

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Backlog), November - December 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

- i. Refrigeration is a science of :
 - a. Air conditioning
 - b. Air cooling
 - c. Air cooling as well as humidification
 - d. None of the above
- ii. For engine it is efficiency so for refrigeration it is
 - a. Coefficient of performance
 - b. Energy efficiency
 - c. Power factor
 - 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. positive pressure at evaporator temperature
 - b. negative pressure at condenser temperature
 - c. atmospheric pressure at condenser and evaporator and condenser
 - 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 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 how refrigeration is used in food preservation
- b. Write thermodynamic requirement of ideal refrigerant

Q.3(a) Why pressurization of cabin is needed in case of aircraft refrigeration? 05

(b) Explain with neat sketch and T-S diagram the working principle of bootstrap evaporation air refrigeration system and regenerative air refrigeration system 05

Q.4 A 10 TR 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 -20°C , with the cooling capacity of 30 TR, 20 TR and 10 TR respectively. Every 25

evaporator is provided with an individual expansion valve. The vapor at the 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 120°C , 30°C and -10°C . Find the COP of the system. 25
 b. In case the heating temperature is increased to 200°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 Investigate the effect of humidity on the density of moist air by computing the vapor density of the moist air for an air-water vapor mixture at dbt of 25°C and relative humidity of 0%, 50% and 100%. Also compare the values of degree of saturation to the values of Relative humidity 25
- Q.6 A cascade refrigeration system employs R 502 on the lower temperature cascade and R 134a on the high temperature cascade. This cascade system produces a refrigeration effect of 10 TR at -40°C , in the lower temperature evaporator with R 502. The condenser of low temperature cascade rejects heat at -10°C , while that of high temperature cascade condenser will reject heat to water at 38°C . Assume a temperature overlap of 6°C in the condenser evaporator (Cascade condenser). Also assume that both the cascade system operate on saturated vapor compression cycle. Determine the following: 20
- Pressure ratio of the cascades
 - Mass flow rate of refrigerant for both cascades
 - Compressor power of each compressor