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Unit – I (Matrices)

1. Find the sum and product of the eigenvalues of a 3×3 matrix A whose characteristic equation is $\lambda^3 - 7\lambda^2 + 36 = 0$.

2. Find the sum and product of all the eigenvalues of $\begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$.

Text Book Page No.: 1.8

3. Given: $A = \begin{pmatrix} -1 & 0 & 0 \\ 2 & -3 & 0 \\ 1 & 4 & 2 \end{pmatrix}$. Find the eigenvalues of A^2 . (Text Book Page No.: 1.7)

4. Find the eigenvalues of A^{-1} where $A = \begin{pmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{pmatrix}$. (Text Book Page No.: 1.8)

5. Find the eigenvalues of the inverse of the matrix $A = \begin{pmatrix} 2 & 1 & 0 \\ 0 & 3 & 4 \\ 0 & 0 & 4 \end{pmatrix}$.

6. If 3 and 6 are two eigenvalues of $A = \begin{pmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{pmatrix}$, write down all the eigenvalues of

A^{-1} . (Text Book Page No.: 1.9)

7. Two eigenvalues of the matrix $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$ are 3 and 0. What is the third

eigenvalue? What is the product of the eigenvalues of A ?

8. If 1 and 2 are the eigenvalues of a 2 X 2 matrix A , what are the eigenvalues of A^2 and A^{-1} ?

9. The product of two eigenvalues of the matrix $A = \begin{pmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix}$ is 16. Find the third

eigenvalue of A . (Text Book Page No.: 1.10)

10. If 2, 3 are the eigenvalues of $\begin{pmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ b & 0 & 2 \end{pmatrix}$, then find the value of b .

11. If $2, -1, -3$ are the eigenvalues of the matrix A , then find the eigenvalues of the matrix $A^2 - 2I$.

12. If the sum of two eigenvalues and trace of a 3 X 3 matrix A are equal, find the value of $|A|$. (Text Book Page No.: 1.10)

13. If the eigenvalues of the matrix A of order 3 X 3 are 2, 3 and 1, then find the eigenvalues of adjoint of A .

14. If λ is the eigenvalue of the matrix A , then prove that λ^2 is the eigenvalue of A^2 .

15. If $\lambda (\neq 0)$ is an eigenvalue of a square matrix A , then show that λ^{-1} is an eigenvalue of A^{-1} .

16. State Cayley- Hamilton theorem. (Text Book Page No.: 1.41)

17. Find the constants a and b such that the matrix $\begin{bmatrix} a & 4 \\ 1 & b \end{bmatrix}$ has 3 and -2 as its eigenvalues.

18. Use Cayley- Hamilton theorem to find $(A^4 - 4A^3 - 5A^2 + A + 2I)$ when $A = \begin{pmatrix} 1 & 2 \\ 4 & 3 \end{pmatrix}$.

Text Book Page No.: 1.54

19. Write down the quadratic form corresponding to the matrix $A = \begin{bmatrix} 0 & 5 & -1 \\ 5 & 1 & 6 \\ -1 & 6 & 2 \end{bmatrix}$.

Text Book Page No.: 1.93

20. Check whether the matrix B is orthogonal? Justify. $B = \begin{pmatrix} \cos \theta & \sin \theta & 0 \\ -\sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$.

Text Book Page No.: 1.57

21. Can $A = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$ be diagonalized? Why?

22. Find the nature of the Quadratic Form $x_1^2 + 2x_2^2 + x_3^2 - 2x_1x_2 + 2x_2x_3$.

Text Book Page No.: 1.94

23. Write down the matrix of the quadratic form $2x^2 + 8z^2 + 4xy + 10xz - 2yz$.

Text Book Page No.: 1.94

24. Give the nature of a quadratic form whose matrix is $\begin{pmatrix} -1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & -2 \end{pmatrix}$.

25. Find the symmetric matrix A , whose eigenvalues are 1 and 3 with corresponding

eigenvectors $\begin{pmatrix} 1 \\ -1 \end{pmatrix}$ and $\begin{pmatrix} 1 \\ 1 \end{pmatrix}$. (Text Book Page No.: 1.88)

Unit – II (Sequences and Series)

1. Define limit of a sequence. (Text Book Page No.: 2.2)
2. Distinguish between a sequence and series.

3. Define convergent sequence. (Text Book Page No.: 2.3)
4. Define convergence series with example.
5. Give an example for conditionally convergent series.
6. Find the nature of the series $1+2+3+\dots+n+\dots$. (Text Book Page No.: 2.9)
7. Examine the convergence of the sequence $u_n = 2n$.

8. Test the convergence of sequence $\left\{ \frac{1}{n} \right\}_{n=1}^{\infty}$. (Text Book Page No.: 2.6)

9. Test the convergence of the series $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \dots \infty$.

10. Test the convergence of the series $1 - \frac{1}{2^2} - \frac{1}{3^2} + \frac{1}{4^2} + \frac{1}{5^2} - \frac{1}{6^2} - \frac{1}{7^2} + \dots \infty$.

Text Book Page No.: 2.90

11. Define bounded sequence. (Text Book Page No.: 2.1)
12. Define oscillating sequence with example. (Text Book Page No.: 2.4)
13. Define monotone sequence.
14. Given an example for decreasing and increasing sequence.
15. State the necessary condition for convergence.
16. Define comparison test. (Text Book Page No.: 2.16)
17. Define Cauchy's integral test. (Text Book Page No.: 2.37)

18. Test the convergence of the series $\sum_{n=1}^{\infty} \frac{1}{n^2+1}$. (Text Book Page No.: 2.39)

19. Determine the convergence or divergence of the series $\sum_{n=1}^{\infty} \frac{n}{n^2+1}$, using integral test.

20. Examine the convergence of the series $\sum_{n=2}^{\infty} \frac{1}{n \log n}$. (Text Book Page No.: 2.41)

21. Define D'Alembert's ratio test. (Text Book Page No.: 2.49)

22. Discuss the convergence of the series $\sum_{n=1}^{\infty} \frac{n^2}{3^n}$. (Text Book Page No.: 2.53)

23. Using comparison test, prove that the series $\frac{1}{1.3} + \frac{2}{3.5} + \frac{3}{5.7} + \dots$ is divergent.

Text Book Page No.: 2.19

24. Using integral test, determine the convergence of $1 + \frac{1}{3} + \frac{1}{5} + \dots + \frac{1}{2n-1} + \dots$.

25. Find the coefficient of x^6 in the expansion of $(1 - x + x^2)e^{2x}$.

26. Define alternating series. (Text Book Page No.: 2.82)

27. State the Leibnitz's rule. (Text Book Page No.: 2.82)

28. Define absolute and conditional convergent. (Text Book Page No.: 2.98)

29. Show that an absolute convergent series is convergent.

Unit – III (Applications of Differential Calculus)

1. For the catenary $y = c \cosh \frac{x}{c}$, find the curvature. (Text Book Page No.: 3.15)

2. Find the radius of curvature for $y = e^x$ at the point where it cuts the y -axis.

Text Book Page No.: 3.11

3. Define circle of curvature. (Text Book Page No.: 3.11)

4. Define geometrically curvature of the curve and centre of curvature at a point.

5. Find the center of curvature of $y = x^2$ at the origin.

6. Find the curvature of the curve $2x^2 + 2y^2 + 5x - 2y + 1 = 0$.

Text Book Page No.: 3.12

7. Find the radius of curvature of the curve $x^2 + y^2 - 4x + 2y - 8 = 0$.

Text Book Page No.: 3.44

8. Find the radius of curvature of the curve $xy = c^2$ at (c, c) .

9. What is the curvature of the circle $(x-1)^2 + (y+2)^2 = 16$ at any point on it?
10. Write down the formula for Radius of curvature in terms of Parametric Coordinates System. (Text Book Page No.: 3.5)
11. Define Involutives and Evolutives. (Text Book Page No.: 3.47)
12. Write the properties of Evolutives. (Text Book Page No.: 3.47)
13. Find the envelope of the lines $y = mx \pm \sqrt{a^2m^2 + b^2}$ where m is the parameter.
Text Book Page No.: 3.79
14. Find the envelope of family of straight lines $y = mx + \frac{a}{m}$, m being the parameter.
Text Book Page No.: 3.78
15. Find the envelope of the family of straight lines $y = mx + \frac{1}{m}$, where m is a parameter.
Text Book Page No.: 3.78
16. Find the envelope of the lines $\frac{x}{t} + yt = 2c$, ' t ' being a parameter.
Text Book Page No.: 3.80
17. Find the envelope of the family of lines $\frac{x}{a} \cos \theta + \frac{y}{b} \sin \theta = 1$, θ being the parameter.
18. Find the envelope of the family of straight lines $x \cos \theta + y \sin \theta = \alpha$ where θ is the parameter. (Text Book Page No.: 3.80)
19. Find the envelope of the lines $x \operatorname{cosec} \theta - y \cot \theta = a$, θ being the parameter.
Text Book Page No.: 3.81
20. Find the envelope of the family of circles $(x-\alpha)^2 + y^2 = r^2$, α being the parameter.
Text Book Page No.: 3.99

Unit – IV (Differential Calculus of Several Variables)

1. If $u = \frac{x}{y} + \frac{y}{z} + \frac{z}{x}$, find $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z}$. (Text Book Page No.: 4.4)
2. Using Euler's theorem, given $u(x, y)$ is a homogeneous function of degree n , prove that $x^2 u_{xx} + 2xy u_{xy} + y^2 u_{yy} = n(n-1)u$. (Text Book Page No.: 4.12)
3. Find $\frac{\partial u}{\partial x}$ and $\frac{\partial u}{\partial y}$ if $u = y^x$.
4. If $u = x^y$, show that $\frac{\partial^2 u}{\partial x \partial y} = \frac{\partial^2 u}{\partial y \partial x}$. (Text Book Page No.: 4.10)
5. Given $u(x, y) = x^2 \tan^{-1}\left(\frac{y}{x}\right)$, find the value of $x^2 u_{xx} + 2xy u_{xy} + y^2 u_{yy}$.
6. If $u = f(y-z, z-x, x-y)$, find $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$. (Text Book Page No.: 4.22)
7. Using the definition of total derivative, find the value of $\frac{du}{dt}$ given $u = y^2 - 4ax$; $x = at^2, y = 2at$. (Text Book Page No.: 4.19)
8. Find $\frac{du}{dt}$ when $u = x^2 y, x = t^2$ and $y = e^t$.
9. If $u = x^2 + y^2$ and $x = at^2, y = 2at$, find $\frac{du}{dt}$.
10. If $u = x^3 y^2 + x^2 y^3$ where $x = at^2$ and $y = 2at$ then find $\frac{du}{dt}$?

Text Book Page No.: 4.38

11. Find $\frac{du}{dt}$, if $u = \frac{x}{y}$, where $x = e^t, y = \log t$.
12. Find $\frac{du}{dt}$ if $u = \sin(x/y)$, where $x = e^t, y = t^2$.

13. If $x^y + y^x = 1$, then find $\frac{dy}{dx}$. (Text Book Page No.: 4.22)

14. If $x^2 + y^2 = 1$, then find $\frac{dy}{dx}$.

15. If $u = \frac{y^2}{2x}$, $v = \frac{x^2 + y^2}{2x}$, find $\frac{\partial(u,v)}{\partial(x,y)}$. (Text Book Page No.: 4.43)

16. If $x = u^2 - v^2$ and $y = 2uv$, find the Jacobian of x and y with respect to u and v .

Text Book Page No.: 4.53

17. If $u = 2xy$, $v = x^2 - y^2$, $x = r \cos \theta$, $y = r \sin \theta$ then compute $\frac{\partial(u,v)}{\partial(r,\theta)}$?

Text Book Page No.: 4.42

18. If $x = r \cos \theta$, $y = r \sin \theta$ find $\frac{\partial(x,y)}{\partial(r,\theta)}$. (Text Book Page No.: 4.41)

19. If $x = r \cos \theta$, $y = r \sin \theta$ find $\frac{\partial(r,\theta)}{\partial(x,y)}$. (Text Book Page No.: 4.41)

20. If $x = u(1+v)$ and $y = v(1+u)$, find $\frac{\partial(x,y)}{\partial(u,v)}$.

21. Write the sufficient condition for $f(x, y)$ to have a maximum value at (a, b) .

Text Book Page No.: 4.69

22. State the conditions for maxima and minima of $f(x, y)$.

Text Book Page No.: 4.69

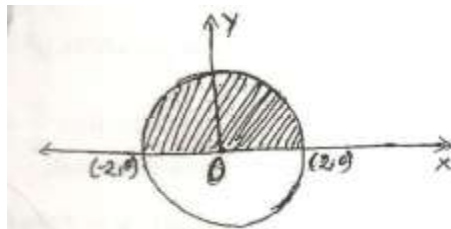
Unit – V (Multiple Integrals)

1. Evaluate $\int_0^a \int_0^b (x + y) dx dy$. (Text Book Page No.: 5.2)

2. Evaluate $\int_0^5 \int_0^2 (x^2 + y^2) dx dy$.

3. Evaluate $\int_1^b \int_1^a \frac{dx dy}{xy}$. (Text Book Page No.: 5.6)
4. Evaluate $\int_1^3 \int_1^2 \frac{1}{xy} dx dy$. (Text Book Page No.: 5.28)
5. Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy(x+y) dx dy$. (Text Book Page No.: 5.9)
6. Evaluate $\int_0^1 \int_0^{x^2} (x^2 + y^2) dy dx$. (Text Book Page No.: 5.8)
7. Sketch the region of integration in $\int_0^1 \int_0^x dy dx$.
8. Write down the double integral, to find the area between the circles $r = 2\sin\theta$ and $r = 4\sin\theta$. (Text Book Page No.: 5.94)
9. Evaluate $\int_0^\pi \int_0^a r dr d\theta$. (Text Book Page No.: 5.6)
10. Evaluate $\int_0^2 \int_0^\pi r \sin^2 \theta d\theta dr$. (Text Book Page No.: 5.7)
11. Evaluate $\int_0^\pi \int_0^{\sin\theta} r dr d\theta$. (Text Book Page No.: 5.14)
12. Evaluate $\int_0^{\pi/2} \int_0^{\sin\theta} r d\theta dr$. (Text Book Page No.: 5.29)
13. Evaluate $\int_C [x^2 dy + y^2 dx]$ where C is the path $y = x$ from $(0,0)$ to $(1,1)$.
14. Find the area bounded by the lines $x = 0$, $y = 1$, $x = 1$ and $y = 0$.
15. Find the area bounded by the lines $x = 0$, $y = 1$ and $y = x$, using double integration.
Text Book Page No.: 5.94
16. Find the area bounded by the line $y = x$ and parabola $x^2 = y$.

17. Evaluate $\iint_R dx dy$, where R is the shaded region in the figure.



(Text Book Page No.: 5.16)

18. Change the order of integration in $I = \int_0^1 \int_{x^2}^{2-x} f(x, y) dx dy$. (Text Book Page No.: 5.60)

19. Change the order of integration for the double integral $\int_0^1 \int_0^x f(x, y) dx dy$.

20. Change the order of integration in $\int_0^a \int_x^a f(x, y) dy dx$. (Text Book Page No.: 5.60)

21. Change the order of integration in $\int_0^a \int_0^y f(x, y) dx dy$. (Text Book Page No.: 5.60)

22. Change the order of integration $\int_0^1 \int_y^1 dx dy$. (Text Book Page No.: 5.32)

23. Express $\int_0^\infty \int_0^\infty f(x, y) dx dy$ in polar co-ordinates.

24. Plot the region of integration to evaluate the integral $\iint_D f(x, y) dx dy$ where D is the region bounded by the line $y = x - 1$ and the parabola $y^2 = 2x + 6$.

25. Evaluate $\int_0^a \int_0^b \int_0^c dx dy dz$.

26. Evaluate $\int_0^1 \int_0^2 \int_0^3 xyz dx dy dz$.

27. Evaluate $\int_1^3 \int_3^4 \int_1^4 xyz dx dy dz$.

28. Evaluate the triple integral $\int_1^3 \int_2^3 \int_1^2 x^2 yz \, dx dy dz$.

29. Evaluate $\int_0^1 \int_0^y \int_0^{x+y} dx dy dz$.

(Text Book Page No.: 5.132)

Textbook for Reference:

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