GUJARAT TECHNOLOGICAL UNIVERSITY ME – SEMESTER-1 (NEW) EXAMINATION – WINTER 2016

Subject Code: 2711003 **Subject Name: Advanced Refrigeration** Time: 2:30 pm to 5:00 pm **Instructions:**

Date:06/01/2017

Total Marks: 70

- - 1. Attempt all questions.
 - 2. Make suitable assumptions wherever necessary.
 - 3. Figures to the right indicate full marks.
 - 4. Use of refrigerants data book is permitted
- (a) Discuss applications where HCFC-22 refrigerant is widely used. Suggest 07 Q.1 HCFC- 22 Eco-friendly alternatives for the various applications.
 - (b) Draw the temperature-entropy and enthalpy-entropy diagram of a steam jet 07 refrigeration system and write the expressions for the following efficiencies: (a) Nozzle efficiency (b) Entrainment efficiency; and (c) Compression efficiency
- **Q.2** Explain the working of regenerative air refrigeration system with a neat sketch 07 (a) and T-s diagram.
 - The following data refer to a boot strap aircraft refrigeration system of 9 TR 07 **(b)** capacity:
 - Ambient air temperature and pressure: 20°C and 0.86 bar

Ram air pressure : 1 bar, Assuming ramming action to be isentropic

Pressure at the exit of main compressor: 3.2 bar

Pressure at the exit of auxiliary compressor: 4.2 bar

Cabin air temperature and pressure : 20°C and 0.9 bar

 $\eta_c = \text{compressors efficiency} = 82\%$

 η_t = turbine efficiency = 86%

Assume that the 45% of enthalpy of air discharged from main compressor is removed in the first HX and 32 % of the enthalpy of air discharged from auxiliary compressor is removed in the second HX

Determine (a) the power required to operate the system and (b) the COP of the system

OR

- (b) Explain the balancing of compressor and capillary tube in VCR system 07 and effects of unbalanced conditions in compressor-capillary tube system
- **(a)** Explain with neat sketch and p-h diagram of the VCR system having two 07 Q.3 evaporators at different temperatures and employed with individual compressors and common condenser.
 - (b) The refrigeration system using R-12 as refrigerant consists of three evaporators 07 of capacity 10 TR, 20 TR and 30TR with multiple expansion valves and individual compressors. The temperature in three evaporators is maintained at 10°C, 5°C and -10°C respectively. The vapor leaving the evaporators is dry and saturated vapor. The condenser temperature is 40°C and the liquid refrigerant leaving the condenser is sub-cooled to 30°C. Assuming isentropic compression determine the refrigerating mass flow rate in each evaporators, power required to drive compressors and COP of system.

OR

- (a) Explain the differences between multi-stage refrigeration and cascade 07 Q.3 refrigeration system.
 - (b) The following data refer to a two stage compression ammonia refrigerating 07

system with water intercooler. Condenser pressure = 14 bar; Evaporator pressure = 2 bar; Intercooler pressure = 5 bar; Load on the evaporator = 10 TR. If the temperature of the de-superheated vapour and sub-cooled liquid refrigerant are limited to 30° C, find (a) the power required to drive the system, and (b) COP of the system.

- Q.4 (a) Draw a neat sketch of a practical vapour absorption refrigeration cycle. Indicate 07 thereon the phases of various fluids and the name of the equipments. Also indicate the direction of the external energy flow to or from the equipments.
 - (b) Explain the working of double effect LiBr-H₂O absorption system along with a **07** neat sketch and ln p -1/T diagram.

OR

Q.4 (a) Simple absorption refrigeration cycle does not consider the rectification column and preheating heat exchanger. In such aqua-ammonia cycle evaporator, absorber, condenser and generator temperatures are 233 K, 303K, 313K, and 373K respectively. The properties of aqua-ammonia are as follows:

	Concentration	Enthalpy
Strong solution leaving absorber	0.421	30
Weak solution leaving generator	0.375	340
Vapour leaving generator	0.945	1870
Liquid leaving generator	0.945	470
Vapour leaving evaporator	0.945	1388

- (i) Draw schematic diagram of the system
- (ii) For one TR refrigerating capacity determine the mass flow rate of solution in evaporator
- (iii) Mass flow rate of strong and weak solutions
- (b) Discuss advantages of vapour absorption refrigeration system over vapour 07 compression refrigeration system.
- Q.5 (a) Discuss various method of refrigeration adopted in refrigerated trucks and 07 containers.
 - (b) What is heat pump? Explain in brief different types of heat pumps.

OR

- Q.5 (a) Explain, in brief, the processing of vegetables and fruits before preserving them 07 in frozen storages.
 - (b) Explain in brief the various sources of heat and type of product load to be 07 considered while making a cold storage design ***********

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