

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), November 2018

B. Tech in Mechanical Engineering, Semester V

Roll No.....

COURSE CODE: ME 602

Time: 3 hours

Max. Marks: 80

COURSE TITLE : Refrigeration and air conditioning

Instructions to students:

1. Do not write anything other than your roll number on question paper.
 2. Assume suitable data wherever required and mention it clearly.
 3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.
 4. Use of Refrigerant and Psychrometric chart is permitted.
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Q.1 Objective type multiple choice questions

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- i. A refrigerator works on a reversed Carnot cycle producing a temperature of -40°C . Work done per TR of refrigeration is 700 kJ per 10 minutes. What is the value of COP?
 - a. 3
 - b. 4.5
 - c. 2.5
 - d. 5
- ii. The power (kW) required per ton of refrigeration is $N/(\text{COP})$, where COP is Coefficient of Performance, then N is equal to
 - a. 2.5
 - b. 3.5
 - c. 4.75
 - d. 5.25
- iii. Replacing a water cooled condenser with an air cooled one in a vapor compression refrigeration system with constant evaporator pressure results in:
 - a. Increase in condensation pressure
 - b. Decrease in pressure ration
 - c. Increase in pressure ratio
 - d. Increase in condensation temperature
- iv. When the lower temperature is fixed, COP of a refrigerating machine can be improved by:
 - a. Operating the machine at higher speeds
 - b. Operating the machine at lower speed
 - c. Raising the higher temperature
 - d. Lowering the higher temperature
- v. Consider the following statements in respect of absorption refrigeration and vapor compression refrigeration system:
 1. Former runs on low grade energy

2. The pumping work in the former is negligible since specific volume of strong liquid solution is small
3. The latter uses an absorber while former uses in generator
4. The liquid pump alone replaces compressor of the later

Which of these statements are correct?

- a. 1 and 2
 - b. 1 and 3
 - c. 1 and 4
 - d. 2 and 4
- vi The clearance volume of a reciprocating compressor directly affects:
- a. Piston speed
 - b. Noise level
 - c. Volumetric efficiency
 - d. Temperature of air after compression
- vii Flash chamber is used in refrigeration for which one of the following?
- a. Decreasing the pressure during multistage compression
 - b. Increasing the compressor pressure ratio
 - c. Effective intercooling medium for the purpose of increasing COP
 - d. Maintaining the same pressure and temperature
- viii For small installations of refrigeration systems (up to 35 kW) which types of condenser is used?
- a. Shell and tube type
 - b. Shell and coil type
 - c. Double tube type
 - d. Air cooled type
- ix Which of the following types of expansion valves is suitable for a refrigeration plant operating at constant load?
- a. Thermostatic expansion valve
 - b. Automatic expansion valve
 - c. Capillary tube
 - d. None of the above
- x In thermos electric refrigeration system works on:
- a. Peltier effect
 - b. Bryton cycle
 - c. Bell Coleman cycle
 - d. Carnot cycle

Q.2 Short answer type questions (4 questions @ 2.5 marks)

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- i In extra low temperature, which type of refrigeration system can be used? Explain with justification.
- ii Which is the equivalent system for air washer?
- iii Which refrigerants can be used after implementation of Kigali amendment?
- iv The ADP should always be lesser than coil temperature why?

- Q.3 An ammonia simple saturation cycle operates between evaporator and condenser temperatures of -25°C and 40°C , respectively. The system is to be used in producing 5000 kg of ice at -10°C from water at 25°C in 20 hrs. Assuming losses to be 20 percent of the heat to be absorbed from the water, determine (a) the mass flow rate, (b) the heat rejected in the condenser, and (c) the power required by the compression. Take average heat capacity of water as 4.187 kJ/kg-K and Latent heat of Freezing of water is 335 kJ/kg. 10
- Q.4 In an auditorium which is to be maintained at a temperature not exceeding 25°C and a relative humidity not more than 60%, a sensible load of 132 kW and 84 kg/h of moisture has to be removed. Air is to be supplied to the auditorium at 15°C . 10
- How many kg of air per hour must be supplied? If latent heat of water at 25°C is 2444.9 kJ/kg?
 - What is the dew point of the supply air and its relative humidity?
- Q.5 An Ammonia refrigeration unit is operating with two evaporators at -10°C and -20°C and have the cooling load of 20 TR and 40 TR respectively. The unit employs compound compression with flash inter cooling at the evaporator pressure operating at higher temperature. The condenser pressure is 15.55 bar. It is assumed that the refrigerant vapor leaving the evaporator is in dry and saturated condition. Determine the following: 10
- Mass flow rate of refrigerant in Each evaporator
 - Total power required
- Q.6 Describe the Vapor absorption system with schematic diagram 10
- OR
- Q.6 In what circumstances multiple evaporator and single compressor system is used. Describe with schematic diagram. 10
- Q.7 Air washer can be used for various applications. Describe them with the help of psychrometric chart 5
- OR
- Q.7 A hotel has kitchens and air conditioned rooms. Which are the conditioning systems you will recommend and why? Explain in detail. 5
- Q.8 A refrigeration system operates with R 12 refrigerant. The evaporator and condenser temperatures are at -5°C to 35°C , respectively. The actual suction to the compressor is at 15°C . If superheating of refrigerant vapor from -5°C to 15°C does not add any refrigerating effect. Determine the percentage increase in volume flow rate per ton of refrigeration system compared to the saturation cycle. 10
- OR
- Q.8 A refrigeration system operates with R 12 refrigerant. The evaporator and condenser temperatures are at -5°C to 35°C , respectively. The actual suction to

the compressor is at 15°C . If superheating of refrigerant vapor from -5°C to 15°C does not add any refrigerating effect.

Determine the COP for saturated and superheated cycle and power required by the compressor.

Q.9 Describe the process of project working using flow diagram

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Questions from Q6 to Q9 may be of 10 marks or maximum 15 marks depending upon the nature of problem as formulated by faculty