R09

Code No: D5103

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
M.Tech II - Semester Examinations, March/April 2011
ADVANCED MATHEMATICS IN CHEMICAL ENGINEERING
(CHEMICAL ENGINEERING)

Time: 3hours **Max. Marks: 60**

Answer any five questions
All questions carry equal marks
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1. An Elevated horizontal Cylindrical tank of 1 mt diameter and 2 mt long is insulated with asbestos lagging of thickness l=4 cm and is employed as a maturing vessel for a batch chemical process. Liquid at 95 degrees centigrade is charged in to the tank and allowed to mature for 5 days. **Calculate the final temperature by forming a differential equation** assuming that heat loss through supports is negligible and the thermal capacity of the lagging can be neglected. Use the following data.

   Liquid film coefficient of Heat transfer $(h_1) = 150 w/m^{2\ 0}c$
   Thermal conductivity of asbestos $(k) = 0.2 w/m^{0}c$
   Surface coefficient of heat transfer by convection and radiation $(h_2) = 10 w/m^{2\ 0}c$
   Density of the liquid $(\rho) = 10^3 kg/m^3$
   Heat capacity of the liquid (s) = $2500 J/kg^{0}c$
   Atmospheric temperature (t) is assumed to vary according to $t = 10 + 10Cos(\pi\theta/12)$, where θ is time in hours
   Atmospheric temperature at the time of charging is $20^0 C$. [12]

2. Solve
   (a) $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = xe^{3x} + \sin 2x$
   (b) $\frac{dy}{dx} = \frac{x^3 + y^3}{xy^2}$
   [12]

3. Apply Cholesky Factorisation method to solve the equations
   $3x + 2y + 7z = 4; 2x + 3y + z = 5; 3x + 4y + z + 7$. [12]

4. Solve in series the equation by Frobenius Method the differential equation
   $9x(1-x)\frac{d^2y}{dx^2} - 12\frac{dy}{dx} + 4y = 0$
   [12]

5. Solve $\frac{\partial^3 z}{\partial x^3} - 2\frac{\partial^3 z}{\partial x^2 \partial y} = 2e^{2x} + 3x^2 y$
   [12]

Contd…2

6. (a) Solve the difference equations

   (b) Prove that $e^x = \left(\frac{\Delta^2}{E}\right)e^x.\frac{Ee^x}{\Delta^2 e^x}$, The interval difference being' h'. [12]

7. Use the Gerschgorin circle theorem to estimate the eigenvalues of:

$$A = \begin{bmatrix} 10 & -1 & 0 & 1 \\ 0.2 & 8 & 0.2 & 0.2 \\ 1 & 1 & 2 & 1 \\ -1 & -1 & -1 & -11 \end{bmatrix}.$$

[12]

8. Determine the Largest Eigen value and corresponding Eigen vector of the matrix

$$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix}$$

[12]

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