Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M.E. SEMESTER I (old course)–EXAMINATION (Remedial) – WINTER 2015

Subject code: 711101 Date: 08/12/2015

Subject Name: Advanced Thermodynamics and Heat Transfer

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.**

Q.1	**(a)**	Derive the equation of heat conduction through hollow sphere with uniform thermal conductivity.	**07**
	(b)	Discuss in details about factors affecting the thermal conductivity.	**07**
Q.2	**(a)**	Derive the momentum equation for Hydrodynamic boundary layer over a flat plate in forced convection.	**07**
	(b)	Consider a 1.2 m thick slab of poured concrete (K = 1.148 W/m°C) with both of side surfaces maintained at a temperature of 20°C. During its curing, chemical energy is released at the rate of 80 W/m^3. Presuming that temperature does not vary with time. Determine: (a) The maximum temperature of concrete. (b) What maximum thickness of concrete can be poured without causing the temperature gradient to exceed 98.5°C per meter anywhere in the slab?	**07**
		OR	
	(b)	A 350 mm long glass plate is hung vertically in the air at 24°C while its temperature is maintained at 80° C. Calculate the boundary layer thickness at the trailing edge of the plate. If a similar plate is placed in a wind tunnel and air is blown over it at a velocity of 5 m/s, find the boundary layer thickness at its trailing edge. Also determine the average heat transfer coefficient, for natural and forced convection for the above mentioned data.	**07**
Q.3	**(a)**	Explain Wienôs displacement law.	**07**
	(b)	Calculate the following for an industrial furnace in the form of a black body and emitting radiation at 2500°C: (a) Monochromatic emissive power at 1.2εm length. (b) Wavelength at which the emission is maximum. (c) Maximum emissive power. (d) Total emissive power. (e) Total emissive power of the furnace if it is assumed as a real surface with emissivity equal to 0.9.	**07**
		OR	
Q.3	**(a)**	Explain the design of Rectangular fin.	**07**
	(b)	A carbon steel rod (K = 55W/m°C) has been attached to a plane wall which is maintained at a temperature of 350°C. The rod is 8 cm long and has the cross section of an equilateral triangle with each side 5 mm. Determine the heat dissipation from the rod if it is exposed to a convection environment at 25°C with unit surface conductance 100W/m°C. Consider end surface loss to be negligible.	**07**

Q.4	**(a)**	Prove that all reversible engines operating between the two constant temperature thermal reservoirs have the same thermal efficiency.	**07**
	(b)	Explain the principle of increase of Entropy.	**07**
		OR	
Q.4	**(a)**	Define Gibbs & Helmholtz free energy and derive Maxwell relations for internal energy, enthalpy, Gibbs energy and Helmholtz energy.	**07**
	(b)	A steam power plant operates between boiler temperature of 160°C and condenser temperature of 50°C. Water enters the boiler as saturated liquid and steam leaves the boiler as saturated vapour. Verify the Clausius inequality for the cycle.	**07**
Q.5	**(a)**	Establish the equivalence of Kelvin-plank and Clausius statements.	**07**
	(b)	Explain any one unsteady flow process.	**07**
		OR	
Q.5	**(a)**	Write down the short note on ñExergyò.	**07**
	(b)	A stream of gases at 7.5 bar, 750°C and 140 m/s is passed through a turbine of a jet engine. The stream comes out of the turbine at 2.0 bar, 550°C and 280 m/s. The process may be assumed adiabatic. The enthalpies of gas at the entry and exit of the turbine are 950 KJ/Kg and 650 K/Kg respectively. Determine the capacity of the turbine if the gas flow is 5Kg/s.	**07**

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