04-06-2026 SE CHEMICAL SEM-III (NEP-2020) CEM QP CODE: 20014667

(2 Hours) **Total Marks: 60**

N.B.

1. Question No. 1 is Compulsory.
2 Attempt any **Three** Questions from remaining **Five** Questions
3. Assume Suitable Data if needed and Justify the Same
4. Figures to the right indicate full marks.

Que.1 Solve any **FIVE**

a) A random variable X has following probability function **[03]**

X	-2	-1	0	1	2	3
$P(X=x)$	0.2	k	0.1	2k	0.1	2k

Find i)k ii) p (x<0)

b) Find the Eigen values of $A^{30} - 9\ A^{28}$ where , **[03]**

$$A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$$

c) Prove that: $\Delta = E-1$ **[03]**

d) Find Laplace Transform of $sin^2t + e^{6t} + sin2t - 5cost$ **[03]**

e) Solve : $U_{n+3} - 2\ U_{n+2} - 5\ U_{n+1} + 6\ U_n = 0$ **[03]**

f) Prove that: $(\frac{\Delta^2}{E})e^x\ \frac{Ee^x}{\Delta^2 e^x} = e^x$ **[03]**

Que.2

a) The pressure (bar) and gas solubility (mole fraction) of CO2 in water are measured. Find Karl Pearson's correlation coefficient. **[05]**

Pressure	100	200	300	400	500
co2	30	40	50	60	70

b) Find the Eigen Value and Eigen Vector of following matrix **[06]**

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

c) Obtain two lines of regression for the following. **[4]**

x	1	2	3	4	5	6
y	49	54	60	73	80	86

Que.3

a) A chemical reaction is carried out in batch reactor and it has been found that concentration of reactant changes as per the equation given below. **[6]**

$$\frac{dC_A}{dt} = \frac{C_A}{1 + 0.5{C_A}^{1.8}}$$

If initial concentration (at t=0) is 0.8 then find concentration of reactant at t=1 with step size, h=0.5 using Euler's method.

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b) Given $\frac{dy}{dx}$ = x + y, and y(0) =1, determine the values of y = 0.2 , h = 0.1by Runge Kutta second order method **[05]**

c) Explain geometric multiplicity and algebraic multiplicity of Eigen value. **[4]**

Que.4

a) Solve $\frac{\partial^2 u}{\partial x^2} - 32\frac{\partial u}{\partial t} = 0$ given u(0,t)=0, u(x,0) = 0, u(1,t) = t assuming h= 0.25, find values of u up to t=5 using bender Schmidt method **[06]**

b) Solve the following Difference equation **[05]**
$y_{n+2} - 5y_{n+1} + 6y_n = n^2 + 3n + 2.$

c) Solve : $(\Delta^2 - 3\Delta + 2)\, y\, n = 0$ **[04]**

Que.5

a) Solve $\frac{\partial^2 u}{\partial x^2} - 16\frac{\partial u}{\partial t}$ subject to the condition u(0,t) = 0, u(1,t) = 100t, u(x,0) = 0 with h=1/4 for a one time step using crank Nicholson method **[06]**

b) Find $\bar{x}$ and $\bar{y}$ and coefficient of regression of the lines **[05]**
$6Y = 5X + 90$, $15X = 8Y + 130$

c) State First Shifting Therom and Solve for $L(e^{-t}cos4t)$. **[04]**

Que.6

a) Find inverse laplace transform for $\frac{S+29}{(S+4)(S^2+9)}$ using method of partial fraction. **[06]**

b) Solve: (3D + 2)y = e^{3t}, y(0) = 1 **[05]**

c) Explain how to check whether the second order partial differential equation is elliptic, hyperbolic or parabolic. **[04]**

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