Code :R5322303 **R5**

III B.Tech II Semester(R05) Supplementary Examinations, April/May 2011
HEAT TRANSFER IN BIO PROCESSES
(Biotechnology)

Time: 3 hours **Max Marks: 80**

Answer any FIVE questions
All questions carry equal marks

⋆ ⋆ ⋆ ⋆ ⋆

1. Derive the expression for heat transfer through furnace wall made of three different materials in series. Assume k_1, k_2, and k_3 be the thermal conductivities of materials and x_1, x_2, and x_3 be the respectively thickness. Assume hot face and cold face temperature be T_1 and T_2 respectively.

2. Consider two identical triangles drawn on the surface of a flat plate. The plate, which is maintained at uniform surface temperature, is cooled by laminar forced convection. Determine the ratio of the heat transfer rate from the two triangles, $q_1\sqrt{q_2}$.

3. Air at 101.325 kPa and 300 K (27^0 C) blows across a 12 mm diameter sphere at a free stream velocity of 4 m/s. A small heater inside the sphere maintains the surface temperature at 350 K (77^0 C). Estimate the heat lost by the sphere.

   Data: The properties of air at the free stream temperature 300 K are:
   $\upsilon = 15.69 \times 10^{-6} m^2/s, k = 0.02624 W/(m.K)$,
   $N_{Pr} = 0.708$, $\mu = 2.075 \times 10^{-5} kg/(m.s)$,
   At $T_w = 350K$, $\mu_w = 2.075 \times 10^{-5} kg/(m.s)$

4. (a) What is the effect of roughness in a pipe on nucleate boiling? Explain in detail.
   (b) What is the limitation of momentum heat analogies? Discuss in detail.

5. (a) What are baffles? What is their function in a shell-and-tube heat Exchanger?
   (b) What are the differences between a single pass and multipass heat exchanger?

6. (a) How and why a multiple effect evaporator is better than a single effect evaporator?
   (b) How do you find the optimum number of effects in a multiple effect evaporator?

7. (a) Describe the consequences that occur if the fermentation process is invaded by foreign microorganisms.
   (b) How do you avoid contamination in a fermentation process ?

8. A certain fermentation medium was sterilized in a fermenter. The heating-up took 30 min from 100^0 to 121^0C and the cooling took 15 min from 121^0 to 100^0 C. The Δ factor value is $\Delta_{1^0/min} = 12.55$. The thermal death constant k_{121^0C} is 2.54 min^{-1}. The Δ for sterilization is 43.5. Find $\Delta_{holding}$ and holding period.

⋆ ⋆ ⋆ ⋆ ⋆