COURSE TITLE : REFRIGERATION & AIR CONDITIONING
COURSE CODE : 6023
COURSE CATEGORY : A
PERIODS/ WEEK : 6
PERIODS/ SEMESTER : 90
CREDIT : 6

TIME SCHEDULE

MODULE	TOPIC	PERIODS
1	Introduction. Applications of refrigeration. Principle of refrigeration. Air refrigeration. Vapour compression system.	24
2	Vapour absorption system. Refrigerating equipments. Refrigerants.	24
3	Psychrometry and psychrometric processes and mixing of air streams. Low temperature refrigeration	22
4	Air conditioning. Load Estimation	20
TOTAL		90

COURSE OUTCOME :

sl.no.	sub	student will be able to
1	1	Understand the importance, principles and application of refrigeration.
	2	Appreciate the working of air refrigeration system
	3	Appreciate the working of vapour compression refrigeration system
2	4	Comprehend the principle of vapour absorption refrigeration system
3	5	Comprehend the major components in refrigeration system.
	6	Appreciate the properties and applications of refrigerants.
	7	Understand the principle of psychrometry and psychrometric processes.
4	8	Understand the principle of Low temperature refrigeration .
5	9	Comprehend the principle of air conditioning and load estimation

SPECIFIC OUTCOME

MODULE I

1.1.0 Understand the importance, Principles and application of refrigeration.
1.1.1 Define the laws of thermodynamics
1.1.2 List the various modes of heat transfer and its application in thermodynamics.
1.1.3 Explain the change of state from liquid to vapour, vapour to liquid, solid to liquid, liquid to solid and state sublimation.

1.1.4 Define sensible heat, latent heat, saturation temperature, critical pressure, critical temperature, enthalpy, entropy.
1.1.5 Outline the importance of refrigeration, psychrometry and air conditioning.

1.2.0 Appreciate the working of air refrigeration system

1.2.1 Define refrigeration
1.2.2 State the purpose of refrigeration
1.2.3 Explain various methods of refrigeration.
1.2.4 Differentiate heat engine, refrigerator and heat pump.
1.2.5 Define COP of a refrigerator
1.2.6 Explain the unit of refrigeration
1.2.7 Appreciate the working of Air Refrigeration System
1.2.8 Analyze the reversed Carnot cycle with the help of P-V and T-S diagrams
1.2.9 Derive COP of reversed Carnot cycle.
1.2.10 Compute the COP and capacity of a refrigerating machine from a given data
1.2.11 Explain the working of air refrigerator based on Bell-Coleman cycle with the help of flow diagram, P-V and T-S diagrams
1.2.12 Derive COP of Bell-Coleman cycle
1.2.13 Compute COP of Bell-Coleman cycle from given data
1.2.14 Explain open and closed cycle air refrigeration system.
1.2.15 List the advantages and disadvantages of Air refrigeration system

1.3.0 Appreciate the working of vapour compression refrigeration system

1.3.1 Explain the principle of working of a vapour compression system
1.3.2 Analyze vapour compression system with the help of T-S and P-H diagram
1.3.3 Derive the COP of vapour compression systems
1.3.4 Derive the power required to drive the system
1.3.5 Compute COP and Power required from the given data
1.3.6 List the factors affecting the COP of vapour compression refrigeration system.
1.3.7 State the function of accumulator and flash chamber in a vapour compression refrigeration system.

MODULE II

2.1.0 Comprehend the principle of vapour absorption refrigeration system

2.1.1 Explain the working of simple vapour absorption system with a flow diagram
2.1.2 Explain the working of Electrolux refrigerator with the help of a flow diagram
2.1.3 Compare vapour compression system and vapour absorption system

2.2.0 Comprehend the major components in refrigeration system

2.2.1 Explain with simple sketch the working of a reciprocating compressor
2.2.2 Explain with sketch the working of roller and vane type compressors
2.2.3 Explain with sketch the working of a centrifugal compressor
2.2.4 Distinguish between hermetically sealed and semi-hermetically sealed compressor
2.2.5 Explain the working of air cooled condensers
2.2.6 Explain the working of water cooled condensers – shell and tube type, shell and coil type and double tube type
2.2.7 Explain the working of dry expansion type evaporator and flooded type evaporator
2.2.8 Distinguish between natural convection type evaporators and forced convection type evaporator.

2.2.9 Explain with suitable sketches the expansion devices such as capillary tube, Automatic expansion valve and thermostatic expansion valve
2.2.10 State the purpose of strainer, drier and muffler in a refrigeration system.
2.2.11 State various methods of defrosting.

2.3.0 Appreciate the properties and applications of refrigerants

2.3.1 Define refrigerant
2.3.2 Distinguish between primary refrigerant and secondary refrigerant with examples
2.3.3 Outline the desirable properties of refrigerants
2.3.4 List various refrigerants such as ammonia, carbon dioxide, Freon 11, Freon 12 and Freon 22
2.3.5 Outline the characteristics of environmentally safe refrigerants R123, R134a, R125

2.4.0 List various fields of applications of refrigeration

2.4.1 Illustrate the working of domestic refrigerator
2.4.2 Explain with a layout, working of ice plants
2.4.3 Illustrate the working of water coolers – pressure type and storage type
2.4.4 Explain the working of a cold storage
2.4.5 Describe the dairy refrigeration system
2.4.6 Explain the freeze drying process
2.4.7 Explain the Ice cream making process

MODULE III

3.1.0 Understand the principle of psychrometry and psychrometric processes

3.1.1 Define Psychrometry
3.1.2 Define dry air, moist air, saturated air, degree of saturation, specific humidity, absolute humidity, relative humidity, dry bulb temperature, wet bulb temperature, wet bulb depression, dew point temperature dew point depression.
3.1.3 State Dalton's law of partial pressure
3.1.4 Explain the enthalpy of moist air
3.1.5 Explain the construction and use of psychrometer
3.1.6 Explain the psychrometric chart and explain various lines in the chart.
3.1.7 Explain the use of psychrometric chart (Simple problems using tables and charts.)

3.2.0 Explain and represent psychrometric process such as sensible heating, sensible cooling, humidifying, dehumidifying, heating and humidifying, cooling and dehumidifying and adiabatic mixing of air streams on psychrometric charts

3.2.1 Explain by-pass factor of heating and cooling coil
3.2.2 Explain the concept of sensible heat factor
3.2.3 Derive efficiency of heating and cooling coils
3.2.4 Solve simple problems using psychrometric chart.

3.3.0 Understand the principle of Low temperature refrigeration

3.3.1 Define Cryogenics
3.3.2 List Advantages and applications of cryogenic refrigeration
3.3.3 Explain Cascade refrigeration
3.3.4 Explain Joule –Thomson effect
3.3.5 Explain Liquefaction of Nitrogen and Hydrogen.
3.3.6 Describe the adiabatic demagnetization of paramagnetic Sault for approaching Absolute zero.

MODULE IV

4.1.0 Comprehend the principle of air conditioning and load estimation

4.1.1 Define air conditioning

4.1.2 Explain the factors affecting human comfort

4.1.3 Explain the concept of effective temperature

4.1.4 Explain the use of comfort chart in air conditioning

4.2.0 Classify air conditioning systems on the basis of major function, season of the year and equipment arrangement

4.2.1 Explain industrial air conditioning, comfort air conditioning

4.2.2 Explain the working of summer, winter and year round air conditioning with line sketches

4.2.3 Explain the construction and working of window type air conditioner

4.2.4 Explain the construction and working of packaged type air conditioner

4.2.5 Explain the central plant system with suitable layout

4.2.6 Define the term HVAC.

4.2.7 Estimate the load and design Air conditioning systems

4.2.8 Explain the sources of heat gain or loss

4.2.9 Estimate heat gain from various sources such as conduction heat load, radiation load of sun, occupants load, infiltration air load, equipment load, fresh air load, miscellaneous heat sources.

4.2.10 Explain sensible, latent and total heat load.

4.2.11 Compute total cooling load.

GENERAL INFORMATION:

Use of Steam Tables, Psychrometric tables & charts may be permitted for Examination

CONTENT DETAILS

MODULE I

Introduction

Review of thermodynamic principles – saturation temperatures; change of state- latent heat-sensible heat- critical pressure- enthalpy- entropy- sublimation- refrigeration- Definition- Introduction to heat transfer – importance of refrigeration- psychrometry - air conditioning.

Principles of Refrigeration-concept of C.O.P- unit of Refrigeration-Application of refrigeration- methods of refrigeration- ice refrigeration-dry ice refrigeration- air expansion refrigeration- evaporative cooling-liquid evaporation refrigeration- steam jet refrigeration- Laws of refrigeration simple problems

Air Refrigeration systems- Air refrigerator- Working- based on reversed carnot cycle- COP- simple problems- Working of Air refrigerator based on Bell-Coleman cycle-flow- PV - TS diagram of Bell Coleman cycle-Simple problems- Air refrigeration –Open systems -closed systems - Advantages - limitations of air refrigeration.

Vapour Compression Refrigeration systems-Principles - working of a vapour compression system with the help of flow diagram-Analysis of vapour compression system with the help of TS and PH diagrams-C.O.P of vapour compression systems- Power required to drive the system- Simple problems- Effect of subcooling- super heating- use of accumulator and flash chamber

MODULE II

Vapour Absorption system-Simple absorption system- Electrolux system-comparison with vapour compression system-Refrigeration Equipments-Compressors- Principle of working of reciprocating compressors- rotary compressor – roller and vane type – centrifugal compressor (Explanation with simple diagram only)-hermetically sealed - semi hermetically sealed compressors

Condensers- Air cooled condensers- water cooled condensers – shell and tube-shell - coil - double tube type (Explanation with line diagram)-Evaporators- Types- Dry and flooded type- Natural - forced convection type Expansion Devices- Capillary tube- Thermostatic expansion valve- automatic expansion valve

Refrigerants-Definition- Primary - secondary refrigerants- desirable properties of refrigerants- properties of ammonia- carbon dioxide- R-11- R-12 - R-22- environmentally safe refrigerants -R123- R 134a-R125- secondary refrigerants -salt brine- glycol.

Application of refrigeration-Domestic refrigerator-Ice plants- water coolers- pressure type -storage type- cold storage-dairy refrigeration- freeze drying- ice cream cabinets.

MODULE III

Psychrometry-Definition- Dry air- moist air- saturated- unsaturated -super saturated air- degree of saturation- dry bulb temperature- wet bulb temperature- dew point temperature- Dalton's law of partial pressures absolute humidity-relative humidity- specific humidity- Enthalpy of moist air - psychrometer- psychrometric chart and tables- (Simple problems using tables and charts).

Psychrometric Processes

Sensible heating - sensible cooling – by pass factor- humidifying- dehumidifying – sensible heat factor- heating –humidifying- cooling –dehumidifying- efficiency of heating -cooling coil- Simple problems using psychrometric chart - tables.

Low temperature refrigeration (Cryogenics)

Definition for the term cryogenics.-advantages - –field of application-Cascade refrigeration system– Joule Thomson effect – (definition only) - liquefaction of Nitrogen -Hydrogen- absolute zero temperature –use Adiabatic demagnetization of paramagnetic salts.

MODULE IV

Air Conditioning-Definition- factors affecting human comfort- effective temperature- comfort chart

Air conditioning systems-Classification – industrial- comfort air conditioning- working of summer air conditioning- winter - year round air conditioning- construction- working of window type- package type- central plant systems - HVAC.

Design and Load estimation of Air Conditioning systems

Introduction – Heat source – External and Internal source - solar radiation through window –conduction of heat due to temperature difference- Heat addition by the occupants and equipments- Infiltration of air – ventilating estimation- Procedure of sensible heat load – latent heat load – total load –.Estimation of total cooling load.

TEXT BOOK

1. Refrigeration & Air conditioning - R.S. Khurmi & J.K. Gupta
2. Refrigeration & Air Conditioning - A.S. Sarao & P.S. Gabi.

REFERENCE

1. A course in Refrigeration & Air Conditioning - S.C. Arora & S. Domkudwar
2. Basic Refrigeration & Air Conditioning - P.N.Ananthanarayanan
3. Cryogenic Systems - Randll Darron
4. Cryogenic engineering - R. D. Scott
5. Principles of refrigeration - ROY.J. Dossat.