

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), April-May 2016

B. Tech Mechanical Engineering, Semester VI

COURSE CODE: ME 602

COURSE TITLE: Refrigeration and air-conditioning

Roll No.....

Time: 3 hours

Max. Marks: 100

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 refrigerant charts, psychrometric chart and steam table

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10

- i. Refrigeration is science of :
 - a. Producing temperature below ambient
 - b. Maintaining a constant temperature
 - c. To create zero net effect thermodynamically
 - d. None of the above
- ii. EER is defined as the ratio of
 - a. Total Work to cooling effect
 - b. Cooling effect to work
 - c. Cooling effect to useful work
 - d. All of the above
- iii. The fluid which absorbs heat from hot space is called:
 - a. Condensate
 - b. Refrigerant
 - c. a and b
 - d. none of the above
- iv. An ideal refrigerant should have :
 - a. High latent heat of vaporization
 - b. High vapor specific heat
 - c. High liquid specific heat
 - d. all of the above
- v. Expansion in refrigeration system is idealized as:
 - a. isentropic process
 - b. isenthalpic process
 - c. polytropic process
 - d. constant volume process
- vi. Primary refrigerant :
 - a. Does not change the phase
 - b. Change the phase
 - c. May or may not change phase
 - d. None of the above



- vii Window air conditioner is used for:
 - a. Isolated space
 - b. Limited occupancy
 - c. Usage is for short period
 - d. None of the above
- viii Psychrometry is a science of:
 - a. Dry air
 - b. Moist air
 - c. Water vapor
 - d. All of the above
- ix Flash intercooler uses
 - a. Single compressor
 - b. Single fluid
 - c. Low evaporator and condenser pressure difference
 - d. All of the above
- x^a Relative humidity of air is defined as the ration of:
 - a. Vapor pressure of water vapor at dew point temperature and dry bulb temperature
 - b. Atmospheric pressure and water vapor pressure at dry bulb temperature
 - c. Atmospheric pressure and water vapor pressure at dew point temperature
 - d. None of the above

Q.2 Short answer type questions 10

- a. Write five applications of refrigeration
- b. Write thermodynamic requirement of ideal refrigerant

Q.3(a) What is the purpose of evaporative cooling? Explain. 05

(b) Explain with neat sketch and T-S diagram the working principle of bootstrap air refrigeration system and reduced ambient air refrigeration system. 25

Q.4 A 10TR capacity Ammonia vapor compression system is working between -20°C evaporator temperature and 40°C condenser temperature. The refrigerant vapor is compressed to an intermediate pressure of 5 bar and then cooled in a flash inter cooler. The vapor is compressed isentropically in both compressors from the saturated vapor condition. Draw both the cycle on p-h diagram 25

- a. Determine the mass flow rate, the compressor power and the COP if the system works in a saturated vapor compression cycle.
- b. For compound vapor compression with flash inter cooling system, find
 - (i) Mass flow rate in the low pressure circuit
 - (ii) Mass flow rate in high pressure circuit
 - (iii) The total compressor power
 - (iv) The COP

OR

Q.4 An R 134a unit operating at three evaporating temperatures 5°C , -5°C and -10°C , with the cooling capacity of 30 TR, 20 TR and 10 TR respectively. Every evaporator is provided with an individual expansion valve. The vapor at the 25

outlet of each evaporator is saturated vapor. The two high pressure evaporators have back pressure expansion valves. The vapor from the evaporators is mixed before it enters the compressor. The condensation takes place at 40°C with no sub cooling effect. Draw the system schematic and process on p-h diagram.

Determine:

- The refrigerant effect per kg of refrigerant in each evaporator
- The mass flow rate of the refrigerant in kg/s in each evaporator
- The compressor power
- The COP of the unit

- Q.5 a. In a vapor absorption system, the heating, cooling and refrigeration temperatures are 100°C , 30°C and -10°C . Find the COP of the system. 25
- b. In case the heating temperature is increased to 150°C and the refrigeration temperature is reduced to -30°C with cooling temperatures remaining the same, find the new COP and percentage change in COP.
- c. If simple vapor compression is used in place of vapor absorption system in (a) and (b) for same evaporator and cooling (condenser) temperature using Ammonia as refrigerant, find out the COP of vapor compression systems (a) and (b) with saturated conditions of refrigerant from evaporator and entering in compressor is considered.

OR

- Q.5 Compare the values of degree of saturation to the values of Relative humidity of moist air by computing the vapor density of the moist air for an air-water vapor mixture at dbt of 26°C and relative humidity of 0%, 50% and 100%. 25