Subject Code………………… **ROLL NO………………………**

SEMESTER EXAMINATION 2022-23
1st year M.Tech. Thermal Engineering

Convective Heat Transfer (TET-303)

Duration : 3 hrs **Max. Marks: 100**

Note:- Attempt all questions. All question carry equal marks. In case any ambiguity or missing data, the same may be assumed and state the assumption made in the answer.

Q.1.	**Answer any four parts of the following.**	**5×4=20**
	a) What is the natural convection? How does it differ from the forced convection? What force causes natural convection currents? b) Discuss laminar sublayer, buffer layer and turbulent layer in a boundary layer? c) What do you understand by hydrodynamically developed flow in a circular tube? d) What do you mean by hydro dynamically developed flow in a circular tube? Explain. e) What is the natural convection? How does it differ from the forced convection? What force causes natural convection currents? f) What do you understand by local and average value of heat transfer coefficient?	
Q.2.	**Answer any four parts of the following.**	**5×4=20**
	a) Explain the Reynold Colburn analogy for laminar flow over plate. b) Discuss in details, the various regimes of pool boiling. c) Drive the energy equation for the laminar boundary layer over a flat plate. d) Define Nusselt number and discuss its significance. e) What property is responsible for development of velocity boundary layer? What property is for thermal boundary layer? f) Show that the coefficient of volumetric expansion for an ideal gas is $\beta = 1/T$, where T is absolute temperature of gas.	
Q.3.	**Attempt any two parts of the following.**	**10×2=20**
	a) Distinguish between I. Subcooled and saturated boiling	

	II. Nucleate and film boiling b) Water at 20^0C flows through a small tube, 1mm in diameter at a uniform speed of 0.2 m/s. The flow is fully developed at a point beyond which a constant heat flux of 6000 W/m^2 is imposed. How much farther down the tube will the water reach 74^0C as its hottest point? Take the physical properties of water at 320K ρ = 989 kg/m^3, C_p = 4180 J/kg.K, $\mu = 577\times10^{-6}$ k_f = 0.640 W/m.K, Pr = 3.77 c) Drive an equation for energy for flow over a flat plate.	
Q.4.	**Attempt any two parts of the following.**	**10×2=20**
	a) Discuss the condition under which the dropwise condensation can take place. Why the rate of heat transfer in dropwise condensation is many times that of filmwise condensation. b) Why is the flow separation in flow over cylinders delayed in turbulent? c) Vertical door of a hot oven is 0.5 m high and is maintained at 200^0C. It is exposed to atmospheric air at 20^0C. Find (a) local heat transfer coefficient half way up the door; (b) average heat transfer coefficient for entire door; (c) thickness of free convection boundary layer at the top of the door. Take properties of atmospheric air at 110^0C ρ = 0.922 kg/m^3, C_p = 1000 J/kg.K, $\mu = 2.24\times10^{-5}$ kg/ms $\nu = 2.429\times10^{-5}$ m^2/s, k_f = 0.0332 W/m.K, Pr = 0.687	
Q.5.	**Attempt any two parts of the following.**	**10×2=20**
	a) The steam condenses on a vertical plane wall, derive expression for the followings. I. Average heat transfer coefficient, II. film thickness	

	III. rate of condensation and IV. rate of heat flow b) Drive the log mean temperature difference for fully developed heat transfer? c) In a constant surface temperature tube, the fluid enters at temperature T_i and leaves the tube at temperature T_o. Prove that $$\frac{T_s - T_o}{T_s - T_i} = exp\left(-\frac{hA_s}{mC_p}\right)$$	