

Q.1) Solve the following:

(a)  $3x(xy - 2)dx + (x^3 + 2y)dy = 0$  [CO 2] [2]

(b)  $(2 \cos y + 4x^2)dx - x \sin y dy = 0$  [CO 2] [3]

Q.2) Find a homogeneous linear second order ordinary differential equation whose solution is the set of all straight lines in the  $xy$ -plane. [CO 1] [1]

Q.3) State whether the following differential equations are linear or non linear, justify and solve:

(a)  $xy' + 2y = \frac{e^{3x}}{x}, x > 0$  with  $y(1) = 1 + \frac{e^3}{3}$ . [CO 2] [3]

(b)  $x^2 y \frac{dy}{dx} - xy^2 = 1$  [CO 2] [3]

Q.4) If  $x^2$  and 1 are solutions of  $yy'' - xy' = 0$  then so is any linear combination of these. State true or false and justify. [CO 4] [2]

Q.5) Solve the following Matrices related questions [CO 2] [6]

1. Find the Rank and Nullity of following Matrix:

$$A = \begin{bmatrix} 4 & -22 & -14 & 1 \\ 3 & 37 & 85 & 2 \\ 2 & 10 & 31 & 4 \\ 15 & 2 & 4 & 7 \end{bmatrix}$$

2. Solve the given equation of form  $AX = B$

$$A = \begin{Bmatrix} 1 & 3 & 1 \\ 1 & 2 & 4 \\ 5 & 4 & 7 \end{Bmatrix}, X = \begin{pmatrix} a \\ b \\ c \end{pmatrix} B = \begin{pmatrix} 16 \\ 4 \\ 5 \end{pmatrix}$$

3. Show that the following matrix is diagonalizable:

$$A = \begin{bmatrix} 5 & 0 & 1 \\ 2 & 3 & 11 \\ 6 & 2 & 3 \end{bmatrix}$$