Code No: 126AM **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech III Year II Semester Examinations, May - 2016
REFRIGERATION AND AIR CONDITIONING
(Mechanical Engineering)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A

(25 Marks)

1.a) Distinguish between Engine and Refrigerator. [2]
b) What is the difference between expander and compressor? [3]
c) State the various types of evaporations used in refrigeration and air conditioning systems. [2]
d) Explain about recuperation. [3]
e) What are the properties of ideal refrigerant? [2]
f) Differentiate between expansion cylinder and expansion valve. [3]
g) What is the meaning of air conditioning? [2]
h) Explain the relation between wet bulb temperature, sensible heaters, sensible cooling. [3]
i) Explain how to calculate load on occupants. [2]
j) Explain infiltration load. [3]

PART - B

(50 Marks)

2. A Carnot refrigerator operates between the temperatures of -50^0C and 50^0C. Determine COP of the refrigerator. If the COP is to be made 4 by changing the temperatures such that increase or decrease in upper temperature is equal to decrease or increase in lower temperature, determine the new temperatures. [10]

OR

3. A refrigerator working on Bell – Coleman cycle operates between pressure limits of 1.05 bar and 8.5 bar. Air is drawn from the cold chamber at 10^0C. Air coming out of compressor is cooled to 30^0C before entering the expansion cylinder. Expansion and compression follow the law $p.v^{1.35}$ = constant. Determine C.O.P. of the system. Take $\gamma = 1.4$ and $C_p = 1$ kJ/kg –k for air. [10]

4. Explain with neat sketch the working principle of a screw compressor. [10]

OR

5. Explain with a neat sketch the working principle of Evaporative condenser. [10]

6. In an absorption type refrigerator, the heat is supplied to NH_3 generator by condensing steam at 2 bar and 90^0C dry. The temperature to be maintained in the refrigerator is -5^0C. The temperature of the atmosphere is 30^0C. Find the maximum C.O.P. is 70% of the refrigerator. If the refrigerator load is 20 tons and actual C.O.P. is 70% of maximum C.O.P. Find the mass of steam required per hour. [10]

OR

7. Draw a neat line diagram of Electrolux refrigerator and explain its working principles. What is the important role of hydrogen in this refrigeration system? [10]

8. A four rows coil with a face velocity of 150 m/min has a contact factor of 0.85. Calculate the contact factors for the following cases:
   a) Face velocity 200 m/min and four rows.
   b) Face velocity 100 m/min and four rows
   c) Face velocity 150 m/min and eight rows
   d) Face velocity 150 m/min and two rows. [10]

OR

9. A stream of moist air at 2^0C dry bulb and 80 per cent relative humidity mixes with another stream of moist air at 30^0C dry bulb and 10^0C dew point in the ration by mass of one part of the first to two parts of the second. Calculate the temperature and specific humidity of the air after mixing. [10]

10. A spray cooling oil is chosen to operate under the following conditions:
    Air –inlet condition ……..28^0C DBT and 21^0C WBT
    Air-outlet conditions…….10^0C DBT and 6^0C WBT
    Total amount of air flow ….. 2000 m^3/min.
    The chilled water inlet and outlet temperatures area 7^0C and 12^0C respectively
    Find the following:
    a) The cooling load on the coil.
    b) Water flow rate through the coil. [5+5]

OR

11. Differentiate between Central, District and Unitary air-conditioning systems. [10]

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JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech III Year II Semester Examinations, December - 2017
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PART - A

(25 Marks)

1.a) What is the difference between Refrigeration and Air Conditioning? [2]
b) Draw the line diagram of simple vapour compression refrigeration system. [3]
c) What are the advantages of multistage compressor? [2]
d) What are different types of expansion devices [3]
e) Discuss the advantages of the dense air refrigerating system over an open air refrigeration system. [2]
f) What are desirable characteristics of absorbent in vapour absorption refrigeration cycle? [3]
g) Prove that the partial pressure of water vapour in the atmospheric air remains constant as long as the specific humidity remains constant. [2]
h) Distinguish sensible and latent heat loads. [3]
i) Classify Air conditioning systems. [2]
j) Distinguish clearly fan and blower. [3]

PART - B

(50 Marks)

2.a) Mention the limitations of Simple vapour compression refrigeration cycle.
b) Briefly explain the working of two stage compression with water intercooler and liquid sub-cooler employed for vapour compression system. [5+5]

OR

3.a) Explain the construction and use of P-H charts in refrigeration system.
b) Define C.O.P. How C.O.P of refrigerators and heat pump can be evaluated? Explain. [5+5]

4.a) How does an actual vapour compression cycle differ from that of a theoretical cycle?
b) A vapour compression refrigeration machine, with Freon-12 as refrigerant, has a capacity of 12 tonne of refrigeration operating between -28^0C and 26^0C. The refrigerant is sub cooled by 4^0C before entering the expansion valve and the vapour is superheated by 5^0C before leaving the evaporator. The machine has a six-cylinder single-acting compressor with stroke equal to 1.25 times the bore. It has a clearance of 3% of the stroke volume. Determine (i) Theoretical power required, (ii) C.O.P, (iii) Volumetric efficiency, (iv) Bore and stroke of cylinder. The speed of compressor is 1000 r.p.m. the following properties of Freon-12 may be us. [5+5]

OR

5.a) Explain the working of following types of evaporators with neat sketches:
(i) Flooded evaporator, (ii) Natural convection evaporator.

b) Give the comparison between air cooled and water cooled condenser. [5+5]

6. An air refrigerator working on Bell-Coleman cycle takes in air at 1 bar and at a temperature of 10^0 C. The air is compressed to 5 bar abs. The same is cooled to 25^0 C in the cooler before expanding in the expansion cylinder to cold chamber pressure of 1 bar. The compression and expansion laws followed are $PV^{1.35}$ = C and $PV^{1.3}$ = C respectively. Determine C.O.P of the plant and net refrigeration effect per kg of air.
Take Cp = 1.009 kJ/kg K and R = 0.287 kJ/kg K for air. [10]

OR

7. A Two stage ammonia refrigeration system operates between overall pressure limits of 15 bar and 2 bar respectively. The liquid is sub-cooled to 30^0C. The temperature of superheated vapour leaving the water intercooler is also 30^0C. The flash chamber separates the dry vapour at 5 bar pressure. The liquid refrigerant then expands to 2 bar, the evaporator pressure. The load on the evaporator is 50 kW. Calculate a) Mass flow rate in different lines b) Power required c) COP. [10]

8.a) Explain the procedure for calculating cooling load due to infiltration air.

b) A summer air conditioning system for a small office building is to be designed. The design is to be based on the following information:
Outside design condition 35^0C Tdb, 28^0C Twb
Inside design condition 26^0C Tdb, 50% RH
Room sensible heat gain 45 kW
Room latent heat gain 9 kW
Ventilation air 0.95 m^3/s
A four row direct expansion refrigerant 134a coil with bypass factor of 0.2 is to be used. Analyze the problem on a psychometric chart and determine the following:
i) The room apparatus dew point (ADP)
ii) The temperature of the air leaving the coil
iii) The total quality of air required (m^3/s). [5+5]

OR

9. The following data apply to an air conditioning system:
Room sensible heat =41868 kJ/hr(11.63 kW); room latent heat=41868 kJ/hr(11.63kW); inside design condition= 25^0C, 50% RH, outside design condition=35^0C, DBT, 27.8 WBT. Return air from the room is mixed with the outside air before entering the cooling coil in the ratio of 4:1. Return air from the room is mixed with the cooling air, i.e. after the cooling coil in the ratio of 1:4. Cooling coil by pass factor is 0.1. The air may be reheated if necessary before supplying to the conditioned space. Assume ADP as 10^0C and determine,
a) Supply air conditions into the room
b) Refrigeration load due to the reheat
c) Total refrigeration capacity
d) The quantity of fresh air supplied. [10]

10.a) Explain the use of HEAT PUMP for heating and cooling cycle with neat diagram.

b) Explain in detail different components of fans. [5+5]

OR

11.a) Describe a centrifugal fan with the help of a neat sketch.

b) Explain in detail about heat pump circuits. [5+5]

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