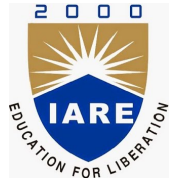# INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

MODEL QUESTION PAPER-II

B.Tech VII Semester End Examinations, November 2020

Regulations: IARE - R16

REFRIGERATION AND AIR CONDITIONING
MECHANICAL ENGINEERING

Time: 3 hour   Maximum Marks: 70

Answer ONE Question from each MODULE
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

MODULE-I

1. (a) Draw the p-h, T-S diagrams for the processes of sub cooling with dry compression and sub cooling with dry compression. **[7m]**

   (b) An ammonia refrigerator works between - 6.7^0C and 26^0C. The vapour leaves the compressor in dry and saturated condition. Assuming there is no under cooling; calculate the theoretical COP of the system. **[7m]**

2. (a) Explain the procedure to recognize whether a refrigerant is charged, under charged or over charged. **[7m]**

   (b) A refrigeration system works on ammonia between pressure limits, 2.36 bar and 15.54 bar. If the refrigerant is sub cooled by 10k before throttling, determine the improvement in COP over simple vapor compression cycle. **[7m]**

MODULE-II

3. (a) What are the different refrigerant - absorbent working pairs and what is the effect of evaporator temperature on performance of absorption systems. **[7m]**

   (b) A Bell - Coleman cycle works between 1 and 6 bar pressure limits. The compression and expansion indices are 1.25 and 1.3 respectively. Obtain COP and tonnage of the unit for an airflow rate of 0.5 kg/s. Neglect clearance volume and take temperature at the beginning of compression and expansion to be 7^0C and 37^0C, respectively. **[7m]**

4. (a) Explain the principle and working of steam jet refrigeration system and the function of steam ejector with a neat sketch. **[7m]**

   (b) Explain the working of a practical Ammonia-water vapour absorption refrigeration system with neat sketch. **[7m]**

MODULE-III

5. (a) Criticize the chloro fluoro carbon, hydro fluoro chloro carbon based refrigerants and state their ozone depleting and global warming potentials. **[7m]**

(b) Discuss the advantages and disadvantages of centrifugal compressors over reciprocating compressors. **[7m]**

6. (a) A capillary tube is used in a small refrigerator to serve the purpose of which component of the refrigerating system? **[7m]**

(b) Discuss the advantages and disadvantages of centrifugal compressors over reciprocating compressors. **[7m]**

MODULE-IV

7. (a) Represent the following process in a skeleton psychometric chart. **[7m]**
   (i) Sensible heating
   (ii) Heating and humidification
   (iii) Cooling and dehumidification.

(b) Ten grams of moisture per kg of dry air is removed from atmospheric air when it is passed through an air conditioning system and its temperature becomes 20^0C. The atmospheric conditions are 40^0C DBT and 60% RH. Calculate the following for the conditioned air. (i) Relative humidity, (ii) Wet-bulb temperature, (iii) Dew point temperature, (iv) Enthalpy change for the air.Assume standard atmospheric pressure. **[7m]**

8. (a) Derive the expression for the following: (i) Specific humidity, (ii) Relative humidity and (iii) Vapor density **[7m]**

(b) 800 m^3/min. of recirculated air at 22^0C DBT and 10^0C DPT is to be mixed with 300 m^3/min. of fresh air at 300C DBT and 50% RH. Determine the enthalpy, specific volume, humidity ratio and DPT of the mixture. **[7m]**

MODULE-V

9. (a) Describe any two methods of humidification of air by atomizing the water into air, with simple line sketches. **[7m]**

(b) Which type of air cleaner would be selected for removing very small dirt particles and smoke from the air? Explain its working principle. **[7m]**

10. (a) What are the advantages and disadvantages of spray type dehumidifier over coil type dehumidifier? **[7m]**

(b) Describe the working of the heat pump by drawing the circuit for the fixed air and fixed refrigerant circuits. **[7m]**

END OF EXAMINATION

COURSE OBJECTIVES:
The course should enable the students to:

1	The principles of thermodynamics in refrigeration and air conditioning, analyze the methods of refrigeration, recognize the necessity and ideal cycle of refrigeration.
2	The nomenclature of refrigerants, realize the desirable properties of refrigerants to probe their ozone depleting and global warming potential.
3	The working principles, limitations, maintenance of refrigeration and air conditioning equipment and study their impact on the performance of the system.
4	The psychrometric relations, processes, utilize their principles to resolve cooling load calculations and design of air conditioning systems.

COURSE OUTCOMES:
After successful completion of the course, students should be able to:

| CO 1	Relate the performance of a vapour compression refrigeration cycles under specified inlet and outlet conditions.
CO 2	Identify the modifications required in an impossible reversed Carnot cycle to convert it into practical cycle for refrigeration applications.
CO 3	Demonstrate the working principle and coefficient of performance of a heat pump, heat engine and refrigerator.
CO 4	Illustrate the working principles, limitations of practical aqua ammonia, LiBr-Water and Electrolux vapour absorption refrigeration systems.
CO 5	Analyze theoritical, practical aircraft refrigeration and steam jet refrigeration cycles with T-S diagrams, by stating merits, limitations, etc.
CO 6	Discuss the measures to protect the ozone layer through global control, eventually elimination of production and utilization of ozone depleting substances.
CO 7	Classify the equipment used for the refrigeration, air conditioning purposes with suitable materials and refrigerant pairs.
CO 8	Construct the sensible heat factor lines, locate alignment circle and SHF scale on a psychrometric chart for the cooling load calculations of air conditioning systems.
CO 9	Explain thermal comfort conditions with respect to effective temperature, relative humidity, etc. and their impact on human comfort, productivity and health.
CO 10	Distinguish the equipment required for air conditioning systems, study the operating principles, safety controls employed in air conditioning systems.
CO 11	Apply the principles of psychrometry to calculate and design the air conditioning systems for particular purpose.
CO 12	Compare the various heat pump circuits for heating, cooling purposes with suitable industrial applications.

MAPPING OF SEMESTER END EXAMINATION QUESTIONS TO COURSE OUTCOMES

Q.No		All Questions carry equal marks	Taxonomy	CO's	PO's
1	a	Draw the p-h, T-S diagrams for the processes of sub cooling with dry compression and sub cooling with dry compression.	Apply	CO 1	PO 1
	b	An ammonia refrigerator works between - 6.7^0C and 26^0C. The vapour leaves the compressor in dry and saturated condition. Assuming there is no under cooling; calculate the theoretical COP of the system.	Apply	CO 2	PO 2
2	a	Explain the procedure to recognize whether a refrigerant is charged, under charged or over charged.	Remember	CO 3	PO 1
	b	A refrigeration system works on ammonia between pressure limits, 2.36 bar and 15.54 bar. If the refrigerant is sub cooled by 10k before throttling, determine the improvement in COP over simple vapor compression cycle.	Apply	CO 2	PO 2
3	a	What are the different refrigerant - absorbent working pairs and what is the effect of evaporator temperature on performance of absorption systems.	Understand	CO 4	PO 4
	b	A Bell - Coleman cycle works between 1 and 6 bar pressure limits. The compression and expansion indices are 1.25 and 1.3 respectively. Obtain COP and tonnage of the unit for an airflow rate of 0.5 kg/s. Neglect clearance volume and take temperature at the beginning of compression and expansion to be 7^0C and 37^0C, respectively.	Apply	CO 2	PO 2
4	a	Explain the principle and working of steam jet refrigeration system and the function of steam ejector with a neat sketch.	Apply	CO 5	PO 4
	b	A In an absorption refrigeration system heating, cooling and refrigeration takes place at the temperature of 12^0C, 40^0C and -10^0C. Find the theoretical COP of the system; if the heating temperature is increased to 20^0C and refrigeration temperature is decreased to -30^0C. Calculate the percentage of change in theoretical COP.	Apply	CO 4	PO 2

5	a	Criticize the chloro fluoro carbon, hydro fluoro chloro carbon based refrigerants and state their ozone depleting and global warming potentials.	Analyze	CO 6	PO 7
	b	Discuss the advantages and disadvantages of centrifugal compressors over reciprocating compressors.	Understand	CO 7	PO 1
6	a	A capillary tube is used in a small refrigerator to serve the purpose of which component of the refrigerating system?.	Understand	CO 7	PO 1
	b	Discuss the advantages and disadvantages of centrifugal compressors over reciprocating compressors.	Apply	CO 7	PO 1
7	a	Represent the following process in a skeleton psychometric chart. (i) Sensible heating (ii) Heating and humidification (iii) Cooling and dehumidification.	Apply	CO 9	PO 1
	b	Ten grams of moisture per kg of dry air is removed from atmospheric air when it is passed through an air conditioning system and its temperature becomes 20^0C. The atmospheric conditions are 40^0C DBT and 60% RH. Calculate the following for the conditioned air. (i) Relative humidity, (ii) Wet-bulb temperature, (iii) Dew point temperature, (iv) Enthalpy change for the air.Assume standard atmospheric pressure.	Apply	CO 8	PO 2
8	a	Derive the expression for the following: (i) Specific humidity, (ii) Relative humidity and (iii) Vapor density	Apply	CO 11	PO 1
	b	800 m^3/min. of recirculated air at 22^0C DBT and 10^0C DPT is to be mixed with 300 m^3/min. of fresh air at 300C DBT and 50% RH. Determine the enthalpy, specific volume, humidity ratio and DPT of the mixture.	Apply	CO 11	PO 1,2
9	a	Describe any two methods of humidification of air by atomizing the water into air, with simple line sketches.	Understand	CO 10	PO 1
	b	Which type of air cleaner would be selected for removing very small dirt particles and smoke from the air? Explain its working principle.	Remember	CO 10	PO 4
10	a	What are the advantages and disadvantages of spray type dehumidifier over coil type dehumidifier?	Understand	CO 10	PO 1

	b	Describe the working of the heat pump by drawing the circuit for the fixed air and fixed refrigerant circuits.	Analyze	CO 12	PO 4

KNOWLEDGE COMPETENCY LEVELS OF MODEL QUESTION PAPER
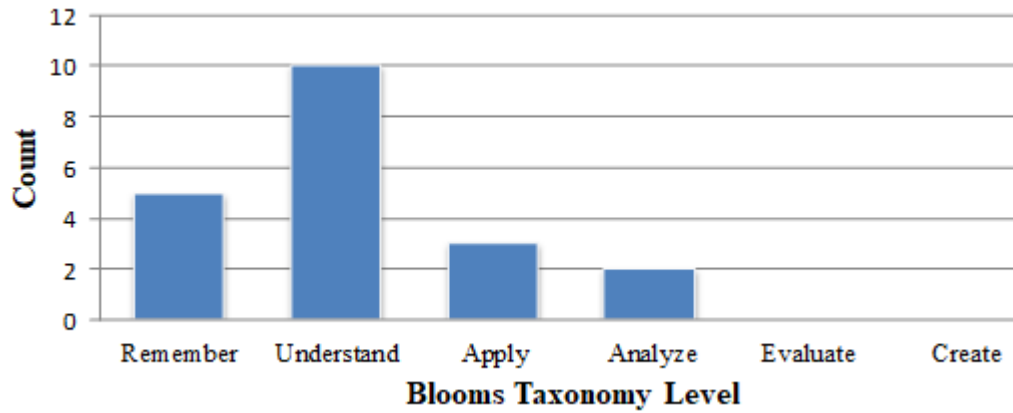
Signature of Course Coordinator   **HOD, ME**
Mr. A Somaiah, Assistant Professor