Sample paper - III

Time: Three hours Maximum: 100 marks

Attempt Three Question from Each Section

Each Question Carries Equal marks

Section A:-

Q.1. What is heat transfer coefficient? Explain its physical significance.

Q. 2 What is the difference between drop-wise and film condensation?

Q. 3 Saturated vapour of methanol condenses on a vertical plate at 1 atm. The vertical plate is maintained at 55 oC by cooling water at the other side. Calculate the following,
(a) Length of the plate over which the condensate film remains laminar.
(b) What is the thickness of the film at the end of the laminar region?
(c) Determine the average heat transfer coefficient and the rate of condensation in the lamina region.
(c) What is the average heat transfer coefficient for the entire plate?

Q. 4 Compare the heat transfer coefficients for boiling water and condensing steam on a horizontal tube for normal atmospheric conditions.

Section B:-

Q.1. A heat transfer fluid is leaving a reactor at a rate of 167 kg/s at 85°C. The fluid is to be cooled to 50°C before it can be recycled to the reactor. Water is available at 30°C to cool the fluid in a 1-2 pass heat exchanger having heat transfer area of 15 m2. The water, which is being used to cool the fluid, must not be heated to above 38°C at the exit of the heat exchanger. The overall heat transfer co-efficient of 400 Kcal/hm2°C can be used for the heat exchanger. The water flows through the shell and the oil flows through the tubes. The specific heat of the fluid may be taken as 0.454 kcal/kg°C. Find out whether the heat exchanger would be suitable for the given heat duty?

Q. 2 A triple effect forward feed evaporator is used to concentrate a liquid which has marginal elevation in boiling point. The temperature of the stream to the first effect is 105°C, and the boiling point of the solution within third effect is 45°C. The overall heat transfer coefficients are,

2,200 W/m2: in the I-effect,
1,800 W/m2: in the II-effect,
1,500 W/m2: in the III-effect.

Find out at what temperatures the fluid boils in the I and II effects.

Q. 3 The surface of a blackbody is at 500 K temperature. Obtain the total emissive power, the wavelength of the maximum monochromatic emissive power.

Q. 4 A steel pipe having inner diameter as 78 mm and outer diameter as 89 mm has 10 external longitudinal rectangular fins of 1.5 mm thickness. Each of the fins extends 30 mm from the pipe. The thermal conductivity of the fin material is 50 W/m oC. The temperature of the pipe wall and the ambient are 160 oC, and 30 oC, respectively, whereas the surface heat transfer coefficient is 75 W/m2 oC. What is the percentage increase in the rate of heat transfer after the fin arrangement on the plane tube?