



JAIPUR ENGINEERING COLLEGE  
AND RESEARCH CENTRE

**JAIPUR ENGINEERING COLLEGE AND RESEARCH CENTRE**  
**JECRC Campus, Shri Ram Ki Nangal, Via-Vatika, Jaipur**

**Department of Mathematics**

**Question Bank**

**Academic Year – 2020-21**

**Subject: Engineering Mathematics-2**

<b>Course Outcomes</b>	
<b>CO1</b>	<b>To understand the concept of rank of matrix, inverse, Eigen values &amp; vectors along with solution of linear simultaneous equation determine inverse of a matrix using Cayley Hamilton Theorem.</b>
<b>CO2</b>	<b>To solve Ordinary D.E of first order, first degree and first order higher degree using various methods.</b>
<b>CO3</b>	<b>To find the complete solution of D.E of higher order with constant coefficient &amp; variable coefficients &amp; their methods of solution</b>
<b>CO4</b>	<b>To solve partial differential equations with its applications in Laplace equation, Heat &amp; Wave equation</b>

Q1. An ordinary differential equation is given below. Find its general solution

(Gate CE 2020)

$$6\frac{d^2y}{dx^2} + \frac{dy}{dx} - y = 0$$

Q2. A 4 X 4 matrix is given below . Find its Eigen Values

$$\begin{bmatrix} 0 & 1 & 3 & 0 \\ -2 & 3 & 0 & 4 \\ 0 & 0 & 6 & 1 \\ 0 & 0 & 1 & 6 \end{bmatrix}$$

(Gate CE 2020)

Q3. Consider the homogeneous equation  $x^2 \frac{d^2y}{dx^2} - 3x \frac{dy}{dx} + 3y = 0, x > 0$ . Find its general solution given that  $y(1) = 1$  and  $y(2) = 14$ . Also find  $y(1.5)$  (Gate EE 2019)

Q4. For the differential equation  $\frac{dy}{dx} + 4y = 5$ , with  $y(0) = 2.25$ , Find the general solution. (Gate ME 2019)

Q5. The solution of the differential equations in terms of constants is  $x^2 \frac{d^2y}{dx^2} - 2x \frac{dy}{dx} + 2y = 4$ .

Q6. The families of curves represented by the solution of the equation  $\frac{dy}{dx} = -\left(\frac{x}{y}\right)^{-n}$ , for  $n=1$  and  $n=-1$  respectively. (Gate E&C 2019)

Q.7 An ordinary differential equation is given herewith. Find its solution

$\frac{dy}{dx} x \ln x = y$  (Gate CE 2019)

Q8. The inverse of the matrix  $\begin{bmatrix} 2 & 3 & 4 \\ 4 & 3 & 1 \\ 1 & 2 & 4 \end{bmatrix}$  is..... (Gate CE 2019)

Q9. If X is an invertible square matrix then comment on its determinant. (Gate CSE 2019)

Q10. The rank of the matrix is  $M = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$  (Gate EE 2019)

Q11. Find the general solution of the differential equation  $y=(2y^4+2x)y'$ .

Q12. Solve the DE  $\frac{dy}{dx} = \frac{2y-x-4}{y-3x+3}$

Q13. Solve the following differential equation:  $(2y^2+3x)dx+2xydy=0$ .

Q14. Solve  $(y + xy^2)dx - xdy = 0$ .

Q15. Solve the equation  $y''+25y=0$ .

Q16. Solve  $t y'' + 4 y' = t^2$

Q17. If a particular integral of the differential equation  $(D^2+2D-1)y=e^{ax}$  is  $(-4/7)e^{ax}$  then the value of a is ?

Q18. Solve the differential equation  $\frac{d^2y}{dx^2} + a^2y = \operatorname{cosec} x$ .

Q19. Solve equation  $\frac{d^2y}{dx^2} - 4y = \cosh(2x - 1) + 3^x$ .

Q20. Solve the equation  $(2D^2 + D - 1)y = 16\cos 2x$

Q21. Solve the differential equation  $(D^4 + 16D^2)y = x^2 + 5$ .

Q22. Solve  $\frac{d^2y}{dx^2} + y = x \sin x$ , using method of variation of parameter.

Q23. Solve  $\frac{d^2y}{dx^2} + (1 - \cot x) \frac{dy}{dx} - \cot x y = \sin^2 x$ .

Q24. Solve the differential equation  $x^3 \frac{d^3y}{dx^3} + 3x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + 8y = 65 \cos(\log x)$

Q25. Solve  $(3x + 2)^2 \frac{d^2y}{dx^2} + 3(3x + 2) \frac{dy}{dx} - 36y = 3x^2 + 4x + 1$

Q26. Solve  $\frac{dx}{dt} + 2y = e^t$ ,  $\frac{dy}{dt} - 2x = e^{-t}$

Q 27. Find the rank of the following matrix  $A = \begin{bmatrix} 1 & 1 & 1 \\ a & b & c \\ a^2 & b^2 & c^2 \end{bmatrix}$

Q28. Verify Cayley-Hamilton theorem for the matrix  $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$  and find its inverse. Also express  $A^5 - 4A^4 - 7A^3 + 11A^2 - A - 10I$  as linear polynomial in  $A$ .

Q29. Find the Eigen value and Eigen vector of the matrix  $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$

Q30. Find the value of  $a$  and  $b$  for which the equation

$x+ay+z=3$ ,  $x+2y+2z=b$ ,  $x+5y+3z=9$  are consistent. When these equation have solution.

Q31. Reduce the matrix  $A = \begin{bmatrix} -1 & 2 & -2 \\ 1 & 2 & 1 \\ -1 & -1 & 0 \end{bmatrix}$  to the diagonal form.

Q 32. Solve the following equation by the method of separation of variable:  $4 \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 3u$ , given  $u = 3e^{-y} - e^{-5y}$  when  $x = 0$

Q33. Using the method of separation of variables Solve  $\frac{\partial u}{\partial x} = 2 \frac{\partial u}{\partial t} + u$  where  $u(x, 0) = 6e^{-3x}$

Q34. Find all the regular singular and irregular singular points of the differential equation  $(x^2 - 4)y'' + (x - 2)y' + y = 0$ .

Q 35. Solve  $y^2p - xyq = x(z - 2y)$

Q36. Solve  $p^2 + q^2 = m^2$  where  $m$  is a constant.

Q37. Find the complete integral of  $q=3p^2$  using Charpits method.

Q38. Find the complete integral of  $pxy + pq + qy = yz$ .

Q39. Solve in series the equation  $\frac{d^2y}{dx^2} - xy = 0$ .

Q40. Solve the following differential equations in series  $\frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = 0$ .

Q41. Solve  $\frac{d^2y}{dx^2} - 2(\tan x) \frac{dy}{dx} + 5y = 0$

Q42. Solve  $\frac{d^2y}{dx^2} - \frac{2}{x} \frac{dy}{dx} + \left(1 + \frac{2}{x^2}\right)y = xe^x$

Q43. Solve  $x \frac{d^2y}{dx^2} - \frac{dy}{dx} - 4x^3y = 8x^3 \sin x^2$

Q44. Solve  $x(y - z) \frac{\partial z}{\partial x} + y(z - x) \frac{\partial z}{\partial y} = z(x - y)$

Q45. Explain the classification of second order partial differential equations.

Q46. State and prove Cayley – Hamilton theorem.

Q47. Write the auxiliary equation of Charpit's method.

Q48. Reduce the following matrix into its normal form and hence find its Rank

$$\begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 4 & 3 \\ 3 & 0 & 5 & -10 \end{bmatrix}$$

Q49. Write two dimensional heat, wave and laplace equations.

Q50. Discuss the method of variation of parameters