

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: 3 hours

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 $(h_1) = 150 \text{ w/m}^2 \text{ } ^\circ \text{C}$

Thermal conductivity of asbestos $(k) = 0.2 \text{ w/m} \text{ } ^\circ \text{C}$

Surface coefficient of heat transfer by convection and radiation $(h_2) = 10 \text{ w/m}^2 \text{ } ^\circ \text{C}$

Density of the liquid $(\rho) = 10^3 \text{ kg/m}^3$

Heat capacity of the liquid $(s) = 2500 \text{ J/kg} \text{ } ^\circ \text{C}$

Atmospheric temperature (t) is assumed to vary according to $t = 10 + 10 \text{ Cos}(\pi\theta/12)$, where θ is time in hours

Atmospheric temperature at the time of charging is 20°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

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6. (a) Solve the difference equations

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

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

$$A = \begin{bmatrix} 10 & -1 & 0 & 1 \\ 0.2 & 8 & 0.2 & 0.2 \\ 1 & 1 & 2 & 1 \\ -1 & -1 & -1 & -11 \end{bmatrix}. \quad [12]$$

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

$$\begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 2 \end{bmatrix} \quad [12]$$
