Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME - SEMESTER– I (OLD course)• EXAMINATION – SUMMER 2015

Subject Code: 713904 **Date: 16/05/2015**

Subject Name: Advanced Thermal Engineering

Time: 10:30 am to 1:00 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 Steam table is permitted.**

Q.1	(a)	Explain Availability and Irreversibility by giving some suitable examples.	07
	(b)	Explain with neat sketch mechanism of flow boiling.	07
Q.2	(a)	Derive General heat conduction equation in Spherical coordinates	07
	(b)	Air at 20^0 C and 7 bar is contained in a rigid tank of 0.57 m^3 volume capacity. The tank is provided with a valve that opens at a pressure of 8.5 bar and remains open till the pressure drops to 8.15 bar. A fire occurs and that causes the valve to operate once. Determine (i) Air temperature just before valve opens (ii) Mass of air lost due to fire. Assume that temperature of air does not change during discharge and air in the tank acts as an ideal gas.	07
		OR	
	(b)	A tank contains 2 m^3 of air at -93^0C and a gauge pressure of 1.4 MPa. Determine the mass of air in Kg. The local atmospheric pressure is 1 atm.	07
Q.3	(a)	Thickness of insulation on a pipe is also a major criterion for heat transfer through pipes. Comment with explanation.	07
	(b)	A system at 450 K receives 225 KJ/s of heat energy from a source at 1500 K, and temp of both system and source remain constant during heat transfer process. Represent the process on temp- entropy diagram and determine(i)Net change in entropy (ii) Available energy of heat sources and system(iii) Decrease in available energy (Ambient temperature is 27^0C)	
		OR	
Q.3	(a)	Using Gibbs relations derive Maxwell relations	07
	(b)	An exterior wall of a house may be approximated by a 0.1 m layer of common brick (k= 0.7 W/m^0C), followed by a 0.04 m layer of gypsum plaster (k= 0.48 W/m^0C). What thickness of loosely packed Rockwool insulation (k= 0.065 W/m^0C) should be added to reduce the heat loss or gain through wall by 80%?	07
Q.4	(a)	Derive the expression of effectiveness by NTU method for counter flow heat exchanger.	07
	(b)	Water is to be boiled at atmospheric pressure in a mechanically polished stainless steel pan placed on top of the heating unit. The inner surface of the bottom of the pan is maintained at 108^0C. If the diameter of the bottom of the pan is 30cm, determine (i) rate of heat transfer to the water (ii)rate of evaporation of water (iii) critical heat flux	07
		OR	
Q.4	(a)	Derive the equation for film thickness for laminar film condensation on vertical plates.	07
Q.4	(b)	Saturated steam at 1 atm. pressure condenses on a 2 m high and 3 m wide vertical plate that is maintained at 80^0C by circulating cooling water through	07

the other side. Determine (i) film thickness (ii) rate of heat transfer (iii) the rate at which condensate drips off the plate at bottom. Neglect density of vapor.

Q.5	(a)	Explain electrical network analogy for thermal radiation systems.	07
	(b)	A rectangular tube, 30 x 50 mm carries water a t a rate of 2 kg/s. Determine the length required to heat the water from 30^0C to 50^0C if the wall temp. is maintained at 90^0C. Use $Nu = 0.023(Re)^{0.8}(Pr)^{0.4}$.	07

OR

Q.5	(a)	Write a short note on Gas radiation.	07
	(b)	Two parallel discs are kept 200cm apart in the surrounding which is at temp. 20^0C. One disc is at temp. 500^0C with emissivity 0.5 and other side is insulated. Other disc is open to environment on both the sides. Determine the heat transfer rate from first disc and temp. of second disc. Take $F_{12} = 0.06$ disc diameter = 1m.	07

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