Code No: 131AA **R16**

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD**

**B. Tech I Year I Semester Examinations, January/February - 2025**

**MATHEMATICS - I**

**(Common to CE, EEE, ME, ECE, CSE, EIE, IT, MCT, MMT, AE)**

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

**Note:** i) Question paper consists of Part A, Part B.
ii) Part A is compulsory, which carries 25 marks. In Part A, answer all questions.
iii) In Part B, Answer any one question from each unit. Each question carries 10 marks and may have a, b as sub questions.

**PART – A**

**(25 Marks)**

1.a) Solve $(x^2y - 2xy^2)dx - (x^3 - 3xy^2)dy = 0$. [2]

b) Find the particular integral of $(D^2 + 5D + 6)y = e^x$. [3]

c) Find the rank of $A = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 5 & 8 \\ -3 & 4 & 4 \end{bmatrix}$. [2]

d) Find the consistency of the system of equations $x + y + z = 1$, $2x + 3y + 2z = 2$, $5x + 4y + 3z = 3$. [3]

e) Find the eigen values of $A, A^2, A^{-1}$ ,where $A = \begin{bmatrix} 1 & 3 & 4 \\ 0 & 2 & 5 \\ 0 & 0 & 3 \end{bmatrix}$. [2]

f) Find the index, signature of the quadratic form $2x_1x_2 + 2x_2x_3 + 2x_3x_1$. [3]

g) If $u = e^{xyz}$, find the value of $\frac{\partial^3 u}{\partial x\,\partial y\,\partial z}$. [2]

h) If $z = log(x^2 + xy + y^2)$, find the value of $x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y}$. [3]

i) Find the solution of $\frac{\partial z}{\partial x} = xy$. [2]

j) Solve $\frac{\partial z}{\partial x} + \frac{\partial z}{\partial y} = 1$. [3]

**PART - B**

**(50 Marks)**

2.a) The rate at which bacteria multiply is proportional to the instantaneous number present. If the original number doubles in 2 hours, in how many hours will it triple?

b) Using the method of variation of parameters, solve $\frac{d^2y}{dx^2} + 4y = tan2x$. [5+5]

**OR**

3.a) Radium decomposes at a rate proportional to the amount present. If a fraction p of the original amount disappears in 1 year, how much will remain at the end of 21 years?

b) Solve $(D^2 + 4)y = x^2 + cos2x$. [5+5]

4. Solve the following equations by LU decomposition method: [10]

$x + 2y + 3z = 9,\ 4x + 5y + 6z = 24,\ 3x + y - 2z = 4$

**OR**

5. For what values of $\lambda$ and μ, the following system of equations. $x + y + z = 6,\ x + 2y + 3z = 10,\ x + 2y + \lambda z = \mu$ have a) No solution b) Unique solution c) More than one solution. [3+3+4]

6. Reduce the quadratic form $2x^2 + 2y^2 + 3z^2 + 2xy - 4yz - 4xz$ to the canonical form. Also find the nature of the quadratic form. [10]

**OR**

7. Verify Cayley-Hamilton theorem for the matrix $A = \begin{bmatrix} 2 & -1 & 0 \\ 3 & 1 & -1 \\ 2 & 0 & 3 \end{bmatrix}$ and hence find $A^{-1}$. [10]

8.a) Expand $x^2y + 3y - 2$ in powers of $x - 1$ and $y + 2$ using Taylor's series.

b) The temperature T at any point $(x, y, z)$ in space is $T = 400xyz^2$. Find the highest temperature on the surface of the sphere $x^2 + y^2 + z^2 = 1$. [5+5]

**OR**

9.a) If $u = \frac{yz}{x}, v = \frac{zx}{y}, w = \frac{xy}{z}$, then find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$.

b) If $u = x^2 + y^2 + z^2$ and $x = e^{2t}, y = e^{2t}cos3t, z = e^{2t}$, then find $\frac{du}{dt}$. [5+5]

10.a) Solve $p(1 + q) = qz;\ p = \frac{\partial z}{\partial x}; q = \frac{\partial z}{\partial y}$.

b) Solve $x^2p + y^2q = (x + y)z;\ p = \frac{\partial z}{\partial x}; q = \frac{\partial z}{\partial y}$. [5+5]

**OR**

11.a) Form the P.D.E by eliminating the arbitrary functions from $z = yf(x) + xg(y)$.

b) Solve $(x^2 - yz)\frac{\partial z}{\partial x} + (y^2 - zx)\frac{\partial z}{\partial y} = (z^2 - xy)$. [5+5]

---ooOoo---