 System of air distribution
 - 1.4.1 Upward flow system
 - 1.4.2 Downward flow system
 - 1.4.3 Ejector system
- 1.5 Laminar flow air distribution for operation theatre

2. Air Purification :

- 2.1 Odour suppression and air sterilization
- 2.2 Classification of aerosols
- 2.3 Classification of air cleaners
 - 2.3.1 Viscous impingement type
 - 2.3.2 Dry type
 - 2.3.3 Cyclone
 - 2.3.4 Rotoclone
 - 2.3.5 Electro static type
 - 2.3.6 Air washers
- 2.4 Cleaning efficiency
- 2.5 Different type of filters eg microvee, HDPE & HEPA filters

3. Air Distribution:

- 3.1 Schematic diagram of typical air distribution system and identification of all the components
- 3.2 Duct shapes and materials
- 3.3 Duct fittings and joints
- 3.4 Duct systems
- 3.5 Air distribution outlets
 - 3.5.1 Types
 - 3.5.2 Functions
 - 3.5.3 Location
- 3.6 Definition of terms connected with outlets

4. Fans :

- 4.1 Fan classification
- 4.2 Fan nomenclature
- 4.3 Fan discharge and arrangement of drive
- 4.4 Total pressure difference developed by a fan
- 4.5 Fan air horse power
- 4.6 Fan efficiencies
- 4.7 Fan selection

5. Solar Heating and Cooling :

- 5.1 Introduction to solar theory
- 5.2 Solar energy-its source of measurement
- 5.3 Solar radiation at the earth's surface
- 5.4 Effect of angle of tilt
- 5.5 Solar heating systems
 - 5.5.1 Approach to solar heating system design
 - 5.5.2 Passive system design
 - 5.5.3 Direct gain systems
 - 5.5.4 Green house systems
 - 5.5.5 Active system design
- 5.6 Flat plate solar collector
- 5.7 Heat storage capabilities
- 5.8 Methods of heating the space
- 5.9 Solar cooling systems
 - 5.9.1 Solar driven absorption cooling
 - 5.9.2 Solar driven Rankine-cycle cooling

6. Water Conditioning Systems :

- 6.1 Design considerations
- 6.2 Fouling factor
- 6.3 Water conditioning chemicals
 - 6.3.1 Feeding equipments
 - 6.3.2 Method of feeding
- 6.4 Corrosion control
- 6.5 Slime and algae control

7. Heating Methods :

- 7.1 Classification
- 7.2 Heating with warm air furnace
 - 7.2.1 Floor furnace
 - 7.2.2 Wall furnace
- 7.3 Heating with steam
 - 7.3.1 One pipe system
 - 7.3.2 Two pipe system
- 7.4 Heating with hot water
 - 7.4.1 Gravity flow system
 - 7.4.2 Forced flow system

- 7.5 Panel heating
 - 7.5.1 Floor heating
 - 7.5.2 Wall heating
- 7.6 Coil arrangement

8. Sound and Vibration Control :

- 8.1 Sound power and sound power level
 - 8.1.1 Sound intensity and characteristics
 - 8.1.2 Loudness or loudness level
- 8.2 Noise, noise level
- 8.3 Motor sound sources
- 8.4 Sound control for outdoor machine
- 8.5 Sound control for indoor machine
- 8.6 Acoustic treatment for duct system
- 8.7 Vibration isolation
- 8.8 Vibration isolation materials

PRACTICALS

1. Determination of bypass factor of cooling coil.
2. Determination of bypass factor of heating coil.
3. Study of air distribution components like grilles, registers, diffusers, control vanes, dampers etc.
4. Study of duct fittings and joints.
5. Measurement of air velocity by anemometer.
6. Test the capacity and efficiency of centrifugal blower.
7. Determination of the condenser load for a window type air-conditioner.
8. To determine the operating characteristics of direct expansion unit coupled with air-cooled condensing unit.
9. To determine apparatus dew point and air dew point in air-conditioned room at various room conditions.
10. To study air handling unit.
11. Measurement of sound from different sources.
12. Study of various vibration isolation materials and equipments.
13. Study of radiant heating equipment.

REFERENCE BOOKS :

- | | |
|-------------------------------------|-----------------------------|
| 1. Modern Air Conditioning Practice | Norman C.Harris |
| 2. Air Conditioning & Refrigeration | Severns & Fellows |
| 3. Principles of Refrigeration | Roy J.Dossat (S.I. Edition) |
| 4. Refrigeration & Air Conditioning | Althouse A.D. |

SYSTEM CONTROL & INSTRUMENTATION

CODE MR 303

L T P
2 -- 2**RATIONALE**

Modern systems are controlled by electronics devices. Systems runs continuously and the operation of equipments should be accurate enough. To make them precise, various control devices are employed. These devices help in maintaining the system operational. Also, maintenance of these devices must be a part of study for learners. The contents of this course will provide knowledge of these control instruments.

CONTENTS**1. Introduction :**

- 1.1 Elementary control system
- 1.2 Purpose of control
- 1.3 Control actions
- 1.4 Energy source for control systems

2. Electric Controls :

- 2.1 Motor control principles
- 2.2 Low voltage control
- 2.3 Refrigeration electric motor controls
- 2.4 Starting relays
 - 2.4.1 Current relay
 - 2.4.2 Potential relay
 - 2.4.3 Thermal (hot wire) relay
- 2.5 Over load protector
 - 2.5.1 Two point
 - 2.5.2 Three point

3. Safety Controls :

- 3.1 High pressure cut out
- 3.2 Low pressure cut out
- 3.3 Oil pressure failure switch

4. Control of mechanical refrigeration :

- 4.1 Capacity control requirement
- 4.2 Suction pressure control of compressor
- 4.3 Temperature control of compressor
- 4.4 Control of multiple compressor
- 4.5 Various methods of compressor capacity control
- 4.6 Control of distribution
 - 4.6.1 Liquid refrigerant
 - 4.6.2 Chilled water
 - 4.6.3 Air
- 4.7 Thermostat
- 4.8 Humidistat

5. Control of Residential Air Conditioning :

- 5.1 Control of chilled water coil
- 5.2 Control of d-x coil
- 5.3 Control of year round central a/c unit
- 5.4 Control of heat pump

6. Control of Commercial Central Fan Cooling System :

- 6.1 Types of cooling equipments
- 6.2 Control of system using cold water cooling coil
- 6.3 Control of system using d-x cooling coil
- 6.4 Proportional control of multistage compressor
- 6.5 Control of air washer system
- 6.6 Control of dehumidifying systems
- 6.7 Control of systems requiring reheat
- 6.8 Control of out door air dampers

7. Measuring Instruments:

- 7.1 Temperature measuring instruments
 - 7.1.1 Thermometers
 - 7.1.2 Thermocouples
 - 7.1.3 Thermister resistance thermometer
- 7.2 Pressure measuring instruments
 - 7.2.1 Pressure gauges
 - 7.2.2 Manometers
- 7.3 Humidity measuring instruments
 - 7.3.1 Psychrometer
 - 7.3.2 Dew point hygrometer
 - 7.3.3 Chemical hygrometer
- 7.4 Flow measuring instruments
 - 7.4.1 Pitot tube
 - 7.4.2 Anemometer
 - 7.4.3 Hot wire resistance anemometer
 - 7.4.4 Rotameter

PRACTICALS

1. Study of starting relays
2. Study of over load protectors.
3. Study of low-pressure cutout and setting of cut- in and cut- out pressures.
4. Study of high-pressure cutout and setting of cut- in and cut- out pressures.
5. Study of oil pressure failure switch and setting of cut- in and cut- out pressures.
6. Study and comparison of different humidity measuring devices.
7. Measurement of air pressures in duct.
8. Study and comparison of different pressure measuring devices.
9. Study and working of thermostatic switch.
10. Study and working of humidistat.

REFERENCE BOOKS:

- | | |
|------------------------------------------------------|-----------------|
| 1. Automatic Control of Heating and Air Conditioning | John E.Haines |
| 2. Principles of Refrigeration | Roy J.Dossat |
| 3. Mechanical Measurements | Beckwith & Bunk |

MODERN R.A.C. PRACTICES

CODE MR 304

| | | |
|---|----|---|
| L | T | P |
| 2 | -- | 2 |

RATIONALE

This subject is tailored to cover the specific needs of service centres for modern refrigeration and air conditioning in all its branches such as domestic, commercial, air conditioning, automotive air conditioners, thermoelectric and special devices and their applications. Subject caters to develop the skill of technician for up to date methods of installing, maintaining, diagnosing and repairing.

CONTENTS

- 1. Construction and working principles of the following :**
 - 1.1 Two way service valve
 - 1.2 Gauge manifold
 - 1.3 Strainer / Dryer
 - 1.4 Oil separators

- 2. The working principles of the following refrigeration valves :**
 - 2.1 Thermostatic expansion valve
 - 2.2 Electronically operated expansion valve
 - 2.3 Expansion valves for ammonia
 - 2.4 Solenoid valve
 - 2.5 Electronic liquid level regulator

- 3. The working principles of the following water valves :**
 - 3.1 Ball Valve
 - 3.2 Butterfly Valve
 - 3.3 Balancing Valve
 - 3.4 Check valve
 - 3.5 Air vent

- 4. The working principles of the following pressure and Temperature Control Devices :**
 - 4.1 Pressure transmitters
 - 4.2 Evaporating pressure regulators
 - 4.3 Condensing pressure regulators
 - 4.4 Electronically controlled temperature regulators

- 5. The working principles of the following instruments/ Devices :**
 - 5.1 Electronic leak detector
 - 5.2 Halide torch
 - 5.3 Gas recovery Unit

- 6. Diagnosis of fault and repair of Window A/C, Water Cooler and Refrigerator.**

PRACTICALS

1. Various methods of locating refrigerant leak.
2. Removing air from refrigeration system, flushing the system and pressure testing.
3. Charging the system through low sides and high side.
4. Recovering the refrigerant from system.
5. Compressor servicing - gasket cutting, oil changing, grinding valve plates.
6. Rewiring and installation of window air conditioner, water cooler and refrigerator and fault finding.
7. Practical visits to modern plants for the study of various devices.

REFERENCE BOOKS :

1. Various Manuals of Danfoss Industries (P) Ltd
2. Refrigeration Servicing Paul & Goliber
3. Refrigeration Air conditioning Althouse
4. Air Conditioning Installation & Maintenance Earnest Tricomi

* * * * *

REFRIGERATION APPLICATION

CODE MR 305

| | | |
|---|----|---|
| L | T | P |
| 2 | -- | 2 |

RATIONALE

Refrigeration and Air-conditioning is considered as the key note of human's comfortable life. The refrigeration branch has vast field of applications right from daily life to industrial uses. Its application in medical sciences has helped in saving human life. The contents of the course comprise of application of refrigeration in food preservation, dairy production, warehouse practice and transport refrigeration. Study of the above aspects will enhance the knowledge of the students.

CONTENTS**1. Food Preservation :**

- 1.1 Factors responsible for spoilage and deterioration
- 1.2 Control of spoiling agents
- 1.3 Refrigerated storage
- 1.4 Storage conditions
- 1.5 Methods of freezing

2. Refrigeration in dairy industry :

- 2.1 Milk plants
- 2.2 Effect of temperature on bacteria growth
- 2.3 Requirement of refrigeration for handling milk at the farms and market milk plants.

3. Refrigerated warehouse practice :

- 3.1 Location of plant
- 3.2 General plan
- 3.3 Division of refrigerated space.
- 3.4 Construction types.
- 3.5 Fire protection
- 3.6 Refrigeration requirement and distribution

4. Transport refrigeration :

- 4.1 Refrigerated trucks and trailers
- 4.2 Insulated body construction and installation of cold plates
- 4.3 Railway refrigerated cars
 - 4.3.1 General constructional features
- 4.4 Merchant ships
 - 4.4.1 Typical arrangement of marine food storage plant

5. Refrigerators :

- 5.1 Commercial and house hold refrigerators
- 5.2 Food freezers
- 5.3 Salient features of various Indian make refrigerators.
- 5.4 Frozen food locker plant.
- 5.5 Bottled beverage coolers and refrigerated vending machine.
- 5.6 Drinking water coolers of various types.
- 5.7 Salient features of Indian make drinking water coolers

6. Ice manufacture :

- 6.1 Ice plant components
- 6.2 Refrigeration equipment
- 6.3 Ice storage
- 6.4 Lay-out of a typical ice-plant
- 6.5 Flake, cube and dry ice.
- 6.6 Ice making machines:-continuous, flake, and soft.

7. Medical Application:

7.1 Fever therapy, cold therapy and refrigeration anaesthesia

PRACTICALS**Visit to :**

1. Ice plant
2. Dairy plant
3. Cold storage plant
4. Deep freezer plant
5. Refrigerated truck.
6. Comparative studies of various Indian make refrigerators.
7. Comparative studies of various Indian make water coolers.

REFERENCE BOOKS :

- | | |
|--------------------------------|---------------|
| 1. Principles of Refrigeration | Dossat R.J. |
| 2. Principles of Refrigeration | Marsh & Olivo |
| 3. ASHRAE Handbooks | |

CODE MR 306

AIR CONDITIONING APPLICATIONL T P
2 -- 2**RATIONALE**

R.A.C. student needs to apply his knowledge of Air conditioning to different fields. This subject will expose student to some of the most common applications of air conditioning.

CONTENTS**1. Automotive Air Conditioning :**

- 1.1 General arrangement of air conditioning equipment for car and bus.
- 1.2 Rear and front end air conditioning system
- 1.3 Types of compressors
- 1.4 General arrangement of equipments on railroad passenger car.
- 1.5 Typical layout of air conditioning plant for aircraft and passenger ships.

2. Hospital Air Conditioning :

- 2.1 Infection problem
- 2.2 Air quality, cleaning, movement and zoning
- 2.3 Air conditioning systems
 - 2.3.1 Limited system
 - 2.3.2 Total system
 - 2.3.3 Room A/C
- 2.4 Design Criteria
 - 2.4.1 Administrative Department
 - 2.4.2 Diagnostic and treatment facilities
 - 2.4.3 Nursery
 - 2.4.4 Nursery Department
 - 2.4.5 Surgical Department
 - 2.4.6 Obstretical Department
 - 2.4.7 Emergency Department
 - 2.4.8 Service Department

3. Textile Application :

- 3.1 Manufacturing Processes
 - 3.1.1 Yarn making
 - 3.1.2 Fabric making
- 3.2 The cotton system
- 3.3 Atmospheric conditions
- 3.4 Woolen and worsted systems
- 3.5 Preparatory processes
- 3.6 Factors, which determine optimum conditions
- 3.7 Air conditioning systems

4. Printing Plant Air Conditioning :

- 4.1 Paper characteristics
- 4.2 Multicolour offset lithography
- 4.3 Air conditioning of multicolour off set lithography plant
- 4.4 Control of paper

5. Libraries and Museum Air Conditioning :

- 5.1 Effect of ambient atmosphere
- 5.2 Benefits to Exhibits
- 5.3 System Design
 - 5.3.1 Design conditions
 - 5.3.2 Load calculations
 - 5.3.3 Equipment
 - 5.3.4 Air transmission and distribution
- 5.4 Maintenance

6. Air Conditioning for Photographic Materials :

- 6.1 Manufacturing
- 6.2 Storage of unprocessed photographic materials
- 6.3 Processing and printing photographic materials
- 6.4 Storage of processed film
- 6.5 Archival storage of safety base film
- 6.6 Storage of nitrate base film

7. Different Techniques to Control Moisture Contents, Hygroscopic Materials, Moisture Regains.**PRACTICALS**

- 1. Visit / study of car A/C.
- 2. Study of Bus A/C systems
- 3. Visit to hospital and conditioning system
- 4. Visit to photographic A/C plant
- 5. Study / visit to textile air conditioning plant
- 6. Study / visit of printing plant A/C.
- 7. Study / visit of museum / library air conditioning plant.

REFERENCE BOOKS :

- 1. Ashrae Guide & Data Hand Book Application S.I. Edition.

A/C DESIGN & DRAWING

CODE MR 307

L T P
1 -- 2**RATIONALE**

For engineers in the field of Air Conditioning it becomes essential to design an Air Conditioning system and prepare drawings showing details related to installations. The student after studying the subject will be able to estimate heat load for air conditioning as well as air-cooling projects. He will also be able to design and make drawings of air distribution system.

CONTENTS

- 1. Air Conditioning Load Estimating :**
 - 1.1 Building survey and load estimate
 - 1.2 Design conditions
 - 1.3 Heat storage, diversity and stratification
 - 1.4 Solar heat gain through glass
 - 1.5 Heat and water vapour flow through structure
 - 1.6 Infiltration and ventilation
 - 1.7 Internal and system heat gain
 - 1.8 Applied psychrometry
 - 1.9 Equipment selection

- 2. Evaporative Cooling System Design :**
 - 2.1 Design conditions
 - 2.2 Sensible heat load calculation
 - 2.3 Determination of air quantity
 - 2.4 Selection of blower, motor, pump, cooling media
 - 2.5 Determination of wetted surface area

- 3. Duct Design :**
 - 3.1 Different methods of duct design
 - 3.1.1 Equal friction
 - 3.1.2 Static regain
 - 3.1.3 Velocity reduction
 - 3.2 Zoning
 - 3.3 Total resistance in duct system
 - 3.4 Duct designing for air conditioning
 - 3.5 Duct designing for air cooling
 - 3.6 Duct designing for ventilation

PRACTICALS

- 1. Calculation of heat load and equipment selection for summer and winter air conditioning for following applications**
 - 1.1 Residential
 - 1.2 Commercial
 - 1.3 Industrial

- 2. Calculation of heat load and equipment selection for evaporative cooling for following applications-**
 - 2.1 Residential
 - 2.2 Commercial
 - 2.3 Industrial

- 3. To design air distribution system and draw detailed ducting layout for applications**
 - 3.1 Air Conditioning
 - 3.2 Evaporative Cooling
 - 3.3 Ventilation

REFERENCE BOOKS :

1. Refrigeration & Air Conditioning C.P.Arora
2. Hand Book of Air conditioning System Design Carrier Air Conditioning Comp.

REFRIGERATION DESIGN AND DRAWING

CODE MR 308

L T P
1 -- 2**RATIONALE**

Cold storage, ice plants and deep freezers are now widely used. Knowledge of load calculation and equipment selection is very essential for R.A.C engineers. Apart from this the subject contents also includes designing piping system for water and refrigerant distribution. After studying the subject the student will be able to design system for Refrigeration and prepare drawings of piping layout.

CONTENTS**1. Refrigeration Load Calculation:**

- 1.1 Cooling load
- 1.2 Equipment running time
- 1.3 Survey of different loads
 - 1.3.1 Wall gain load
 - 1.3.2 Air change load
 - 1.3.3 Product load
 - 1.3.4 Miscellaneous loads
- 1.4 Calculating refrigeration load for cold storage, deep freezer and ice plant

2. Refrigerant Piping Design:

- 2.1 Design principles
- 2.2 Friction loss
- 2.3 Oil return
- 2.4 Pipe sizing
 - 2.4.1 Liquid line design
 - 2.4.2 Suction line design
 - 2.4.3 Discharge line design
 - 2.4.4 Condenser to receiver piping design
- 2.5 Refrigerant piping layout
 - 2.5.1 Suction line loops
 - 2.5.2 Hot gas loops

3. Water Piping Design :

- 3.1 Water piping design
 - 3.1.1 Once through
 - 3.1.2 Recirculating
- 3.2 Pipe friction losses
- 3.3 Piping diversity
- 3.4 Pump selection
- 3.5 System accessories
 - 3.5.1 Expansion tank
 - 3.5.2 Strainer
 - 3.5.3 Thermometer
 - 3.5.4 Gauges
 - 3.5.5 Air vents

- 3.6 Water piping layouts
 - 3.6.1 Air washer
 - 3.6.2 Condenser and cooling tower
 - 3.6.3 Chiller

PRACTICALS

1. **Calculation of heat load and equipment selection for following:-**
 - 1.1 Cold storage
 - 1.2 Deep freezer
 - 1.3 Ice Plant
2. **To design water-piping system and draw detailed layout for air conditioning application.**
3. **To design refrigerant piping system and draw layout for a central station system.**
4. **Draw water-piping layouts for**
 - 4.1 Air washer
 - 4.2 Condenser and cooling tower
 - 4.3 Chiller
5. **Draw refrigerant piping layout for single and multiple evaporator system.**

REFERENCE BOOKS :

1. Refrigeration & Air Conditioning Roy J.Dossat
2. Hand Book of Air Conditioning System Design Carrier Air Conditioning Company

FIRE PREVENTION & PROTECTION

CODE MR 309

L T P
2 1 --**RATIONALE**

This subject deals with safety from fire. The objective of this subject is to provide the basic knowledge of various rules and regulations related to fire safety & fire protection measures.

With the increase in high rise buildings, fire safety has become an important part of building services & the understanding of the subject will help the students for their better job placement.

CONTENTS**1. Introduction:**

- 1.1 Combustion process
- 1.2 Triangle of fire
- 1.3 Nature of flame
- 1.4 General terminology

2. Methods of Fire Extinguishment & Extinguishing Media:

- 2.1 Starvation
- 2.2 Smothering/ Blanketing
- 2.3 Cooling
- 2.4 Classification of Fires
- 2.5 Extinguishing Agents
 - 2.5.1 Water
 - 2.5.2 Foam & Foam Making Compounds
 - 2.5.3 Halogenated Agents
 - 2.5.4 Carbon di-oxide
 - 2.5.5 Inert gases
 - 2.5.6 Dry Chemical Powders

3. Active Fire Protection Measures:

- 3.1 Fire Detection and Alarm Systems
 - 3.1.1 Heat detectors
 - 3.1.2 Smoke Detectors
 - 3.1.3 Optical Detectors
 - 3.1.4 Flame Detectors
- 3.2 General Requirements for Automatic Fire Detection & Alarm systems
- 3.3 Water Based Fixed Fire Extinguishing Systems
 - 3.3.1 Hydrant Systems- External & Internal
 - 3.3.2 Sprinkler Systems

4. First Aid Fire Fighting Equipments:

- 4.1 General
- 4.2 Type of Extinguishers
 - 4.2.1 Water Type Extinguishers
 - 4.2.2 Foam Extinguishers
 - 4.2.3 Dry Powder Extinguishers
 - 4.2.4 CO2 Extinguishers
 - 4.2.5 Halon/ Halon Alternative Type Extinguishers

5. Life Hazards & Means of Escape:

- 5.1 Fire & Life Safety
- 5.2 Factors affecting Life Safety of Occupants
- 5.3 General Exit Requirements

- 5.4 Internal & External Staircases
- 5.5 Horizontal Exits, Refuge Areas, Ramps etc.
- 5.6 Azeotropes
- 5.7 Ozone safe refrigerants

6. Fire Safety Management for Various Classes of Occupancies:

- 6.1 Classes of Occupancies
- 6.2 Fire Safety Management
- 6.3 Fire Safety Measures in Health Care Facilities

7. Building Codes & Regulations:

- 7.1 Role of Codes in Community
- 7.2 National Building Code
- 7.3 International Trends in Building Codes

REFERENCE BOOKS :

- | | |
|------------------------------------|----------------------------|
| 1. Handbook on Building Fire Codes | G. B. Menon |
| 2. National Building Code of India | Bureau of Indian Standards |

* * * * *

INDUSTRIAL MANAGEMENT

CODE MR 310

L T P
2 1 --**RATIONALE**

To achieve the target and goals in an organisation it is essential to co-ordinate the entire system. For this purpose the knowledge of principles of management, human resources development, material management and financial management is required.

CONTENTS**1. Principles of Management :**

- 1.1 Management, administration and organisation, difference between them.
- 1.2 Scientific management : Meaning, characteristics, object and advantage : Taylor's scientific management – Fayol's principles of management, functions of management
- 1.3 Types of ownership, sole trading, partnership, joint stock, co-operative and public enterprise
- 1.4 Types of organisation, different types and their charts.
- 1.5 Importance of human relation professional ethics
- 1.6 Need for leadership, leadership qualities
- 1.7 Motivation

2. Human Resources Development :

- 2.1 Introduction, object and functions of human resource development department
- 2.2 Recruitment, sources and methods of selection, need for effective training, method of training, duties of supervisor / Foremen, role of HRD in industries.

3. Wages and Incentives:

- 3.1 Definition and requirements of good wage system methods of wage payment
- 3.2 Wage incentives - type of incentive, difference in wage incentive and bonus. Incentive to supervisor.

4. Material Management:

- 4.1 Purchasing Functions and duties of purchase department organisation of purchase department, methods of purchasing, purchase order contracts, legality of contracts types of contracts i.e. piece work contract, lump sum contract, item rate contract, percentage contract, merits and limitation of each contract system, departmental execution of works, rate contract - D.G.S & D and C.S.P.O. tender, necessity, types of tenders, tendering procedure, earnest money and security money
- 4.2 Store and store keeping: Functions and duties of store department, location and layout of store, bin cards, store ledger, receipt and issue procedure of materials, physical verification of stores, disposal method of unserviceable articles and protection of stores.
- 4.3 Sales: function and duties of sales department sales promotion advertisement service after sales.

5. Financial Management:

- 5.1 Function and duties of finance department
- 5.2 Brief idea of journal, ledger, trial balance, trading account, profit and loss account, and balance sheet.
- 5.3 Cheques (crossed and bearer), draft, promissory note, letter of credit, brief idea of cost accounting.
- 5.4 Numerical problems.

6. Marketing Management:

- 6.1 Concept of Marketing
- 6.2 Problems of Marketing
- 6.3 Pricing policy
- 6.4 Distribution channels and methods of marketing

7. Tax System and Insurance:

- 7.1 Idea of income tax, sales tax, excise duty and custom duty
- 7.2 Industrial and fire insurance, procedure for industrial insurance.

8. Labour Legislation and Pollution Control Acts:

- 8.1 Industrial acts: factory act 1948
- 8.2 Workmen's compensation act 1923
- 8.3 Apprentices act 1961
- 8.4 Water pollution contract act 1974 and 1981
- 8.5 Air pollution contract act 1981
- 8.6 Environmental protection act 1986
- 8.7 Forest (animal conservation act 1972)
- 8.8 Pollution control provisions in motor vehicle act.

9. Introduction to Work Study:

- 9.1 Definition, need and concept of work study
- 9.2 Advantage of work study
- 9.3 Techniques of work study
- 9.4 Work study and management
- 9.5 Work study and productivity
- 9.6 Objectives of method study
- 9.7 Objectives of work measurement

10. Inventory Control and Management:

- 10.1 Inventory and inventory control
- 10.2 Inventory classification
- 10.3 Inventory management
- 10.4 Objectives of inventory and inventory control
- 10.5 Costs affecting inventory
- 10.6 Economic order quantity
- 10.7 ABC analysis

11. PERT AND CPM:

- 11.1 Introduction
- 11.2 Terminology used in PERT and CPM
- 11.3 Rules to draw network
- 11.4 Similarities and differences between PERT and CPM
- 11.5 Determination of critical path
- 11.6 PERT: Time estimates

12. Management Information System:

- 12.1 Introduction
- 12.2 Need/Objectives/Functions of MIS
- 12.3 Need and qualities of good information
- 12.4 Application of MIS
- 12.5 Future of MIS

REFERENCE BOOKS:

- | | |
|---------------------------------------|----------------------------|
| 1. Industrial Management | V.K. Sharma & O.P. Harkut |
| 2. Industrial Engg. & Management | O.P. Khanna |
| 3. Industrial Engg. & Management | T.R. Banga |
| 4. Industrial Engg. & Operations Mgmt | S K Sharma & Savita Sharma |
