

III B.Tech II Semester Supplementary Examinations, Apr/May 2006
MATHEMATICAL METHODS FOR CHEMICAL ENGINEERING
(Chemical Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Write about the formulation of differential equation of physical problem.
 (b) Discuss a flow process in which a precipitation is being carried out by mixing two streams A and B to form a third stream C in which the precipitate is carried away. [6+10]
2. Discuss about the flow process from the Eulerian point of view. [16]
3. At a given instant the sides of a rectangle are 4ft and 3 ft respectively and they are increasing at the rate of 1.5 ft/sec and 0.5 ft/sec respectively. Find the rate at which the area is increasing at that instant. [16]
4. The temperature T at any point (x,y,z) in space is $T = 400xyz^2$. Find the highest temperature on the surface of the unit sphere $x^2 + y^2 + z^2 = 1$. [16]
5. (a) Define a vector. Distinguish between vectors and scalars by giving examples.
 (b) Explain the laws of vector addition and subtraction. [8+8]
6. (a) Prove that in any curvilinear coordinate system $\nabla \cdot (\nabla X \bar{F}) = 0$.
 (b) Find the unit vectors \hat{e}_1 , \hat{e}_2 , \hat{e}_3 , of a cylindrical coordinate system in terms of i, j, k . [8+8]
7. A hollow cylinder has the inner face ($r = R_o$) maintained at $T = f_o(\theta)$ and the outer face ($r = R_1$) maintained $T = f_1(\theta)$. Determine the steady-state temperature distribution within the cylinder. θ denotes a coordinate in a cylindrical coordinate system. [16]
8. (a) Two concentric cylindrical metallic shells of radii a & b (i.e. $a < b$) are separated by a solid material. If the two metal surfaces are maintained at different constant temperatures T_a & T_b , derive the steady state temperature distribution within the separating material. Heat is transferring from inner surface to outer surface by conduction by assuming the thermal conductivity of solid k is constant.
 (b) Consider a perfectly mixed stirred-tank heater, with a single feed stream and a single product stream. Assuming that the flow rate and temperature of the inlet stream can vary, that the tank is perfectly insulated, and the rate of heat added per unit time (Q) can vary, develop a model to find the tank temperature as a function of time. State your assumptions. [8+8]
