

Code No: 121AB

**JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD****B.Tech I Year Examinations, August - 2018****MATHEMATICS-I****(Common to CE, EEE, ME, ECE, CSE, EIE, IT, MCT, AE, AME, MIE, PTM, CEE MSNT)****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) A body is heated to  $110^{\circ}\text{C}$  and placed in air at  $10^{\circ}\text{C}$ . After one hour its temperature is  $60^{\circ}\text{C}$ . How much additional time is required for it to cool to  $30^{\circ}\text{C}$ ? [2]
- b) Find the integrating factor for the following equation  
 $(3xy - 2ay^2)dx + (x^2 - 2axy)dy = 0$  [3]
- c) Find the rank of the matrix  $\begin{bmatrix} 1 & -2 & 3 & -1 \\ 2 & -1 & 2 & 2 \\ 3 & 1 & 2 & 3 \end{bmatrix}$ . [2]
- d) Find the value of  $x$  such that the Rank of the following matrix is 2 [3]
- $$\begin{bmatrix} 4 & 2\sqrt{5} & 0 \\ 2\sqrt{5} & 4 & \sqrt{5} \\ 0 & \sqrt{5} & x \end{bmatrix}$$
- e) Find the sum and product of Eigen values of  $A = \begin{pmatrix} 8 & -1 \\ 2 & 2 \end{pmatrix}$ . [2]
- f) If 1, 3, -2 are eigen values of a matrix A, then find the eigen values of  $2A+3I$ . [3]
- g) Write the Taylor's series expansion for  $f(x,y)$  about the point (a,b). [2]
- h) Find the value of  $\frac{\partial^3 u}{\partial x \partial y \partial z}$ , where  $u = x^3 y^3 z^3$  [3]
- i) Form the partial differential equation of  $z = ax^2 + by^2$  where a and b are arbitrary constants. [2]
- j) Find the order and degree of the partial differential equation  

$$\frac{\partial^2 z}{\partial x \partial y} = 5 \left( \frac{\partial^2 z}{\partial x^2} \right)^2 + 7 \left( \frac{\partial z}{\partial y} \right)$$
 [3]

**PART-B****(50 Marks)**

- 2.a) Solve the differential equation  $(D^2 - 1)y = x^2 e^x$ . [5+5]
- b) Find the orthogonal trajectories of the lines  $y = m x$ , m is arbitrary constant. [5+5]
- OR**
- 3.a) Solve the differential equation  $(D^2 - 5D + 6)y = \sin 4x$ . [5+5]
- b) In a culture of yeast, the active ferment doubles itself in 3 hours. Determine the number of times it multiplies itself in 15 hours. [5+5]

4.a) Find the eigen values and eigen vectors of the matrix  $\begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & -13 \end{bmatrix}$

b) Find by LU decomposition method solve the linear system. [5+5]

$$\begin{bmatrix} -3 & 12 & -6 \\ 1 & -2 & 2 \\ 0 & 1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} -33 \\ 7 \\ -1 \end{bmatrix}$$

**OR**

5.a) Find the value of k for which the system of equations  
 $(k+1)x + 8y = 4k$ ;  $kx + (k-3)y = 3k-1$  has infinitely many solutions.

b) Solve the system of equations by the Gauss Seidel method [5+5]

$$\begin{aligned} 10x + y + z &= 12 \\ 2x + 10y + z &= 13 \\ 2x + 2y + 10z &= 14 \end{aligned}$$

6.a) If a matrix  $A = \begin{bmatrix} -1 & 0 & 0 \\ 2 & -3 & 0 \\ 1 & 4 & 2 \end{bmatrix}$  then find the Eigen values of  $A^2$ ?

b) If  $A = \begin{bmatrix} 1 & 2 & -3 \\ 0 & 3 & 2 \\ 0 & 0 & -2 \end{bmatrix}$  then find eigenvalues of  $3A^3 + 5A^2 - 6A - 2I$ . [5+5]

**OR**

7.a) Reduce the quadratic form  $6x_1^2 + 3x_2^2 + 3x_3^2 - 4x_1x_2 - 2x_3x_2 + 4x_3x_1$  to canonical form.

b) If  $\lambda$  is an eigenvalue of A, then prove that  $\lambda^m$  is an eigenvalue of  $A^m$ , (m is any positive integer). [5+5]

8.a) If  $u = x \log xy$  where  $x^3 + y^3 + 3xy = 1$  find the value of  $\frac{du}{dx}$

b) Find the Taylor's series expansion of  $f(x, y) = \sin(xy)$  about the point  $(0, \pi)$ . [5+5]

**OR**

9.a) Find the maximum and minimum values of the function  $f(x, y, z) = 2x + 3y + z$ , under the conditions

$$x^2 + y^2 = 5 \text{ and } x + y = 1$$

b) The sum of three positive numbers is constant. For what values of x, y and z is their product a maximum? [5+5]

10. If  $p = \frac{\partial z}{\partial x}$  and  $q = \frac{\partial z}{\partial y}$  Solve the following partial differential equations

a)  $p - q = \log(x + y)$

b)  $y^2p - xyq = x(z - 2y)$ . [5+5]

**OR**

11. If  $p = \frac{\partial z}{\partial x}$  and  $q = \frac{\partial z}{\partial y}$  Solve the following partial differential equations

a)  $p = \log(px - y)$

b)  $p - x^2 = q + y^2$ . [5+5]