Reg.No. _____

Karunya UNIVERSITY

(Karunya Institute of Technology & Sciences)
(Declared as Deemed-to-be University under Sec.3 of the UGC Act, 1956)

End Semester Examination – Nov/Dec – 2016

Semester : 2016-17 ODD
Code : 14AE3003 **Duration : 3hrs**
Sub. Name : Thermodynamics and Heat Transfer **Max. marks : 100**

ANSWER ALL QUESTIONS (5 x 20 = 100 Marks)

Q. No.	Sub Div.	Questions	Course Outcome	Marks
1.	a.	Air at a temperature of 15°C passes through a heat exchanger at a velocity of 30 m/s where its temperature is raised to 800°C. It then enters a turbine with the same velocity of 30 m/s and expands until the temperature falls to 650°C. On leaving the turbine, the air is taken at a velocity of 60 m/s to a nozzle where it expands until the temperature has fallen to 500°C. If the air flow rate is 2 kg/s, calculate (a) the rate of heat transfer to the air in the heat exchanger,(b) the power output from the turbine assuming no heat loss, and (c) the velocity at exit from the nozzle, assuming no heat loss. Take the enthalpy of air as h = c_pT, where c_p is the specific heat equal to 1.005 kJ/kg K and t the temperature.	CO1	**20**
		(OR)		
2.	a.	Energy is always conserved, but its quality is always degraded. Explain.	CO1	**20**
3.	a.	Explain the ways of entropy generation in closed system.	CO1	**10**
	b.	Write a short notes on availability in chemical reactions.	CO1	**10**
		(OR)		
4.	a.	Derive the TdS equation in terms of coefficient of volume expansion (β) and isothermal compressibility (K_T). $$TdS = C_v dT + T\frac{\beta}{k}dV = C_p dT - TV\beta\, dp = \frac{k\, C_v\, dp}{\beta} + \frac{C_p}{\beta V}dV$$	CO1	**20**
5.	a.	Derive the general three-dimensional heat conduction equation in Cartesian coordinates.	CO1	**20**
		(OR)		
6.	a.	A furnace wall consists of steel plate 20 mm thick, thermal conductivity 16.2 W/mK lined on inside with silica bricks 150 mm thick with conductivity 2.2 W/mK and on the outside with magnesia brick 200 mm thick, of conductivity 5.1 W/mK. The inside and outside surfaces of the wall are maintained at 650°C and 150°C respectively. Calculate the heat loss from the wall per unit area. If the heat loss is reduced to 2850 W/m^2 by providing an air gap between steel and silica bricks, find the necessary width of air gap if the thermal conductivity of air may be taken as 0.030 W/mK.	CO2	**20**
7.	a.	An aluminium sphere mass 5.5 kg and initially at a temperature of 290°C is suddenly immersed in a fluid at 15°C with heat transfer co-efficient 58 W/m^2K. Find the Biot number and verify the lumped heat capacity analysis is applicable. Also find the time required to cool the aluminium sphere to 95°C and time constant.	CO2	**20**
		(OR)		
8.	a.	Air at 20 °C and at a pressure of 1 bar is flowing over a flat plate at a velocity of 3 m/s. If the plate is 300 mm wide and at 60 °C, Calculate the following. (a) Boundary layer thickness (b) Local convective heat transfer coefficient (c) Average convective heat transfer coefficient (d) Rate of heat transfer by convection and (e) total mass flow rate through the boundary.	CO2	**20**

		Compulsory:		
9.	a.	Emissivities of two large parallel plates maintained at 850^{o} C and 350^{o}C are 0.4 and 0.6 respectively. Find net radiant heat exchange per square meter for these plates. Find the percentage reduction in heat transfer when a polished aluminum radiation shield of emissivity 0.05 is placed between them. Also find the temperature of the shield.	CO2	**20**

ALL THE BEST