Seat No.: _____ Enrolment No._____

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 kJ/kg-°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. °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 (ρ_s = 2800 kg/m^3, C_{ps} = 0.9365 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 NH_3-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/ m^2-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/ m^2-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

****