

Code No: RT32037A

R13

SET - 1

III B. Tech II Semester Regular/Supplementary Examinations, April - 2018
REFRIGERATION & AIR CONDITIONING
(Mechanical Engineering)

Time: 3 hours

Maximum Marks: 70

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- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answering the question in **Part-A** is compulsory
3. Answer any **THREE** Questions from **Part-B**

(Refrigeration and Psychrometric tables and charts allowed)

PART -A

- 1 a) Explain the term “ton of refrigeration”. [4M]
b) Explain the effect of sub-cooling in vapour compression refrigeration system [4M]
c) What is purpose of condenser in vapour compression system? [3M]
d) What are the refrigerant and absorbent in Li-Br and water absorption system? [4M]
e) List psychrometric properties of air. [3M]
f) What is the function of a humidifier? [4M]

PART -B

- 2 a) A Bell-Coleman refrigerator operates between pressure limits of 1 bar and 8 bar. [8M]
Air is drawn from the cold chamber at 9°C , Compressed and then it is cooled to 29°C before entering the expansion cylinder. Expansion and compression follows the law $PV^{1.35}=\text{constant}$. Calculate the theoretical COP of the system. For air take $\gamma =1.4$, $C_p=1.003 \text{ kJ/kg.K}$.
b) With a neat sketch explain the working of Bell-Coleman cycle and derive the [8M]
expression for its COP
- 3 An ammonia ice plant operates between condenser temperature of 35°C and an [16M]
evaporator temperature of -15°C . It produces 5 tonnes of ice per day from water at 25°C to ice at -5°C . The ammonia enters as dry saturated vapor and leaves the condenser as saturated liquid. Determine:
(i) The capacity of the refrigerating plant
(ii) Mass flow of the refrigerant
(ii) Discharge temperature of ammonia from the compressor
(iv) Power of the compressor motor if the isentropic efficiency of the compressor is 85% and mechanical efficiency of the compressor is 90%
(v) Relative efficiency. The latent heat of formation of ice is 335 kJ / kg and specific heat of ice is 2.1 kJ / kg-k .
- 4 a) Classify the Evaporators used in refrigeration system and explain the working of [8M]
flooded type Evaporator with a neat diagram.
b) List the commonly used refrigerants in practice and explain in detail desirable [8M]
chemical properties of refrigerants.

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- 5 a) Draw the T-s and h-s diagrams representing steam jet refrigeration system. [8M]
b) Explain with help of neat sketches, vapour absorption cycle for refrigeration. How is it different from vapour compression refrigeration system. [8M]
- 6 a) Sketch the psychrometric chart and represent the different psychrometric properties on the same. [8M]
b) What is comfort air-conditioning? Draw a rough comfort chart. [8M]
- 7 a) Explain any two types of humidifiers. [8M]
b) Explain the principle of various dehumidification methods. [8M]

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(Refrigeration and Psychrometric tables and charts allowed)

PART -A

- 1 a) If in an air refrigeration plant, the temperatures of air entering and leaving the expander are 300K and 200K respectively, determine the COP of the plant assuming isentropic compression and expansion. [4M]
- b) List out the components of vapour compression refrigeration system and which component of the vapour compression Refrigeration system produces the refrigeration effect [3M]
- c) List the different types of expansion devices. [3M]
- d) What is the function of an absorber in an vapour absorption system. [4M]
- e) Write a short note on by-pass factor for cooling coils. [4M]
- f) What is the difference between fan and blower in air conditioning system. [4M]

PART -B

- 2 a) Explain Air refrigeration system working on Bell-Coleman cycle with P-V and T-S diagrams. [8M]
- b) An aircraft is cruising with a speed of 900 kmph at an altitude of 11,000 metre where the ambient conditions are 0.3 bar and -30°C. Assuming the compression ratio 5, cabin pressure 0.8 bar and air leaving the cabin at 27°C, obtain the power for pressurization and refrigeration and COP. The flow rate through the system is 1.0 kg/s. [8M]
- 3 a) Explain the effect of sub cooling and superheating on the performance of vapour compression refrigeration system. [8M]
- b) Explain with a flow diagram, the working of vapour absorption refrigeration system. [8M]
- 4 a) What are the advantages of thermostatic expansion valve? Describe its operation. [8M]
- b) Discuss why CFC refrigerants needs to be phased out. [8M]
- 5 a) Explain working principle and components of thermo electric refrigerating system. [8M]
- b) Explain, with the help of a neat diagram, the working of Ammonia-Water absorption system. [8M]
- 6 a) Calculate the following when the DBT is 35⁰C, WBT is 23⁰C and the barometer reads 750mm Hg: (i) Relative humidity (ii) Humidity ratio (iii) DPT (iv) Density (v) Enthalpy of atmospheric air [8M]
- b) Briefly explain the requirements of comfort air conditioning [8M]
- 7 What are the different types of fans used in air-conditioning systems? Discuss their applications with their relative advantages and disadvantages. [16M]



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3. Answer any **THREE** Questions from **Part-B**

(Refrigeration and Psychrometric tables and charts allowed)

PART -A

- 1 a) What is the formula for the COP of an air refrigeration cycle? [3M]
- b) What is the effect of super heating of vapor on the COP? [4M]
- c) Explain the designation of refrigerant with an example. [4M]
- d) Write the advantages of vapour absorption refrigeration system [3M]
- e) Define sensible heat factor. [4M]
- f) What are the sources of heat for heat pumps? [4M]

PART -B

- 2 a) Derive the expression for COP of Carnot vapour compression refrigeration system. [8M]
- b) List the advantages and disadvantages of air refrigeration system. [8M]
- 3 a) A simple vapour compression plant produces 5 tonnes of refrigeration. The enthalpy values at inlet to compressor, at exit from the compressor and at exit from the condenser are 183.19, 209.41 and 74.59 kJ/kg respectively. Estimate: [8M]
 - i) The refrigerant flow rate
 - ii) The C.O.P.
 - iii) The power required to drive the compressor
 - iv) The rate of heat rejection to the condenser
- b) Explain the effect of change in the following operating conditions on the performance of vapour compression refrigeration cycle using p-h chart. [8M]
 - i) Evaporator pressure
 - ii) Condenser pressure
- 4 a) What are the different types of compressors? Mention the fields for the use of each in refrigeration systems giving reasons. [8M]
- b) Discuss the classification of refrigerants. [8M]
- 5 a) With a neat sketch explain the working principle of a three fluid vapour absorption refrigeration system. [8M]
- b) Explain the working of Vortex tube refrigerator. [8M]
- 6 In an air conditioning system air at a flow rate of 2 kg/s enters the cooling coil at 25°C and 50% RH and leaves the cooling coil at 11°C and 90% RH. The apparatus dew point of the cooling coil is 7°C. Find i) The required cooling capacity of the coil, [16M]
 - ii) Sensible Heat Factor for the process, and
 - iii) By-pass factor of the cooling coil.
 Assume the barometric pressure to be 1 atm. Assume the condensate water to leave the coil at ADP ($h_w = 29.26$ kJ/kg)
- 7 a) What do you understand by Grills and Registers? Explain any two factors which affect Grill performance. [8M]
- b) Describe the following psychrometric processes [8M]
 - i) cooling with dehumidification
 - ii) cooling with adiabatic humidification



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3. Answer any **THREE** Questions from **Part-B**

(Refrigeration and Psychrometric tables and charts allowed)

PART -A

- 1 a) What are the processes of Air refrigeration cycle? [3M]
- b) Draw the vapour compression refrigeration cycle and indicate the processes. [4M]
- c) Give the classification of compressors. [3M]
- d) List the major disadvantages of steam jet refrigeration system. [4M]
- e) What is the purpose of ventilation in air-conditioning system? [4M]
- f) What is the difference between grill and register used in air conditioning system [4M]

PART -B

- 2 a) An air refrigeration open system operating between 1Mpa and 100kpa is required to produce a cooling effect of 2000 kJ/min. Temperature of the air leaving the cold chamber is -5°C and at leaving the cooler is 30°C . Neglect losses and clearance in the compressor and expander. Determine: i) Mass of air circulated per minute
ii) Compressor work, expander work, cycle work iii) C.O.P and power in kW required [10M]
- b) Give a brief description of an ideal cycle of air refrigeration. [6M]
- 3 a) Distinguish between vapour compression refrigeration system and vapour absorption refrigeration system. [8M]
- b) A Freon 12 vapour compression system operating between -5°C and 50°C develops 15 TR. Determine i) mass flow rate of the refrigerant ii) piston displacement per ton iii) the Carnot COP and actual COP of the cycle. [8M]
- 4 a) Write a note on [8M]
i) Shell and tube condenser ii) Screw compressor.
- b) Suggest substitutes for CFC Refrigerants from the point of Ozone Depletion & Global Warming. [8M]
- 5 a) draw a compact diagram of Lithium bromide water absorption refrigeration system and explain its working [8M]
- b) Discuss the advantages of vapor absorption refrigeration system over vapor compression refrigeration system. [8M]
- 6 a) Atmospheric air having DBT= 16°C and RH=25% is passed through a furnace and then through a humidifier to maintain a final DBT of 30°C and 50% R.H. Find the heat and moisture added to the air during the process. Also calculate the sensible heat factor of the process. [8M]
- b) What is meant by Effective temperature? List the factors governing optimum effective temperature. [8M]
- 7 Classify the heat pump circuits and explain air-air heat pump circuit with a neat diagram. [16M]