JHARKHAND Rai University RANCHI

PRACTICE SET 2025

Subject: MATHEMATICS I **Semester: I**
Program: B. Tech **Branch: CSE +Mining**
Subject code: BSC102

Course Outcome:
On the completion of the Course, the students will be able to:
CO 1: Able to calculate rank of matrix, characteristic equation & characteristic roots & use the applicability of Caylay Hamilton Theorem to find inverse of matrix which is very important in many engineering application
CO 2: Ability to understand calculus and its application in engineering
CO 3: Gain knowledge about multiple differentiations which is helpful in Engineering & it is also useful in Research & Development
CO 4: Gain knowledge about multiple Integration which is helpful in Engineering & it is also useful in Research & Development
CO 5: Appreciate knowledge of sequences and series and its application in real world problems.

Module – I

Marks: 01

1.If A =$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$, then the determinant of A is **Understand (CO1) LOT**

(a) -2 (b) 2 (c) 10 (d) -10

2. The trace of a square matrix is: **Remember (CO1) LOT**

(a) The product of diagonal elements (b) The sum of diagonal elements

(c) The determinant of the matrix (d) The sum of all elements

3. If A is a 3×3 identity matrix, then A^{-1} is: **Understand (CO1) LOT**

(a) Zero matrix (b) Identity matrix (c) Negative of A (d) Undefined

4. A matrix is singular **if:** **Remember (CO1) LOT**
(a) It has all elements zero (b) It has no inverse (c) Its determinant $\neq 0$(d) It is symmetric

5. For a diagonal matrix, the eigenvalues are: Remember (CO1) LOT
(a) All equal (b) The diagonal elements (c) The sum of diagonal elements (d) Zero

6. The rank of a matrix is equal to: Remember (CO1) LOT
(a) Number of non-zero rows in echelon form (b) Number of rows
(c) Number of columns (d) The determinant value

7. If a matrix A is symmetric, then A^T=? Remember (CO1) LOT
(a) –A (b) A (c) A^{-1} (d) 0

8. **The characteristic equation of a 2×2 matrix $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ is Understand (CO1) LOT**
(a) $\lambda^2-(a+d)\lambda+(ad-bc)=0$ (b) $\lambda^2+(a+d)\lambda+(ad-bc)=0$ (c) $\lambda^2 -ad+bc=0$ (d) None

9. **If A has an eigenvalue λ, then the determinant of A equals: Remember (CO1) LOT**
(a) λ (b) Sum of eigenvalues (c) Product of eigenvalues (d) Trace of matrix

10. The determinant of a triangular matrix is: Remember (CO1) LOT
(a)Sum of diagonal elements (b) Product of diagonal elements (c) Always zero
(d) Undefined

Marks: 10

11. Find the Eigen value of the matrix $A^3 + 5A^2 - 6A + 2I$ if the matrix $A = \begin{bmatrix} 1 & 2 & -3 \\ 0 & 3 & 2 \\ 0 & 0 & -2 \end{bmatrix}$.
Evaluate (CO1) HOT

12. Determine the condition for which the system $x + y + z = 1$; $x + 2y - z = b$; $5x + 7y + az = b^2$
Admits (i) only one solution (ii) no solution (iii) many solution. Evaluate (CO1) HOT

13. Verify that the matrix $A = \begin{bmatrix} 2 & -1 & 2 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ satisfies its own characteristic equation and hence find A^{-1}. Evaluate (CO1) HOT

Marks: 20

14. (i) Show that $\begin{bmatrix} 1 & -1 & 0 \\ -2 & 3 & -4 \\ -2 & 3 & -3 \end{bmatrix}$ is the inverse of $\begin{bmatrix} 3 & -3 & 4 \\ 2 & -3 & 4 \\ 0 & -1 & 1 \end{bmatrix}$ and hence evaluate system of the equation $3x - 3y + 4z = 5$; $2x - 3y + 4z = 4$; $0 - y + z = 0$. Evaluate (CO1) HOT

(ii) Show that the matrix $A = \begin{bmatrix} 0 & 0 & 1 \\ 3 & 1 & 0 \\ -2 & 1 & -4 \end{bmatrix}$ satisfies its own characteristics equation. Hence find A^{-1}. Evaluate (CO1) HOT

15. Find eigen value and eigen vector of $\begin{bmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -1 \end{bmatrix}$. Evaluate (CO1) HOT

Module – II

Marks: 01

16. Rolle's theorem is applicable to a function f(x) if: Remember (CO2) LOT
(a) f(x) is continuous on [a, b] (b) f(x) is differentiable on (a, b) (c) f(a)=f(b) (d) All of the above

17. The conclusion of Rolle's theorem is: Remember (CO2) LOT

(a) $f'(a)=f'(b)$ (b) $f'(c)=0$ for some $c \in (a, b)$ (c) $f(a)=f(b)$ (d) $f(c)=0$

18. The Mean Value Theorem (MVT) states that: Remember (CO2) LOT

(a) $f'(c)=0$ (b) $f'(c)=b-af(b)-f(a)$ for some $c\in(a, b)$ (c) $f(a)=f(b)$ (d) None of these

19. If $f(x)=x^2-4x+3$ on [1, 3], then $f'(c)=0$ at: Understand (CO2) LOT

(a) c=1 (b) c=2 (c) c=3 (d) c=0

20. If $f(x)=x^3-3x^2+2x$ on [0, 2], the value of c in Rolle's theorem is: Understand (CO2) LOT

(a) 0 (b) 1 (c) 2 (d) 3

21. Lim x→0 $(1-\cos x)/x^2=$ Understand (CO2) LOT

(a) 0 (b) 1 (c) 1 / 2 (d) 2

22. lim x→0 $(e^x-1)/x=$ Understand (CO2) LOT

(a) 0 (b) 1 (c) e (d) Undefined

23. limx→∞ 1/x = Understand (CO2) LOT

(a) 0 (b) ∞ (c) 1 (d) Undefined

24. limx→0 $(a^x-1)/x=$ Understand (CO2) LOT

(a) 0 (b) 1 (c) lna (d) a

25. **If $f(x)=x^3$ on [–1, 1], then Rolle's theorem gives: Understand (CO2) LOT**

(a) c=0 (b) c = 1 /2 (c) c = -1 /2 (d) None

26. limx→0 tan2x/x= Understand (CO2) LOT

(a) 2 (b) 1 (c) 0 (d) ∞

Marks: 10

27. Determine a, b and c such that

$$\lim_{n\to 0} \frac{a\,e^x - b\cos x + ce^x}{x\sin x} = 2$$ Evaluate (CO2) HOT

28. Find the relation between beta and gamma function. Or prove that $\beta(m,n) = \frac{\Gamma m.\Gamma n}{\Gamma m+n}$. Evaluate (CO2) HOT

29. Evaluate $\int_0^1 x^2(1-x^2)^{\frac{7}{2}}dx$ Evaluate (CO2) HOT

Marks: 20

30. Prove that if 0 < a < 1, 0 < b < 1; then $\frac{b-a}{\sqrt{1-a^2}} < sin^{-1}b - sin^{-1}a < \frac{b-a}{\sqrt{1-b^2}}$ hence deduce that $\frac{\pi}{6} - \frac{1}{2\sqrt{3}} < sin^{-1}\frac{1}{4} < \frac{\pi}{6} - \frac{1}{\sqrt{15}}$ Evaluate (CO2) HOT

31. Evaluate (i) $\lim_{x\to 0} \frac{x^{1/2}tanx}{(e^x-1)^{3/2}}$ (ii) $\lim_{\theta\to\alpha} \frac{1-\cos(\theta-\alpha)}{(sin\theta-sin\alpha)^2}$ Evaluate (CO2) HOT

Module – III

Marks: 01

32. A partial differential equation involves: Remember (CO3) LOT
(a) Only one independent variable (b) More than one independent variable
(c) Only algebraic functions (d) Only one dependent variable

33. The order of a partial differential equation is: Remember (CO3) LOT
(a) The degree of the equation (b) The highest derivative involved (c) The number of variables (d) The total number of terms

34. The equation $\partial^2z/\partial x^2+\partial^2z/\partial y^2=0$ is known as: Remember (CO3) LOT
(a) Heat equation (b) Wave equation (c) Laplace equation (d) Poisson equation

35. The equation $\partial^2u/\partial t^2=c^2\partial^2u/\partial x^2$ represents: Remember (CO3) LOT
(a) Laplace equation (b) Wave equation (c) Heat equation (d) Poisson equation

36. The equation $\partial u/\partial t=k\partial^2u/\partial x^2$ is called: Remember (CO3) LOT
(a) Wave equation (b) Heat equation (c) Laplace equation (d) None of these

37. For f(x, y, z, p, q) = 0 where p = ∂z/∂x, q = ∂z/∂ the equation is: Remember (CO3) LOT
(a) Ordinary differential equation (b) Partial differential equation
(c) Integral equation (d) Algebraic equation

38. A function f(x, y) has a maximum at (a, b) if: Remember (CO3) LOT
(a) $f_x=0, f_y=0$, and $f_{xx} f_{yy}-(f_{xy})^2 > 0$, $f_{xx} < 0$ (b) $f_x=0, f_y=0$, , and $f_{xx} > 0$
(c) $f_x=0, f_y=0$, and $f_{xx}f_{yy}-(f_{xy})^2 < 0$ (d) None of these

39. If $f_{xx}f_{yy}-(f_{xy})^2 < 0$, the point is: Remember (CO3) LOT
(a) Maximum (b) Minimum (c) Saddle point (d) None

40. The critical points of a function are obtained by: Remember (CO3) LOT

A) Solving f(x,y)=0 (b) Solving f_x= 0, and f_y=0 (c) Taking second derivative (d) None of these)

41. The function f(x,y)=$3x^2+2y^2+5$ has minimum value at: Understand (CO3) LOT

(a) (1,1) (b) (0,0) (c) (-1, 0) (d) None

Marks: 10

42. If $u = \log(x^3 + y^3 + z^3 - 3xyz)$ then show that$(\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z})^2 u = \frac{9}{(x+y+z)^2}$ Evaluate (CO3) HOT

43. Examine the function $u = x^3y^2(12 - 3x - 4y)$ for extreme values. Evaluate (CO3) HOT

44. Show that the rectangular solid of maximum value that can be inscribed in a sphere is a cube. Evaluate (CO3) HOT

Marks: 20

45. (i) Find the maximum value of the $f = x^2y^3z^4$ subject to the condition x + y + z = 5. Evaluate (CO3) HOT

(ii) If $u = x^2 + y^2 + z^2 - 2xyz = 1$ show that $\frac{dx}{\sqrt{1-x^2}} + \frac{dy}{\sqrt{1-y^2}} + \frac{dz}{\sqrt{1-z^2}} = 0$ Evaluate (CO3) HOT

46. Find the extreme values of $u = x^3 + y^3 - 63(x + y) + 12xy$

Module – IV

Marks: 01

47. The double integral $\iint_R 1\, dx\, dy$ represents: Remember (CO 4) LOT

(a) Volume under a surface (b) Area of the region RRR (c) Length of a curve (d) None

48. The order of integration in $\int_0^2 \int_0^x f(x,y)dydx$ is:

(a) dy dx (b) dx dy (c) dx only (d) None

49. The region bounded by y=0, x=1, and y = x^2 is: Understand (CO 4) LOT

(a) Rectangular region (b) Triangular region (c) Parabolic region (d) Circular region

50. Changing the order of integration involves: Remember (CO 4) LOT

(a) Changing limits only (b) Changing both limits and order (c) Changing the integrand (d) None

51. Evaluate $\iint_R xy\, dx\, dy$, R:$0 \le x \le 1, 0 \le y \le 2$ Understand (CO 4) LOT

(a) 1 (b) 2 (c) ½ (d) None of these

52. For the region bounded by x=0, y=0, x+y=1, $\iint_R x\, dx\, dy$= ? Understand (CO 4) LOT

(a) 1/6 (b) 1/3 C) ½ (d) None of these

53. The limits of integration for the region bounded by y = x and y = x^2 are: Understand (CO 4) LOT

(a) x=0 to x= 1 (b) x=−1 to x= 1 (c) y=0 to y = 1 (d) x=1 to x = 2

54. The value of $\iint_R e^{x+y}$ dx dy, R:0 ≤x ≤1, 0 ≤y ≤1 Understand (CO 4) LOT

(a) e^2-1 (b) e−1 (c) $(e-1)^2$ (d) None

55. Evaluate $\iint_R x^2$ dx dy, R:0 ≤x ≤2,0 ≤y ≤1 **Understand (CO 4) LOT**

(Aa) 4/3 (b) 2 (c) 8/3 (d) 4

56. When limits of integration are interchanged, the sign of the integral: Remember (CO 4) LOT

(a) Always changes (b) Never changes (c) Changes only in single integrals (d) May or may not change

Marks: 10

57. Evaluate $\int_0^\infty \int_0^\infty \frac{e^{-x^3}}{\sqrt{x}} y^4 e^{-y^6} dxdy$ Evaluate (CO 4) HOT

58. Evaluate $\int\int e^{ax+by} dxdy$, over the triangle bounded by x = 0, y = o, ax + by = 1. Evaluate (CO 4) HOT

59. Evaluate $\int\int (x^2 + y^2) dxdy$ over the ellipse $2x^2 + y^2 = 1$ Evaluate (CO 4) HOT

60. Evaluate $\int\int ydxdy$ over the region enclosed by the parabola $x^2 = y$ and the line y = x + 2. Evaluate (CO 4) HOT

61. Find the value $\int_0^2 \int_1^z \int_0^{yz} xyzdxdydz$. Evaluate (CO 4) HOT

Marks: 20

62. (i) Evaluate $\int_1^e \int_1^{logy} \int_1^{e^x} logzdxdydz$ Evaluate (CO 4) HOT

(ii) Find the area bounded by the parabola $y^2 = 4x$ and the line 2x – 3y + 4 = 0. Evaluate (CO 4) HOT

63. (i) Find the area bounded between the parabola $x^2 = 4ay$ and $x^2 = 0 - 4a(y - 2a)$. Evaluate (CO 4) HOT

(ii) Find the area of the loop of the curve $x(x^2 + y^2) = a(x^2 - y^2)$. Evaluate (CO 4) HOT

Summary Sheet

CO Wise

CO	Q. No.	Marks
CO1	1 to 15	80
CO2	16 to 31	81
CO3	32 to 46	80
CO4	47 to 63	90
		331

Unit Wise

Unit	Q. No.	Marks
Unit 1	1 to 15	80
Unit 2	16 to 31	81
Unit 3	32 to 46	80
Unit 4	47 to 63	90
	Total =	**331**

Blooms Taxonomy Level (BTL) Wise

BTL	Q. No.	Marks
LOT	1 to 10, 16 to 26, 32 to 41, 47 t0 56	41
HOT	11 to 15, 27 to 31,42 to 46,57 to 63	290
	Total =	**331**

Prepared by – Wakil Kumar

Disclaimer: -This is a Practice Set. The Question in End term examination will differ from the Practice Set. This Practice Set is meant for practice only.