Code No: 126AR **R13**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech III Year II Semester Examinations, May - 2016
CHEMICAL ENGINEERING MATHEMATICS
(Chemical Engineering)

Time: 3 hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART - A (25 Marks)

1.a) Explain quasi Newton and Newton's method. [2]
b) Discuss Jacobi Iteration method. [3]
c) Formulate conservation of energy equation for radial heat transfer through a cylindrical conductor. [2]
d) Write the law of conservation of momentum. [3]
e) Write the formula for Euler's method. [2]
f) Write short notes on boundary conditions. [3]
g) Write the Finite Difference form of the following unsteady heat conduction equation in a slab. [2]

$$\frac{\partial T}{\partial t} = \alpha \frac{\partial^2 T}{\partial x^2}.$$

h) Write the Bessel's interpolation formula. [3]
i) What is the importance of central composite method? [2]
j) What is meant by fractional factorial design? [3]

PART - B (50 Marks)

2. Solve the following system of equations using Gauss-Seidal method: [10]

$$10x + 2y + z = 9$$
$$2x + 20y - 2z = -44$$
$$-2x + 3y + 10z = 22$$

OR

3. Find the eigen values and eigen vectors of the following matrix: [10]

$$K = \begin{bmatrix} -1 & 0 & 0 \\ 0 & -2 & 3 \\ 0 & 2 & -3 \end{bmatrix}$$

4. A thermometer at equilibrium with ambient temperature (25 ^{0}C) is plunged into water at 50 ^{0}C at time t=0. If the thermometer has a time constant of 1 min, give the differential equation for the first order dynamic response of this thermometer. determine the temperature values for t=15and 45 sec. [10]

OR

5. A solute dissolves in a solvent at a rate proportional to the product of the amount undissolved at any time and the difference of concentration in the saturated solution and the instantaneous concentration in the solution at that time. A quantity of 10 kg solution is taken is taken in a tank containing 60 kg of solvent and at the end of 10 min, the concentration is observed to be one part of solute in 25 parts of solvent. If the saturation concentration is one part of solute in four parts of the solvent, find the concentration of the solution as a function of time. [10]

6. 8540 lb/h of an animal fat are to hydrolyzed and extracted in a spray column using 3760 lb/hr of water. When the column is operating under counter current flow conditions, the percentage of hydrolyzed glycerin in the fat is 8.53 % by weight and the glycerin in the fatty acid leaving the tower is 0.24 % by weight. A mass balance gives a glycerin concentration in the sweet water of 18.8% and the total weight of fat phase held up in the column is 12, 200 lb. The distribution ratio of glycerin between water and fat is 10.32 and the reaction rate constant is 10.2 h^{-1}. Calculate the number of theoretical stages in the column. **[**10]

OR

7. An insulated rod of length l has its A and B maintained at 0^0C and 80^0C respectively until steady state conditions exist. If the temperature of A is raised to 40^0C and B is raised to 80^0C, find an expression for the temperature at a distance x from A at time t **[**10]

8. Consider the data given in the table below

Temperature (^{0}C)	20	25	30	35	40	45	50	55	60
Vapour pressure (kN/m^2)	805	985	1170	1365	1570	1790	2030	2300	2610

Apply Lagrange's or Newton's interpolation technique to estimate the vapour pressure of ammonia at 75^0C. [10]

OR

9. Apply finite difference technique to solve the following boundary value problem

$\frac{d^2y}{dx^2} + 4y = 4x, \quad y(0) = -2$ and $y(2) = 2.$ with a step size of 0.5. [10]

10. Apply the central composite design to any chemical process assuming a sample data. [10]

OR

11. Explain the role of design of experiments in engineering systems. Discuss the factorial design. [10]

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