Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER II (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2722109 **Date: 25/05/2016**

Subject Name: Advanced Refrigeration Engineering

Time:10:30 am to 01:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** In spite of CFCs being suitable for every specific application from the point of view of their thermodynamic and thermophysical properties, these refrigerants are not eco-friendly. Comments on this statement and explain how these refrigerants are being contemplated to be replaced under Montreal and Kyoto Protocols. **07**

(b) Explain the working of regenerative air refrigeration system with a neat sketch and T-s diagram. **07**

Q.2 **(a)** Explain the working principle of thermostatic expansion valve with the help of a neat diagram. **07**

(b) The following data refer to a boot strap aircraft refrigeration system of 10 TR capacity: **07**

Ambient air temperature and pressure: 20 ℃ and 0.85 bar
Ram air pressure : 1 bar, Assuming ramming action to be isentropic
Pressure at the exit of main compressor: 3 bar
Pressure at the exit of auxiliary compressor: 4 bar
Cabin air temperature and pressure : 20℃ and 0.9 bar
η_c = compressors efficiency = 80%
η_t = turbine efficiency = 85%
assume that the 50% of enthalpy of air discharged from main compressor is removed in the first HX and 30 % 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) Draw the temperature-entropy and enthalpy-entropy diagram of a steam jet refrigeration system and write the expressions for the following efficiencies: (a) Nozzle efficiency (b) Entrainment efficiency; and (c) Compression efficiency **07**

Q.3 **(a)** Describe the graphical method used to obtain the performance characteristics of a condensing unit by matching the characteristics of compressor and condenser. **07**

(b) In an ammonia system one evaporator is to provide 180 kW of refrigeration at -30℃ and another evaporator is to provide 200 kW at 5 ℃. The system uses two stage compressions with flash intercooling and also flash gas removal. The condensing temperature is 40 ℃. Calculate power required by the compressors. **07**

OR

Q.3 **(a)** Explain cascade refrigeration system with a neat sketch and also comment on intermediate temperature (Ti) if upper and lower stage system COP is same. **07**

(b) Calculate the power required by the two compressors in an ammonia system which servers a 250 kW evaporator at -25 ℃. The system uses two-stage compression with intercooling and flash gas removal. The condensing **07**

temperature is 35°C. The intermediate pressure in flash intercooler is equal to

$$P_i = \sqrt{P_d P_s}$$

Q.4	**(a)**	Derive an expression for COP of an ideal vapour absorption refrigeration system in terms of temperature T_G at which heat is supplied to the generator, the temperature T_E at which heat is absorbed in the evaporator and the temperature T_C at which heat is discharged from the condenser and absorber.	**07**
	(b)	Draw a neat diagram of LiBr-H_2O absorption system and explain its working.	**07**
		OR	
Q.4	**(a)**	Discuss differences between NH3-H_2O vs LiBr-H_2O vapour absorption system	**07**
	(b)	Locate the state point on the enthalpy and concentration (h-c) diagram of ammonia ï water mixture corresponding to 20 bar and 130 ℃ saturation liquid state in the generator. Hence get enthalpy and concentration of the mixture. Also determine the enthalpy and concentration of vapour using isotherm.	**07**
Q.5	**(a)**	Explain the use of cold storage. Discuss various factors considered in the design of cold storage.	**07**
	(b)	Explain in brief about freezing method of food preservation.	**07**
		OR	
Q.5	**(a)**	Explain in brief about the refrigerating systems employed by trucks and containers.	**07**
	(b)	Describe the VCR cycle with P-h diagram having multiple evaporators with individual expansion valve and with individual compressor.	**07**

****