Code No: NR320804 **NR**

III B.Tech II Semester Supplementary Examinations, November/December 2005

MATHEMATICAL METHODS FOR CHEMICAL ENGINEERING

(Chemical Engineering)

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

Answer any FIVE Questions

All Questions carry equal marks

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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. Form a linear differential equation with constant coefficients for consecutive reversible reactions at constant volume. [16]

3. Derive an expression for the heat flow rate through a hollow sphere of ID d_1 and OD d_2 whose internal and external surfaces are maintained at temperatures T_1 and T_2 respectively. The thermal conductivity varies linearly with temperature form K_1 at T_1 to K_2 at T_2. [16]

4. Change the following equation in Cartesian coordinates to the spherical coordinates.
   $\partial^2T/\partial x^2 + \partial^2T/\partial y^2 + \partial^2T/\partial z^2 = 0$
   Given $x = rsin\theta cos\phi$ $y = rsin\theta sin\phi$ and $z = rcos\theta$. [16]

5. Given A = i - 2j - 3k B = 2i + j - 3k C = i + j + k Verify
   (a) A . (B X C) = B . (C X A).
   (b) (A X B) X C = (A . C) B - (B . C) A. [8+8]

6. (a) Explain the concept of line integral. Define circulation of a vector.
   (b) Evaluate the line integral $\int_c F\,dr$ where $F = 3xyi + y^2j$ and the space curve c is the Curve in the xy- plane $y = 2x^2$ from (0, 0) to (1, 2) [6+10]

7. A solid sphere of radius R is placed in an incompressible, inviscid fluid of infinite extent. The flow was initially uniform and parallel to the z axis, flowing with a speed V_0 in the negative z direction. It is desired to determine the velocity of the fluid after the sphere is placed in the flow and steady-state has been achieved.[16]

8. Solve the following differential equation with the laplace transform method.
   (a) $\frac{d^2x}{dt^2} + 5\frac{dx}{dt} + 6x = t$, $Where\, x(0) = x^1(0) = 0$
   (b) Find the lap lace inverse transform of $C_A(s) = \frac{k_p/\tau_p^3}{s(s+1/\tau_p)^3}$ $where\, k_p\, and\, \tau_p\, are\, constants$ [8+8]

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