

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), April-May 2018

B. Tech in Mechanical Engineering, Semester VI

Roll No.....

COURSE CODE: ME 602

Time: 3 hours

Max. Marks: 100

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.1A Objective type multiple choice questions

10

- i. The COP of a refrigerator working on a reversed Carnot cycle is 4. The ratio of the highest absolute temperature to lowest absolute temperature is:
 - a. 1.2
 - b. 1.25
 - c. 3.33
 - d. 4
- ii. Round the clock cooling of an apartment having a load of 300 MJ/day requires and air conditioning plant of capacity of
 - a. 1 TR
 - b. 2 TR
 - c. 10 TR
 - d. 300 TR
- 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
Carnot cycle

- Q.2 Short answer type questions (4 questions @ 2.5 marks) 10
- i In space, which type of refrigeration system can be used? Explain with justification.
 - ii Which is the equivalent system for cooling tower?
 - iii Which refrigerants can be used after implementation of Kigali amendment?
 - iv The ADP should always be lesser than coil temperature why?

- Q.3 A fifteen ton refrigeration system is used to make ice. Water is available at 20°C. Refrigerant 12 is used with saturated temperature limits of - 25°C and 54°C. Determine: 10
- a. COP
 - b. Refrigerant Flow rate
 - c. Temperature at the discharge of compressor
 - d. Volume flow rate

Maximum Kg of ice produced per day if water specific heat is 4.187 kJ/kg-K and Latent heat of Freezing of water is 335 kJ/kg.

- Q.4 In an auditorium which is to be maintained at a temperature not exceeding 24°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

- a. How many kg of air per hour must be supplied? If latent heat of water at 24°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 -4°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

- a. Mass flow rate of refrigerant in Each evaporator
- b. 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 15

OR

Q.7 A hotel has kitchens and air conditioned rooms. Which are the conditioning systems you will recommend and why? Explain in detail. 15

Q.8 Describe desirable thermodynamic properties of refrigerants. 10

Q.9 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. 15

Determine the percentage increase in volume flow rate per ton of refrigeration system compared to the saturation cycle.

OR

Q.9 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. 15

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