

**II B.Tech I Semester Supplementary Examinations, May 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 equation for heat flow through a sphere under steady state conduction.  
(b) A sphere with internal radius 3 cm and external radius 8cm is placed with a centrally located radius 8 cm is placed with a centrally located heater of 10 watts. The inside and outside temperatures are  $95^{\circ}\text{C}$  and  $85^{\circ}\text{C}$ . Determine the thermal conductivity and temperature and mid thickness of wall assuming steady state conditions.
2. (a) What is shape factor? What is its advantage?  
(b) The annealing furnace for continuous bar stock is open at both ends. The interior dimensions are 0.6m x 0.6m x 1.5m long with a wall of 0.3m thick all around. Calculate the shape factor.
3. (a) Distinguish between regenerators and recuperators.  
(b) Exhaust gases ( $C_p = 1.15 \text{ kJ/kg-deg}$ ) flowing through a tubular heat exchanger at 1000kg/hr are cooled from  $450^{\circ}\text{C}$  to  $150^{\circ}\text{C}$  by water ( $C_p = 4.18 \text{ kJ/kg. K}$ ) entering at  $15^{\circ}\text{C}$  at the rate of 2000kg/hr. If the overall heat transfer coefficient is  $550 \text{ kJ/m}^2\text{-hr-deg}$  calculate the heat exchanger area for
  - i. Parallel flow and
  - ii. Counter current flow arrangement
4. (a) State and explain the laws of thermal radiation.  
(b) An iron billet measuring 20 x 15 x 80 cm is exposed to a convective flow with convection coefficient  $h = 11.5 \text{ W/m}^2 - \text{K}$ . IF  $k_{Fe} = 65 \text{ W/mK}$  determine the Biot number and the suitability of lumped analysis to represent the cooling rate if the billet is initially hotter than the environment.
5. Compare and contrast the construction, working, uses, advantages and limitations of arc and induction furnaces.
6. (a) Explain Pettier and Thompson emfs. What are the properties required for Thermocouple materials?  
(b) Explain the principles and construction of resistance thermometers. What is callenders convection?
7. State Wiens and Planck's laws of monochromatic radiation. Explain with a neat sketch of a Disappearing filament. Optical pyrometer, The principles, construction and working of the instrument for temperature measurement.

8. Write short notes on:

- (a) Factors affecting optical pyrometer reading
- (b) Continuous furnaces
- (c) Heat balance and Sankey diagram
- (d) Reveberatory furnaces.

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