**SHAHEED BHAGAT SINGH STATE TECHNICAL CAMPUS, FEROZEPUR**

**ROLL NO :** | | | | | | | | | | | | | **Total number of pages:[2]**

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**M.Tech. -CHE/ 3rd Sem**

# Advanced Heat Transfer

**Subject Code : MTCH 301**

**Paper ID :**

**Batch:2011onwards**

**Time allowed: 3 Hrs** **Max Marks: 100**

**Important Instructions:**

- **Attempt any five questions**
- **Assume any missing data**
- **Additional instructions, if any**

Q 1. (a) Show the laminar and turbulent boundary flow regimes over a flat plate. (5)
(b) Derive the energy equation in the thermal boundary layer in laminar flow over a flat plate. (10)

Q 2. a) Write down the governing equations of natural convection heat transfer.

b) A 0.5 m high flat plate of glass at 93C is removed from an annealing furnace and hung vertically in the air at 28 C,1 atm. Calculate the initial rate of heat transfer to the air. The plate is 1 m wide.

Q 3. (a)Derive the expression for Nusselt number for constant wall heat flux case considering laminar flow in tube.

(b) Water at 25°C enters a pipe with constant wall heat flux of 1 $kW/m^2$. The flow is hydro dynamically and thermally fully developed. The mass flow rate of water is 0.01 kg/s and the pipe radius is 1cm. Calculate. a) Reynolds number b) the heat transfer coefficient and c) The difference between the local wall temperature and the local mean (bulk ) temperature.

Q 4. (a)Discuss Colburn analogy and Linton Sherwood analogy.
(b) Nucleate boiling of water at atmospheric pressure occurs at the bottom of a polished copper pan maintained at $118^0$ C. find the boiling heat flux and maximum heat flux. Take $c_{pl}$ =4.215 kJ/kg.$^0$C, $\mu_l = 0.2822 \times 10^{-3}$ kg/m.s and $Pr_l = 1.76$.

Q5. Design a counter flow, concentric tube heat exchanger to use water for cooling hot engine oil from an industrial power station. The mass flow rate of the oil is given as 0.2 kg/s, and its inlet temperature is 90°C. water is available at 20°C but its temperature rise is restricted to 12.5°C because of environmental concerns. The outer tube diameter must be less than 5 cm, and the inner tube diameter must be greater than 5 cm due to constrains

arising from space and piping considerations The engine oil must be cooled to a temperature below 50°C. Obtain an acceptable design if the length of the heat exchanger must not exceed 200 m. Cp (in J/kgK), $\mu$ (in kg/sm) , and k (W/mK) for oil and water are 2100,0.03,0.15 and 4179, 8.55×10^-4, 0.613 respectively. Assume the thickness of the inner tube (made of brass) to be small.

Q6.(a) A sphere having diameter of 25 cm is heated to a surface temperature of 240 °C. The sphere is exposed to air at 25°C. Calculate the natural convective heat transfer.

(b) Water is to be heated from 50°C to 100°C in a smooth hot pipe. The pipe is maintained at a constant temperature above 30°C that of bulk water temperature under the condition of constant heat flux. Calculate the length of the pipe required for heating, if the tube diameter is 0.6 m and the Reynolds number of the water inside the pipe is 95000?

Q7. Discuss and compare conduction and convection effects in packed and fluidized beds.

Q8. Write short notes on:
(a) Heat transfer from radiating fins.
(b) The flat plate solar collector.
(c) The heat pipe.