

GUJARAT TECHNOLOGICAL UNIVERSITY
M. E. - SEMESTER – I • EXAMINATION – WINTER 2012

Subject code: 711005N**Date: 16-01-2013****Subject Name: Advaced Heat and Mass Transfer****Time: 02.30 pm – 05.00 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) What is thermal conductivity? Show that how thermal conductivity of solid, liquid and gases get vary with temperature? **07**
- (b) Define critical thickness. Explain its physical significance and derive an expression for the same. **07**

- Q.2** (a) What is pool boiling? Explain the different regime of pool boiling with neat sketch? **07**
- (b) Explain dropwise condensation and film condensation. **07**

OR

- (b) Discuss the basic aspects of heat transfer in porous media. **07**
- Q.3** (a) Derive general three dimensional heat conduction equations in Cartesian coordinates. **07**
- (b) A stainless steel fin ($k = 20 \text{ W/mK}$) having a diameter of 20 mm and a length of 0.1 m is attached to a wall at 300°C . The ambient temperature is 50°C and the heat transfer coefficient is $10 \text{ W/m}^2\text{K}$. The fin tip is insulated. Determine (a) the rate of heat dissipation from the fin (b) the temperature at the fin tip. (c) the rate of heat transfer from the wall area covered by the fin if the fin was not used and (d) the heat transfer rate from the same fin geometry if the stainless steel fin is replaced by a fictitious fin with infinite thermal conductivity. wall area covered **07**

OR

- Q.3** (a) Derive general three dimensional heat conduction equations in cylindrical coordinates. **07**
- (b) A parallel flow heat exchanger has its tubes of 5 cm internal and 6 cm external diameter. The air flows inside the tubes and receives heat from hot gases circulated in the annular space of the tube at the rate of 100 kW. Inside and outside heat transfer coefficients are $250 \text{ W/m}^2\text{K}$ and $400 \text{ W/m}^2\text{K}$ respectively. Inlet temperature of hot gases is 500°C , outlet temperature of hot gases is 300°C , inlet temperature of air 50°C , Exit **07**

temperature of air 140°C . Calculate :

- (1) Overall heat transfer coefficient based on outer surface area
- (2) Length of the tube required to affect the heat transfer rates.
Neglect the thermal resistance of the tube.
- (3) If each tube is 3 m length find the number of tubes required.

Q.4 (a) Discuss how effectiveness –NTU method is useful in designing heat exchanger. **07**

(b) What do you mean by extended surface in heat transfer? Discuss its effect on heat transfer. What are the considerations in determining the proper length of the fins attached to a surface? **07**

OR

Q.4 (a) The engine cylinder of a motor cycle is made of aluminium alloy ($k = 186 \text{ W/mK}$) and is 0.15 m long and outside diameter 50 mm. The temperature of the outer surface is 500 K and the ambient air is 300 K. To increase the rate of heat transfer, five annular fins of the same material are provided. The length and thickness of the fins are 20 mm and 6 mm respectively. The fins are equally spaced. Estimate the percentage increase in the heat transfer rate due to fins if the convective heat transfer coefficient is $50 \text{ W/m}^2\text{K}$. **07**

Q.4 (b) Discuss the criteria of selection of fins. What is the difference between fin effectiveness and the fin efficiency? When is the use of fins not justified? **07**

Q.5 (a) Discuss Fick's Law of Diffusion. **07**

(b) State and explain Lambert's cosine law of radiation **07**

OR

Q.5 (a) Explain the phenomenon of two-phase flow in a horizontal pipe. **07**

(b) Discuss compact heat exchanger. **07**
