Code No: NR211802 **NR**

II B.Tech I Semester Supplementary Examinations, November 2005
FURNACE TECHNOLOGY AND PYROMETRY
(Metallurgy & Material Technology)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Derive an expression for steady state conduction of heat through a composite plane wall.
   (b) A furnace wall is made upof a steel plate of 10mm thickness ($k = 15kcal/m - hr - \text{deg}$). A silica brick layer on inside is laid to 150mm thickness and a magnesia brick of 200mm thickness on outside. The inside and outside wall surfaces are at 650 ^oC and 125 ^oC respectively. Calculate heat loss from unit area of wall if $K_{Sio_2} = 1.75kcal/m-hr-\text{deg}$ and $K_{Mgo} = 4.5kcal/m-hr-\text{deg}$ If heat loss is to be reduced to 2000Kcal/hour by keeping an air gap between steel and magnesia bricks estimate necessary air gap if K_{air} =0.03 $kcal/m - hr - \text{deg}$.

2. Distinguish between free and forced convection. Define the important dimensionless groups and explain their significance. [16]

3. (a) Give examples of heat exchangers. Develop an expression for heat transfer from one fluid ot another in a
      i. Parallel flow and
      ii. counter current flow heat exchanger in terms of inlet and outlet temperatures of the fluids and overall heat transfer coefficient.
   (b) A tubular heat exchanger is to be designed for cooling oil from a temperature of 80^0c to 30^0C by a large body of stagnant water at a constant temperature of 20^0C. The heat transfer surface consists of 30m long straight tube of 20mm inside diameter. The oil ($c_p = 0.6kcal/kg.\,\text{deg},\ sp.gr = 0.8$) flows through the cylindrical tube with an average velocity of 50cm/sec. Calculate the overall heat transfer coeff. of the oil cooler. [8+8]

4. (a) Define the terms:
      i. Black, gray and real surfaces
      ii. Emissivitly, luminous and non-luminous flames.
   (b) A 2cm thicksteel slab heated to 525^0C is held in air stream of mean temperture 25^0C.Calculate the time interval for the slab to reach the temperature 25^0C without deviation not more than 0.5^0C at any point in the slab. Data given: Density of steel = 7950kg/m^3 C_p =455J/kg.deg, k=46w/m.deg, heat transfer coefficient on plate surfce = 36W/m^2 .deg. [8+8]

5. What are the characteristic features of vertical shaft furnaces? Draw the profiles of furnaces for melting of iron ores and melting of cast irons. Explain the differences. [16]

6. (a) Explain Peltier and Thomson emfs. compare and contrast noble and base metal thermocouples.
   (b) Describe the principles, working and range of temperature measurement of resistance pyrometers. Give typical applications. [8+8]

7. State Wien's law. With a neat sketch explain the functioning principle of any type of optical pyrometer. What factors affect the pyrometer reading and how? [16]

8. Write short notes on:
   (a) Planck's law of monochromatic radiation.
   (b) Arc furnaces.
   (c) Sources of heat losses in furnaces
   (d) Thermopile. [4×4=16]

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