

GUJARAT TECHNOLOGICAL UNIVERSITY
ME SEMESTER III (NEW) EXAMINATION – SUMMER - 2017

Subject Code: 2733905**Date: 02/05/2017****Subject Name: Solar Refrigeration and Air-conditioning****Time: 02:30 pm to 05:00 pm****Total Marks: 70****Instructions:**

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks
4. Use of solar refrigeration data book, steam table and refrigerant property table is permitted after verification.

- Q.1** (a) A flat plate collector array is to be installed at location 28.58°N . Calculate the optimum tilt for the data given in table -1 for the three situations: (i) Insolation falling on the array over the whole year is to be maximized. (ii) Insolation for the months of April, May and June is to be maximized. (iii) Insolation for the months of December, January and February is to be maximized. **09**

- (b) Write a short note on thermo-chemical storage **05**

- Q.2** (a) Explain thermodynamic modeling of solar operated Rankin cycle cooling system. **09**

- (b) Discuss the important thermodynamic properties of selection of vapour compression refrigeration system. **05**

OR

- (b) Explain in brief thermodynamic operation of steam jet ejector compression solar cooling system with neat layout. **05**

- Q.3** (a) Explain with neat sketch the closed cycle solid-vapour adsorption system. **07**

- (b) Explain in brief cross flow desiccant dehumidifier studied by Lavan. **07**

OR

- Q.3** (a) Explain with neat sketch the experimental study carried out by Kaudinya and Kaushik for the open and forced flow solar regenerator. **09**

- (b) Discuss in brief the desirable characteristics of liquid absorbent for solar dehumidifier. **05**

- Q.4** (a) An ammonia refrigerator works between the pressure limit of 11.65 and 2.69 bar. The vapour leaves the compressor at 40.5°C and there is no under-cooling in condenser. If actual C.O.P. is 70 % of theoretical, find analytically the motor power in kW to run the compressor to produce one ton of ice per hour at -5°C . The other data is given as: **07**

- Temperature of water supplied is 13.3°C
- Specific heat of ice is $2 \text{ kJ/kg}^{\circ}\text{C}$
- Latent heat of ice is 336 kJ/kg
- Total heat of vapour leaving the compressor is 1508 kJ/kg

The properties of NH_3 are given below:

Pre. (bar)	Temp. $^{\circ}\text{C}$	h_f (kJ/kg)	h_g (kJ/kg)	s_f (kJ/kg-K)
2.69	-12.2	125.6	1309.0	0.507
11.6	29.4	321.5	1473.1	1.199

- (b) Explain the analysis of sensible heat storage device for situation (1) well mixed (2) Thermal stratification. **07**

OR

- Q.4 (a)** Explain the working of pressure – temperature – concentration measuring device. **07**

- (b) A packed-bed storage unit, 1.016 m in height and 0.70 m in diameter, is filled with rock pieces ($\rho_s = 2800 \text{ kg/m}^3$, $C_{ps} = 0.9365 \text{ kJ/kg-K}$) having an average diameter of 2 cm. The void fraction is 0.35. Initially the bed is at a uniform temperature of 25 °C everywhere. Air heated to a temperature of 70 °C in solar air heaters, starts flowing in with a flow rate of 0.4 kg/s. find the temperature distributions in the bed after 11 minutes at distance (1) 0 m (2) 0.3046 m (3) 0.8122 m (4) 1.016 m. Calculate also the pressure drop across the bed. **07**

- Q.5 (a)** Explain the working of solar powered thermo-acoustic cooling system with neat sketch. **07**

- (b) Explain the thermodynamic modeling of $\text{NH}_3\text{-LiBr}$ vapour absorption system. **07**

OR

- Q.5 (a)** Explain with neat sketch design and performance of thermoelectric refrigerator. **07**

- (b) Explain with neat sketch working of absorption air-conditioning system with refrigerant storage. **07**

Month	J	F	M	A	M	J	J	A	S	O	N	D
n (Representative day)	16	45	75	105	136	166	197	228	258	289	319	350
H_g (kWh/ $\text{m}^2\text{-day}$)	3.987	5.001	6.138	6.935	7.287	6.544	5.334	5.053	5.602	5.355	4.523	3.843
H_d (kWh/ $\text{m}^2\text{-day}$)	1.240	1.474	1.861	2.473	2.922	3.540	3.135	2.727	2.152	1.465	1.141	1.117

Table -1
