ST.ANNE'S

COLLEGE OF ENGINEERING AND TECHNOLOGY

(An ISO 9001:2015 Certified Institution)
Anguchettypalayam, Panruti – 607106.

QUESTION BANK (R-2017)

MA3151
MATRICES AND CALCULUS

ST.ANNE'S

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(An ISO 9001:2015 Certified Institution)

Anguchettypalayam, Panruti – 607106.

QUESTION BANK

PERIOD: AUG - DEC 2021 **BATCH**: 2021 – 2025

BRANCH: COMMON **YEAR/SEM:** I/01

SUB CODE/NAME: MA3151 - MATRICES AND CALCULUS

UNIT-1 MATRICES

PART – A

1. State Cayley- Hamilton theorem.
2. Find the sum and product of the Eigenvalues of the matrix $A = \begin{pmatrix} 3 & 8 & 6 \\ 8 & 4 & 2 \\ 6 & 2 & 5 \end{pmatrix}$
3. Find the sum and product of the Eigenvalues of the matrix $A = \begin{pmatrix} -1 & 1 & 1 \\ 1 & -1 & 1 \\ 1 & 1 & -1 \end{pmatrix}$
4. The Eigen value of a matrix $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$ are 3 and 0, what is the third Eigen value? And find the product of the Eigen value?
5. Find the sum and product of all the Eigenvalues of $\begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$.
6. If 2 and 3 are the two eigenvalues of $\begin{pmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ b & 0 & 2 \end{pmatrix}$ then find the value of b.
7. The product of two Eigenvalues of the $A = \begin{pmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix}$ is 16.find the third Eigenvalue.
8. Find the Eigenvalues of the matrix $\begin{pmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{pmatrix}$.
9. Find the Eigenvalues of 3A+2I, where A= $\begin{pmatrix} 5 & 4 \\ 0 & 2 \end{pmatrix}$.
10. If λ is an Eigen value of a matrix A, then λ^{-1} is the Eigen value of A^{-1}.
11. If λ is an Eigen value of a matrix A, then λ^2 is the Eigen value of A^2.
12. Prove that the Eigen value of a orthogonal matrix are of unit modulus.
13. If the Eigen value of the matrix 3x3 are 2,3,1 then find the Eigen value of adjoint of A.
14. If 2,-1,-3 are the Eigen value of the matrix A,then find the Eigen value of $A^2 - 2I$.
15. If the sum of two Eigen values and trace of a 3x3 matrix A are equal, find the value of |A|.

16. Prove that $x^2 + 2y^2 + 3z^2 + 2xy + 2yz - 2zx = 0$ is indefinite.

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

18. What is the nature of the quadratic form $x^2 + y^2 + z^2$ in four variables?

19. Discuss the nature of the quadratic form $2x^2 + 3y^2 + 2z^2 + 2xy$.

20. Write down the matrix corresponding to the quadratic form $2x_1^2 + 5x_2^2 + 4x_1x_2 + 2x_3x_1$.

PART-B

CHAPTER-1.1 (8-MARKS)

1. Find the **Eigen values** and **Eigen vectors** for the matrix $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$

2. Find the **Eigen values** and **Eigen vectors** for the matrix $\begin{bmatrix} 2 & 0 & -1 \\ 0 & 2 & 0 \\ -1 & 0 & 2 \end{bmatrix}$

3. Find the **Eigen values** and **Eigen vectors** for the matrix $\begin{bmatrix} 7 & -2 & 0 \\ -2 & 6 & -2 \\ 0 & -2 & 5 \end{bmatrix}$

4. Find the **Eigen values** and **Eigen vectors** for the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$

5. Find the **Eigen values** and **Eigen vectors** for the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$

6. Find the **Eigen values** and **Eigen vectors** for the matrix $\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$

7. Find the **Eigen values** and **Eigen vectors** for the matrix $\begin{bmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{bmatrix}$

8. Find the **Eigen values** and **Eigen vectors** for the matrix $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$

CHAPTER-1.2 (8-MARKS)

1. Verify the **Cayley-Hamilton** theorem and also find $\boldsymbol{A^{-1}}$ for the matrix $\begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$
2. Verify the **Cayley-Hamilton** theorem and also find $\boldsymbol{A^{-1}}$ for the matrix $\begin{bmatrix} 1 & 2 & -1 \\ 3 & -3 & 1 \\ 2 & 1 & -2 \end{bmatrix}$
3. Verify the **Cayley-Hamilton** theorem and also find $\boldsymbol{A^{-1}}$ for the matrix $\begin{bmatrix} -3 & 2 & 1 \\ 3 & -1 & -2 \\ 1 & 2 & 3 \end{bmatrix}$
4. Verify the **Cayley-Hamilton** theorem and also find $\boldsymbol{A^{-1}}$ for the matrix $\begin{bmatrix} 2 & -1 & 1 \\ 0 & 1 & 2 \\ 1 & 0 & 1 \end{bmatrix}$
5. Verify the **Cayley-Hamilton** theorem and also find $\boldsymbol{A^{-1}}$ for the matrix $\begin{bmatrix} 1 & 0 & -1 \\ 2 & 1 & 1 \\ 1 & 0 & -2 \end{bmatrix}$
6. Verify the **Cayley-Hamilton** theorem and also find $\boldsymbol{A^{4}}$ for the matrix $\begin{bmatrix} 3 & -4 & 4 \\ 1 & -2 & 4 \\ 1 & -1 & 3 \end{bmatrix}$
7. **Use Cayley-Hamilton theorem to find the value of**

   $\boldsymbol{A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I}$ Where A=$\begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$

8. Verify the **Cayley-Hamilton** theorem and also find $\boldsymbol{A^{4}}$ for the matrix $\begin{bmatrix} 1 & 2 & 1 \\ 2 & 2 & 1 \\ 1 & 1 & 3 \end{bmatrix}$

CHAPTER-1.3 (16-MARKS)

1. Reduce the quadratic form into the canonical by using orthogonal transform $6\boldsymbol{x_1^2 + 3x_2^2 + 3x_3^2 - 4x_1x_2 - 2x_2x_3 + 4x_3x_1}$ and also find Rank, signature, Index

2. Reduce the quadratic form into the canonical by using orthogonal transform $\boldsymbol{x^2 + 5y^2 + z^2 + 2xy + 2yz + 6zx}$ and also find Rank, signature, Index

3. Reduce the quadratic form into the canonical by using orthogonal transform $\boldsymbol{8x_1^2 + 7x_2^2 + 3x_3^2 - 12x_1x_2 - 8x_2x_3 + 4x_3x_1}$ and also discuss the nature

4. Reduce the quadratic form into the canonical by using orthogonal transform $\boldsymbol{3x_1^2 + 3x_2^2 + 3x_3^2 + 2x_1x_2 - 2x_2x_3 + 2x_3x_1}$ and also discuss the nature

5. Reduce the quadratic form into the canonical by using orthogonal transform $\boldsymbol{3x_1^2 + 5x_2^2 + 3x_3^2 - 2x_2x_3 + 2x_3x_1 - 2x_1x_2}$ and also find Rank, signature, Index

6. Reduce the quadratic form into the canonical by using orthogonal transform $\boldsymbol{3x^2 - 3y^2 - 5z^2 - 2xy - 6yz - 6xz}$. and also discuss the nature

7. Reduce the quadratic form into the canonical by using orthogonal transform $\boldsymbol{x^2 + y^2 + z^2 - 2xy - 2yz - 2zx}$. and also find Rank, signature, Index

8. Reduce the quadratic form into the canonical by using orthogonal transform $\boldsymbol{x_1^2 + 2x_2^2 + x_3^2 - 12x_1x_2 + 2x_2x_3}$ and also find Rank, signature, Index

Reduce the quadratic form into the canonical by using orthogonal transform $\boldsymbol{2x^2 + y^2 + z^2 + 2xy - 2xz - 4yz}$ and also find Rank, signature, Index

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BRANCH: COMMON **YEAR/SEM:** I/01

SUB CODE/NAME: MA3151 - MATRICES AND CALCULUS

UNIT- 2 DIFFERENTIAL CALCULUS

PART – A

1. Find the domain and range **f(x) =3x-2.**
2. Sketch the graph of the absolute value function **f(x)=**$|x|$
3. Prove that $\lim_{x\to 0}|x| = 0$.
4. If $\mathbf{x^2 + y^2 = 25}$, then find $\frac{dy}{dx}$.
5. Find the derivative $\mathbf{y = (x^3-1)^{100}}$ **.**
6. Find the domain and range $\boldsymbol{y = x^2}$**.**
7. Sketch the graph of function $|\boldsymbol{x}| = \begin{cases} \boldsymbol{x}, & \boldsymbol{if x} > 0 \\ -\boldsymbol{x}, & \boldsymbol{if\ x} < 0 \end{cases}$.
8. Find the $\lim_{x\to 3^+}\left(\frac{2x}{x-3}\right)$.
9. Prove that $\lim_{x\to 0}\left(\frac{|x|}{x}\right)$.
10. Define derivative of a function $f(x)$.
11. Evaluate $\lim_{x\to 1}\left(\frac{x^4-1}{x^3-1}\right)$, if it exists.
12. Find the derivative of the function $\boldsymbol{f(x) = \sqrt[3]{1+tanx}}$.
13. Sketch the graph of the function $\begin{cases} 1+x, x<-1 \\ x^2, -1\le x\le 1 \\ 2-x, x\ge 1 \end{cases}$ and use it to determine the value of "a" for which $\lim_{x\to a} f(x)$ exists? **(Jan-18)**
14. Does the curve $y = x^4 - 2x^2 + 2$ have any horizontal tangents? If so where? **(Jan-18)**
15. State Rolle's Theorem and verify the Rolle's theorem for $f(x) = x^3 + 5x^2 - 6x$ on the interval (0, 1).
16. State Mean value theorem
17. Find the critical numbers for $f'(x) = \frac{x^2(x-1)}{x+2}, x \ne -2$
18. Define concavity and point of inflection.

19. Define maxima and minima of one variable and write the conditions.

20. Find the tangent line and normal line to the given curve $y = 2xe^{x}$ at (0, 0).

21. Find the domain of $f(x) = \sqrt{3-x} - \sqrt{2+x}$ **(Nov 2018)**

22. Evaluate $\lim_{t\to 1}\frac{t^4-1}{t^3-1}$ **(Nov 2018)**

23. check whether $\lim_{t\to 1}\frac{3x+9}{|x+3|}$ exist. **(APR 19)**

24. Find the critical points of $y = 5x^3 - 6x$ **(APR 19)**

PART – B

Limits

1. Find the value of $\lim_{x\to 0}\frac{\sin x}{x}$.

2. Find the domain of the functions a) $y = x^2$, b) $f(x) = \sqrt{x-2}$, c) $g(x) = \frac{1}{x^2-x}$

3. Find $\lim_{x\to 0}\left(\frac{1}{x^2}\right)$.

4. Evaluate $\lim_{x\to\frac{\pi}{2}}\frac{1+\cos 2x}{(\pi-2x)^2}$.

5. Find the limit of the function $\lim_{x\to 0}\frac{e^{5x}-1}{x}$, given numbers $x = \pm 0.5 , \pm 0.1 , \pm 0.01 , \pm 0.001 ,$ ± 0.001 (correct 6 decimal places) **(Nov 2018)**

Continuity

1. Show that the function **f(x) = 1-** $\sqrt{1-x^2}$ is continuous on the interval [-1, 1] .

2. Find an equation of the tangent line to the parabola **y = x²** at the point (1,1) .

3. Find an equation of the tangent line to the hyperbola $y = \frac{3}{x}$ at the point (3,1) .

4. If $(x) = \sqrt{x}$, find the equation for $f'(x)$.

5. Determine whether $f'(0)$ exist or not for the given function

$$f(x) = \begin{cases} x\sin\left(\frac{1}{x}\right) & , x \neq 0 \\ 0 & , x = 0 \end{cases}$$

6. Where is the function $f(x) = |x|$ is differentiable?

7. Find $\lim_{t\to 0}\frac{\sqrt{t^2+9}-3}{t^2}$.

8. Find the value of $\lim_{x\to 1}\left(\frac{x-1}{x^2-1}\right)$

9. For what value of the constant "c" is the function "f" continuous on $(-\infty,\infty)$,

$$f(x)=\begin{cases} cx^2+2x, x<2 \\ x^3-cx, x\geq 2 \end{cases}$$

10. For what value of the constant "b" is the function "f" continuous on $(-\infty,\infty)$,

if $f(x)=\begin{cases} bx^2-2x & if\ \ x<2 \\ x^3-bx & if\ \ x\geq 2 \end{cases}$ **(Apr 19)**

Differentiability

1. If the function **f(x)** is differentiable at a, then f(x) is continuous at a .
2. Find an equation of the tangent line to the hyperbola $y=\frac{3}{x}$ at the point (3,1).
3. Find an equation of the tangent line to the parabola **y = x² -8x+9** at the point (3,-6) .
4. Where is the function $f(x)=|x|$ is differentiable?
5. Show that $\lim_{x\to 0} x^2 \sin\frac{1}{x}$ =0.
6. Show that the sum of x and x intercepts of any tangent line to the curve $\sqrt{x}+\sqrt{y}=\sqrt{c}$ is equal to c.
7. Verify that the function **f(x) = 5-12x+3x²** satisfies the Rolle's theorem on the interval **[1,3]**.
8. Find the local maximum and local minimum values of the function **g(x)=x+2sinx.**
9. Find the absolute maximum and minimum values of the function

$$f(x)=x^3-3x^2+1,\quad \frac{-1}{2}\leq x\leq 4.$$

10. Find the local maximum and local minimum values of the function

$$f(x)=2x^3+3x^2-36x.$$

11. Find the values of a and b such that the function $f(x)=\begin{cases} x+2, & x<2 \\ ax^2-bx+3, & 2\leq x<3 \\ 2x-a+b, & x\geq 3 \end{cases}$

is continuous everywhere.

12. Find the derivative of the function $f(x)=\frac{1}{\sqrt{x}}$ using the definition of derivative. 0
13. Find the values of a and b such that the function $f(x)=\begin{cases} \frac{x^3-8}{x-2}, & x<2 \\ ax^2-bx+3, & 2\leq x<3 \\ 2x-a+b, & x\geq 3 \end{cases}$ **(Nov 2018)**
14. find the derivative of $f(x)=\cos^{-1}\left[\frac{b+a\cos x}{a+b\cos x}\right]$ **(Nov 2018)**
15. find y' for $\cos(xy)=1+\sin y$ **(Nov 2018)**
16. Find $\frac{dy}{dx}$ if $y=x^2e^{2x}(x^2+1)^4$ **(Apr 19)**

Maxima and minima

1. Find the maximum and minimum values of $f(x)=\frac{x^2+x+1}{x^2-x+1}$.

2. Find the local maximum and minimum values of $f(x)=\sqrt{x}-\sqrt[4]{x}$ using both the first and second derivative tests. **(Jan-18)**

3. Find y'' if $x^4+y^4=6$. **(Jan-18)**

4. Find the tangent line to the equation $x^3+y^3=6xy$ at the point (3, 3) and at what point the tangent line horizontal in the first quadrant. **(Jan-18)**

5. For the function $\boldsymbol{f(x)=2+2x^2-x^4}$ find the intervals of increase or decrease , local maximum and minimum values, concavity and inflection points (**Nov 2018)**

6. For the function $\boldsymbol{f(x)=2x^3+3x^2-36x}$ find the intervals of increase or decrease, local maximum and minimum values. **(Apr 19)**

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UNIT- 3 FUNCTIONS OF SEVERAL VARIABLE

PART – A

1. If $\boldsymbol{u} = \frac{y}{z} + \frac{z}{x} + \frac{x}{y}$ then find the value of $\boldsymbol{x}\frac{\partial u}{\partial x} + \boldsymbol{y}\frac{\partial u}{\partial y} + \boldsymbol{z}\,\frac{\partial u}{\partial z} = ?$
2. If $\boldsymbol{x^y + y^x = 1}, \boldsymbol{then\ find}\ \frac{dy}{dx} = ?$
3. If $\boldsymbol{u = x^2 + y^2}$ and $\boldsymbol{x = at^2}, \boldsymbol{y = 2at}$, find $\frac{du}{dt}$.
4. If $\boldsymbol{x = r\cos\theta}, \boldsymbol{y = r\sin\theta}$, then find $\frac{\partial(x,y)}{\partial(r,\theta)}$.
5. If $\boldsymbol{u} = \frac{y^2}{x}, \boldsymbol{v} = \frac{x^2}{y}$, find $\frac{\partial(u,v)}{\partial(x,y)}$.
6. If u = $\sin^{-1}\left(\frac{x}{y}\right) + \tan^{-1}\left(\frac{y}{x}\right)$ then prove that $\boldsymbol{x}\frac{\partial u}{\partial x} + \boldsymbol{y}\frac{\partial u}{\partial y} = \mathbf{0}$
7. If $\boldsymbol{u} = \frac{y}{z} + \frac{z}{x}$ then find the value of $\boldsymbol{x}\frac{\partial u}{\partial x} + \boldsymbol{y}\frac{\partial u}{\partial y} + \boldsymbol{z}\,\frac{\partial u}{\partial z} = ?$
8. If **u = x+y** and **y = uv**, find the Jacobian $\frac{\partial(x,y)}{\partial(u,v)}$.
9. Write down Taylor's formula.
10. Find dy/dx when $\mathbf{x^2+y^2 = xy}$.
11. Are $u = x + y\ and\ v = x - y$ functionally independent? Justify the claim.
12. If $x = r\cos\theta, y = r\sin\theta$, then find $\frac{\partial r}{\partial x}$ **(Jan-18)**
13. If x= $uv, y = \frac{u}{v}$, find $\frac{\partial(x,y)}{\partial(u,v)}$. **(Jan-18)**
14. Find $\frac{\partial u}{\partial x}$ and $\frac{\partial u}{\partial y}$ if $u = y^x$
15. If $u = (x-y)(y-z)(z-x)$, prove that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$.
16. If u= $(x-y)^4 + (y-z)^4 + (z-x)^4$ show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$
17. Find $\frac{du}{dt}$ if u = $\frac{x}{y}$ where x = e^t, y = log t
18. Find $\mathbf{\frac{du}{dx}}$ **if** $\mathbf{u = \sin(x^2 + y^2)}$**, where** $\mathbf{3x^2 + y^3 = 4}$

19. If $x = u^2 - v^2, y = 2uv$ evaluate the Jacobian of **x, y** with respect to **u, v** **(Apr19)**

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

21. Find $\frac{dy}{dx}$ if $x^y + y^x = c$, where **c** is a constant **(Nov18)**

22. State the properties of jacobians **(Nov18)**

23. Find $\frac{du}{dt}$ in trems of t , if $x^3 + y^3 = u$ where $x = at^2, y = 2at$ **(Apr19)**

PART – B

Implicit functions

1. If u = $\sin^{-1}\left(\frac{x^3 - y^3}{x + y}\right)$ then prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 2tanu.$

2. If $g = \Psi(u, v)$ *where* $u = x^2 - y^2$ *and* $v = 2xy$,

   show that $\frac{\partial^2 g}{\partial x^2} + \frac{\partial^2 g}{\partial y^2} = 4(x^2 + y^2)\left[\frac{\partial^2 \Psi}{\partial u^2} + \frac{\partial^2 \Psi}{\partial v^2}\right]$

3. If $u = f(x - y, y - z, z - x)$ *then show that* $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0.$

4. If $\emptyset = \emptyset(u, v)$ *where* $u = e^x \cos y$, $v = e^x \sin y$

   Show that $\frac{\partial^2 \emptyset}{\partial x^2} + \frac{\partial^2 \emptyset}{\partial y^2} = (u^2 + v^2)\left[\frac{\partial^2 \emptyset}{\partial u^2} + \frac{\partial^2 \emptyset}{\partial v^2}\right].$

5.If u = $\tan^{-1}\left(\frac{x^3 + y^3}{x - y}\right)$ then prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = sin2u.$

6. If $u = x^2 \tan^{-1}\frac{y}{x} - y^2 \tan^{-1}\frac{x}{y}$, then find the value of $x^2\frac{\partial^2 u}{\partial x^2} + 2xy\frac{\partial^2 u}{\partial x \partial y} + y^2\frac{\partial^2 u}{\partial y^2}$,

   using Euler's theorem.

7. If z = f(x,y),where x= $e^u cosv$ *and* $y = e^u sinv$ then show that $x\frac{\partial z}{\partial v}$+y $\frac{\partial z}{\partial u}$=$e^{2u}\frac{\partial z}{\partial y}$.

8. If $u = \left(x^2 + y^2 + z^2\right)^{-1/2}$ then find the value of $u_{xx} + u_{yy} + u_{zz}$. **(Jan-18)**

9. If $u = f\left(\frac{y-x}{xy}, \frac{z-x}{xz}\right)$ *find* $x^2\frac{\partial u}{\partial x} + y^2\frac{\partial u}{\partial y} + z^2\frac{\partial u}{\partial z}$. **(Nov-18)**

10. If $u = f(2x - 3y, 3y - 4z, 4z - 2x)$ then find $\frac{1}{2}\frac{\partial u}{\partial x} + \frac{1}{3}\frac{\partial u}{\partial y} + \frac{1}{4}\frac{\partial u}{\partial z}$ **(Apr19)**

Maxima and minima

11. Find the Maximum and Minimum of $f(x, y) = x^2 - xy + y^2 - 2x + y.$
12. Find the Maximum and Minimum of $f(x, y) = x^3 + y^3 - 3x - 12y + 20.$
13. Find the Maximum and Minimum of $f(x, y) = x^4 + y^4 - 2x^2 + 4xy - 2y^2$. **(Nov-18)**
14. Examine $f(x, y) = x^3 - 15y^2 - 15x^2 + 3xy^2 + 72x$ for extreme values. **(Apr19)**

Jacobian

15. *If* $y_1 = \frac{x_2 x_3}{x_1}$, $y_2 = \frac{x_3 x_1}{x_2}$, $y_3 = \frac{x_1 x_2}{x_3}$ *then find* $\frac{\partial(y_1, y_2, y_3)}{\partial(x_1, x_2, x_3)}$.

16. If $x + y + z = u, y + z = uv, z = uvw$, prove that $\frac{\partial(x,y,z)}{\partial(u,v,w)} = u^2 v.$

17. Find the maximum and minimum values of $f(x, y) = 3x^2 - y^2 + x^3$. **(Jan-18)**

Lagrange's multiplier method

18. A rectangular box open at the top is to have a volume of 32cc. Find the dimensions of the box requiring, the least material for the construction.

19. The temperature at any point (x, y, z) in space is $T = 400xyz^2$. Find the highest temperature on the surface of the unit sphere $x^2 + y^2 + z^2 = 1$.

20. Find the shortest and the longest distances from the point (1,2,-1) to the spher $x^2 + y^2 + z^2 = 24$. **(Apr19)**

21. Find the dimensions of the rectangular box without a top of maximum capacity, whose surface area is 108 sq. cm. **(Jan-18)**

22. Find the volume of the greatest rectangular parallelepiped that can be Inscribed in the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$, using Lagrange's method.

23. Find the shortest distances from the point $(1, 2, 0)$ to the cone $x^2 + y^2 = z^2$. **(Nov-18)**

Taylor's series method

24. Expand $f(x, y) = e^x \cos y \ \ at \ \left(0, \frac{\pi}{2}\right)$ upto 3rd term using Taylor's series.

25. Obtain the Taylor's series expansion of $x^3 + y^3 + xy^2$ in terms of power of (x-1) and (y-2) upto third degree terms. **(Jan-18)**

26. Find the taylor's series of function $f(x) = \sqrt{1 + x + y^2}$ in powers $(x - 1)$ $and\ y$ upto second degree terms. **(Nov-18)**

27. Expand Taylor's series expansion of $x^2y^2 + 2x^2y + 3xy^2$ in terms of power of $(x + 2)$ and $(y - 1)$ upto third degree terms. **(Apr19)**

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UNIT-4 INTEGRAL CALCULUS

PART – A

1. Find the derivative of $g(x) = \int_0^x \sqrt{1+t^2}\,dt$.
2. Find the derivative of $g(x) = \int_a^x (t^3+1)dt$.
3. Evaluate $\int_{-1}^{2}(x^3-2x)dx$ using Fundamental theorem of calculus.
4. Evaluate $\int_1^4 (5-2t+3t^2)dt$ using Fundamental theorem of calculus.
5. Evaluate $\int e^{x^3}x^2dx$.
6. Evaluate $\int e^{cosx}sinxdx$.
7. Evaluate $\int xsinxdx$.
8. Evaluate $\int te^t dt$.
9. Write down reduction formula of $\int_0^{\frac{\pi}{2}} \sin^n x\ dx$.
10. Evaluate the improper integral $\int_0^\infty \frac{1}{x}dx$.
11. Evaluate $\int \cos^2 x\,dx$.
12. Evaluate $\int \frac{1}{\sqrt{a^2-x^2}}\ dx$.
13. What is wrong with the equation $\int_{-1}^{2}\frac{4}{x^3}dx = \left[\frac{-2}{x^2}\right]_{-1}^{2} = \frac{3}{2}$? **(Jan-18)**
14. Evaluate $\int_4^\infty \frac{1}{\sqrt{x}}dx$ and determine whether it is convergent or divergent. **(Jan-18)**
15. Use the properties of integrals to evaluate $\int_0^4 (4+3x^2)dx$.
16. Write the substitution rule and solve $\int \frac{x}{\sqrt{1-4x^2}}dx$.

17. Determine whether $\int_0^{\pi/2} \mathbf{secxdx}$ converges or diverges.

18. Define improper integral for discontinuous integrands.

19. Determine whether the integral $\int_1^{\infty} \frac{1}{x^2}\,dx$ is convergent or divergent.

20. Evaluate $\int \frac{1}{x\sqrt{x+9}}\,dx$.

21. State the fundamental theorem of calculus. **(Nov18)**

22. If f is continuous and $\int_0^4 f(x)dx = 10$, find $\int_0^2 f(2x)dx$ **(Nov18)**

23. Evaluate $\int \frac{1}{1+tanx}dx.$ limits **0 to** $\frac{\pi}{2}$ **(Apr19)**

24. Evaluate $\int_3^{\infty} \frac{dx}{(x-2)^{\frac{3}{2}}}$ and determione whether it is convergent or divergent. **(Apr19)**

PART – B

Definite integrals

25. Evaluate $\int_0^3 (x^2 - 2x)dx$ by using Riemann sum by taking right end points as the sample points.

26. Prove that $\int_a^b x dx = \frac{b^2-a^2}{2}$ by using Riemann sum by taking right end points as the sample points.

Indefinite integrals

27. Evaluate $\int \frac{\tan x}{\sec x + \cos x}\,dx.$ **(Jan-18)**

28. Evaluate $\int_0^{\frac{\pi}{2}} \frac{sinx\, cosx}{cos^2x+3cosx+2}\,dx$ **(Apr19)**

29.Evaluate $\int_0^{\pi/2} \cos^5 x dx$. **(Jan-18)**

30. Evaluate the integrals 1) $\int x^3 \cos(x^4 + 2)dx$ 2) $\int_1^2 \frac{1}{(3-5x)^2}dx$

31. Evaluate $\int_0^{\frac{\pi}{4}} x\, tan^2\, x\, dx$ **(Apr19)**

Substitution methods

32. Find $\int \sin^n x\, dx$ using reduction formula and evaluate $\int_0^{\frac{\pi}{2}} \sin^n x\, dx.$ **(Nov18)**

33. Evaluate $\int e^{ax} \cos bx dx.$ using integration by parts. **(Jan-18)**

34. Evaluate $\int e^{-ax} sinbx\, dx$ $(a > 0)$ using integration by parts. **(Apr19)**

35. Evaluate $\int (log\, x)^2\, dx$ using integration by parts

36. Evaluate $\int e^x sinxdx.$

37. Evaluate $\int \tan^{-1} x\, dx$.Also find $\int_0^1 \tan^{-1} x\, dx$

38. Evaluate $\int e^{\tan^{-1} x}\left(\frac{1+x+x^2}{1+x^2}\right) dx$.

39. Evaluate $\int \frac{(\log x)^2}{x^2} dx$ using integration by parts. **(Nov18)**

40. Evaluate $\int \tan^{-1} x\, dx$. Also find $\int_0^1 \tan^{-1} x\, dx$.

Improper integrals

41. For what values of 'p' is the integral $\int_1^{\infty} \frac{1}{x^p} dx$ convergent? **(Nov18)**

42. Determine whether the integral $\int_1^{\infty} \frac{\log x}{x^2} dx$ is convergent or divergent.

Partial fraction method

43. Evaluate $\int \frac{10}{(x-1)(x^2+9)} dx$.

44. Evaluate $\int \frac{x^4-2x^2+4x+1}{x^3-x^2-x+1} dx$.

45. Evaluate $\int \frac{x^2+x+1}{(x-1)^2(x-2)} dx$,by using partial fraction.

Integral of the form

46. Evaluate $\int (3x-2)\sqrt{x^2+x+1}\, dx$

47. Evaluate $\int_{\frac{\sqrt{2}}{3}}^{\frac{2}{3}} \frac{1}{x^5\sqrt{9x^2-1}} dx$ **(Nov18)**

48. Evaluate $\int \frac{x}{\sqrt{x^2+x+1}} dx$. **(Jan-18)**

49. Evaluate $\int \frac{2x+5}{\sqrt{x^2-2x+10}} dx$ **(Apr19)**

ST.ANNE'S

COLLEGE OF ENGINEERING AND TECHNOLOGY

(An ISO 9001:2015 Certified Institution)

Anguchettypalayam, Panruti – 607106.

QUESTION BANK

PERIOD: AUG - DEC 2021 **BATCH**: 2021 – 2025

BRANCH: COMMON **YEAR/SEM:** I/01

SUB CODE/NAME: MA3151 - MATRICES AND CALCULUS

UNIT -5 MULTIPLE INTEGRAL

PART – A

1.Sketch the region of integration of the of the integral $\int_0^1 \int_0^x f(x,y)dydx$ and change the order of integration.

2. Sketch the region of integration of the of the integral $\int_0^\infty \int_0^y ye^{-y^2/x}\, dxdy$ and change the order of integration.

3. Evaluate integral $\int_0^1 \int_1^2 x(x+y)\, dydx$.

4. Evaluate integral $\int_0^{\frac{\pi}{2}} \int_0^{sin\theta} r\, d\theta dr$.

5. Evaluate integral $\int_0^\pi \int_0^a r\, d\theta dr$.

6. Evaluate integral $\int_1^2 \int_1^3 \frac{dxdy}{xy}$.

7. Evaluate the triple integral $\int_0^1 \int_0^2 \int_0^3 e^{x+y+z} dzdxdy$.

8. Evaluate the triple integral $\int_0^\pi \int_0^{\frac{\pi}{2}} \int_0^1 r^2 sin\theta dr d\theta d\varphi$.

9. Change the order of integration in $\int_0^1 \int_{x^2}^{2-x} f(x,y)dydx$.

10. Evaluate the triple integral $\int_0^1 \int_0^y \int_0^{x+y} dzdxdy$.

11. Find the value of $\int_0^\infty \int_0^y \left(\frac{e^{-y}}{y}\right) dxdy$ **(Jan-18)**

12. Find the limits of the integration in the double integral $\iint_R f(x,y)dxdy$ where R is in the first quadrant and bounded by x=1, y=0, $y^2=4x$. **(Jan-18)**

13. Evaluate $\int_0^3 \int_0^2 e^{x+y} dydx$

14. Find the area bounded by the lines x= 0, y =1 and y = x using double integration.

15. Sketch the region of integration in $\int_0^1 \int_0^x dxdy$

16. Transform into polar co-ordinates the integral $\int_0^a \int_y^a f(x, y)dxdy$.

17. Transform into polar co-ordinates the integral $\int_0^\infty \int_0^\infty f(x, y)dydx$

18. Write down the double integral to find area between the circles $r = 2\sin\theta$ and $r = 4\sin\theta$

19. Evaluate $\int_0^a \int_0^b (x+y)dxdy$

20. Evaluate $\int_0^4 \int_0^{x^2} e^{y/x} dydx$

21. Evaluate $\int_1^{log8} \int_0^{logy} e^{x+y} \, dx \, dy$ **(Nov18)**

22. Change the order of integration in $\int_0^1 \int_{y^2}^{y} f(x,y) \, dxdy$ **(Nov18)**

23. Evaluate $\int_1^a \int_2^b \frac{1}{xy} \, dxdy$ **(Apr19)**

24. Find the limits of integraton $\iint f(x,y) \, dxdy$ bounded by $x = 0, y = 0, x + y = 2$ **(Apr19)**

PART – B

Double Integrals

1. Evaluate $\iint xydxdy$ over the region in the positive quadrant bounded by $\frac{x}{a} + \frac{y}{b} = 1$ **(Apr19)**
2. Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx\,dy$ using polar coordinates

Change of Order of Integration

3. Evaluate integral $\int_0^1 \int_y^{2-y} xy \, dxdy$ by changing the order of integration.

4. Evaluate integral $\int_0^a \int_0^{2\sqrt{ax}} x^2 dydx$ by changing the order of integration. **(Jan-18)**

5. Evaluate integral $\int_0^\infty \int_x^\infty \frac{e^{-y}}{y} \, dydx$ by changing the order of integration **(Apr19)**

6. By changing the order of integration, evaluate $\int_0^1 \int_y^1 \frac{x}{x^2 + y^2} dxdy$

7. Change the order of integration in the integral $\int_0^1 \int_{x^2}^{2-x} xy\,dx\,dy$

Area as Double Integral

8. Find the area which is inside the circle $r = a\sin\theta$ but lying outside the cardioids $r = a(1-\cos\theta)$

9. Find by double integral, the area enclosed by the curves $y^2 = 4ax$ and $x^2 = 4ay$

10. Find the area of the Ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

11. Find the area which is inside the circle $r = a\sin\theta$ but lying outside the cardioids $r = a(1-\cos\theta)$

12. Find by double integral, the area enclosed by the curves y=x and y=x^2 **(Jan-18)**

13. Evaluate $\iint xy(x+y)dxdy$ over area between y=x and y=x^2 **(Nov18)**

14. Find the area bounded by the parabolas $y^2 = 4 - x$ and $y^2 = x$ **(Nov18)**

Triple Integration

15. Evaluate $\iiint x^2 yz\, dx\, dy\, dz$ taken over the tetrahedron bounded by the planes x=0,y=0,z=0 and $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$

16. Evaluate $\iiint_V \frac{1}{(x+y+z+1)^3} dx\, dy\, dz$ where V is the region bounded by $x=0, y=0, z=0, x+y+z=1$.

17. Evaluate $\iiint xyzdxdydz$ over the first octant of $x^2+y^2+z^2=a^2$ **(Jan-18)**

18.Evaluate $\int_0^{\log 2}\int_0^{x}\int_0^{x+\log y} e^{x+y+z}\, dz\, dy\, dx$

19. Evaluate $\iiint xyzdxdydz$ through the positive spherical octant for which $x^2+y^2+z^2 \le a^2$ **(Apr19)**

Change of Variables

20. Evaluate by changing into polar coordinates the integral $\int_0^a\int_y^a \frac{x}{x^2+y^2} dxdy$ **(Jan-18)**

21. Transform the integral into polar coordinates and hence evaluate $\int_0^a\int_0^{\sqrt{a^2-x^2}} \sqrt{x^2+y^2}\, dy\, dx$

22. Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)}\, dxdy$ by changing to polar co-ordinates and hence

find the value of $\int_0^\infty e^{-x^2} dx$.

23. Express $\int_0^a\int_y^a \frac{x^2}{(x^2+y^2)^{\frac{3}{2}}} dxdy$ in polar coordinates and then evaluate it **(Nov18)**

24. Evaluate by changing into polar coordinates the integral $\int_0^a\int_y^a \frac{x}{\sqrt{x^2+y^2}} dxdy$ **(Apr19)**

Volume

25. Using triple integration, find the volume of the sphere $x^2+y^2+z^2=a^2$

26. Find the volume of the tetrahedron bounded by the plane $x+y+z=1$ and the coordinate plane.

27. Evaluate $\iiint dxdydz$ where V is the finite region of space bounded by the planes $x=0, y=0, z=0$ and $2x+3y+4z=12$.(tetrahedron) **(Nov18)**