SRM VALLIAMMAI ENGINEERING COLLEGE

(An Autonomous Institution)

S.R.M. Nagar, Kattankulathur - 603203

DEPARTMENT OF MATHEMATICS

QUESTION BANK

I SEMESTER

(COMMON TO ALL BRANCHES)

1918102 - ENGINEERING MATHEMATICS-I

Regulation – 2019

Academic Year – 2022 - 2023

Prepared by

Ms. A. Karpagam,Assistant Professor / Mathematics

Ms. B. Vasuki,Assistant Professor / Mathematics

Mr.D.Captain Prabakaran, Assistant Professor / Mathematics

SRM VALLIAMMAI ENGNIEERING COLLEGE

(An Autonomous Institution)

SRM Nagar, Kattankulathur – 603203.

DEPARTMENT OF MATHEMATICS

SUBJECT : 1918102-Engineering Mathematics –I

SEM / YEAR: I / I year B.E./ B.Tech.

(Common to all Branches)

UNIT I - MATRICES

System of Equations – Consistency and inconsistency - Eigen values and Eigenvectors of a real matrix – Characteristic equation – Properties of Eigen values and Eigenvectors – Statement and application Cayley-Hamilton theorem– Reduction of a quadratic form tocanonical form by orthogonal transformation.

Q.No.	Question	BT Level	Competence
	PART – A		
1.	Examine the consistency of the equations $x + y = 3$, $2x + 3y = 7$.	BTL-5	Evaluating
2.	Examine the consistency of the equations $x + y = 2$, $x + 2y = 3$.	BTL-5	Evaluating
3.	Find the characteristic equation of A=$\begin{pmatrix} 1 & -2 \\ -5 & 4 \end{pmatrix}$	BTL-1	Remembering
4.	If the eigen values of the matrix A of order 3X3 are 2,3 and 1, then find the determinant of A	BTL-2	Understanding
5.	Prove that sum of eigen values of a matrix is equal to its trace.	BTL-3	Applying
6	Find the sum of the eigen values of 2A, if A= $\begin{pmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{pmatrix}$	BTL-3	Applying
7.	Find the sum and product of the eigen values of A= $\begin{pmatrix} 2 & -2 & 2 \\ -2 & -1 & -1 \\ 2 & -1 & -1 \end{pmatrix}$	BTL-1	Remembering
8	Find the constants a and b such that the matrix $\begin{pmatrix} a & 4 \\ 1 & b \end{pmatrix}$ has 3,-2 be the eigen values of A	BTL-4	Analyzing
9.	Write any 2 applications of Cayley Hamilton theorem	BTL-2	Understanding
10	If A=$\begin{pmatrix} 1 & 0 \\ 4 & 5 \end{pmatrix}$ find A^3 using Cayley Hamilton theorem	BTL-2	Understanding
11.	Find the quadratic form corresponding to the matrix A= $\begin{pmatrix} 2 & 2 & 0 \\ 2 & 5 & 0 \\ 0 & 0 & 3 \end{pmatrix}$	BTL-5	Evaluating
12.	Define Index, Signature and Rank.	BTL-2	Understanding
13.	Find the eigen values of A^{-1} if A=$\begin{pmatrix} 4 & 1 \\ 3 & 2 \end{pmatrix}$	BTL-1	Remembering
14.	If the sum of 2 eigen values and the trace of a 3×3 matrix are	BTL-1	Remembering

	equal, find the value of $\|A\|$		
15.	Prove that the eigen values of A^{-1} are $\frac{1}{\lambda_1}, \frac{1}{\lambda_2}, \frac{1}{\lambda_3}$……..$\frac{1}{\lambda_n}$	BTL-3	Applying
16.	The product of the 2 eigen values of A= $\begin{pmatrix} 6 & -2 & 2 \\ -3 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix}$ is 14. Find the 3rd eigen value.	BTL-1	Remembering
17.	Find the sum and product of the eigen values of A= $\begin{pmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{pmatrix}$	BTL-1	Remembering
18.	State Cayley-Hamilton theorem.	BTL-2	Understanding
19.	Use Cayley Hamilton theorem to find A^{-1} if A=$\begin{pmatrix} 2 & 1 \\ 1 & -5 \end{pmatrix}$	BTL-2	Understanding
20.	Find the matrix corresponding to the quadratic form 2xy-2yz+2xz.	BTL-4	Analyzing
21.	Find the matrix corresponding to the quadratic form $x^2+y^2+z^2$	BTL-5	Evaluating
22.	Two eigen values of A= $\begin{pmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{pmatrix}$ are equal to unity each. Find the 3rd eigen value.	BTL-1	Remembering
23.	For the given matrix A of order 3,|A|=32, and two eigen values are 8 & 2. Find the sum of the Eigenvalues.	BTL -3	Applying
24.	Find the Rank,Index,Signature and Nature of given matrix A= $\begin{pmatrix} 3 & -1 & 4 \\ 0 & 5 & 2 \\ 0 & 0 & -1 \end{pmatrix}$	BTL-1	Remembering
25.	If the characteristic equation of a matrix is $\lambda^2 - 3\lambda - 10 = 0$,then find the the eigen values of the matrix $10A^{-1} - 2I$.	BTL-4	Analyzing
	PART – B		
1.	Investigate for the value of λ,μ the system of equations $x + y + z = 6, x + 2y + 3z = 10, x + 2y + \lambda z = \mu$ have (i) Unique solution, (ii) Infinitely many solution, (iii) No solution	BTL-6	Creating
2.(a)	Find the eigen values and eigen vectors of the matrix A= $\begin{pmatrix} 1 & 0 & -1 \\ 1 & 2 & 1 \\ 2 & 2 & 3 \end{pmatrix}$	BTL-2	Understanding
2.(b)	Examine the consistency of the equations $x + y + z = 3$, $2x - y + 3z = 4, 5x - y + 7z = 11$.	BTL-5	Evaluating
3.	Test for the consistency of the following system of equations and solve them, if consistent $3x + y + z = 8$, $-x + y - 2z = -5, x + y + z = 6, -2x + 2y - 3z = -7$	BTL-5	Evaluating
4.(a)	Find the eigen values and eigen vectors of the matrix A= $\begin{pmatrix} 5 & 0 & 1 \\ 0 & -2 & 0 \\ 1 & 0 & 5 \end{pmatrix}$	BTL-2	Understanding
4.(b)	Find the Characteristic equation of the matrix	BTL-4	Analyzing

	A= $\begin{pmatrix} 2 & -1 & 2 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{pmatrix}$ and hence find A^{4}.		
5.	Verify Cayley-Hamilton theorem and hence find A^{-1} of A= $\begin{pmatrix} 1 & 0 & 3 \\ 2 & 1 & -1 \\ 1 & -1 & 1 \end{pmatrix}$	BTL-1	Remembering
6.(a)	Obtain the eigen values and eigen values and eigen vectors of the matrix A= $\begin{pmatrix} 3 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 3 \end{pmatrix}$.	BTL-4	Analyzing
6.(b)	Find the eigen values and eigen vectors of the matrix A= $\begin{pmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{pmatrix}$	BTL-2	Understanding
7.	For the value of μ the system of equations $x + y + 3z = 0$, $4x + 3y + \mu z = 0, 2x + y + 2z = 0$ have a (i)Trivial solution, (ii) Non-trivial solution.	BTL-6	Creating
8.(a)	Find the eigen values and eigen vectors of the matrix A= $\begin{pmatrix} 1 & 1 & -2 \\ -1 & 2 & 1 \\ 0 & 1 & -1 \end{pmatrix}$	BTL-2	Understanding
8.(b)	Verify Cayley-Hamilton theorem for the matrix A= $\begin{pmatrix} 1 & -2 & 3 \\ 2 & 4 & -2 \\ -1 & 1 & 2 \end{pmatrix}$.	BTL -4	Analyzing
9.			
10.	Verify Cayley-Hamilton theorem for the matrix A= $\begin{pmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{pmatrix}$ and also find A^{-1}.	BTL-4	Analyzing
11.	Reduce the quadratic form $8x^2 + 7y^2 + 3z^2 - 12xy + 4xz - 8yz$ into canonical form by orthogonal reduction.	BTL-5	Evaluating
12.	Use Cayley-Hamilton theorem to find the value of the matrix given by A^{8}-5A^{7}+7A^{6}-3A^{5}+A^{4}-5A^{3}+8A^{2}-2A+I if the matrix $A = \begin{pmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{pmatrix}$	BTL -3	Applying
13.	Reduce the quadratic form $6{x_1}^2 + 3{x_2}^2 + 3{x_3}^2 - 4x_1x_2 - 2x_2x_3 + 4x_3x_1$ into canonical form by an orthogonal reduction.	BTL-2	Understanding
14.(a)	Find the eigen values and eigen vectors of the matrix A= $\begin{pmatrix} 1 & -1 & 4 \\ 3 & 2 & -1 \\ 2 & 1 & -1 \end{pmatrix}$	BTL-2	Understanding
14.(b)	Using Cayley-Hamilton theorem evaluate the matrix A^{4}+A^{3}-18A^{2}-39A+2I given the matrix $A = \begin{pmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & -1 \end{pmatrix}$	BTL -3	Applying

15.	Reduce the quadratic form $2{x_1}^2 + {x_2}^2 + {x_3}^2 + 2x_1x_2 - 2x_1x_3 - 4x_2x_3$ into canonical form by an orthogonal reduction.	BTL-1	Remembering
16.	Determine the nature of the quadratic form $2xy - 2yz + 2xz$ by reducing it into canonical form by orthogonal transformation	BTL -4	Analyzing
17.	Reduce the quadratic form $2{x_1}^2 + 5{x_2}^2 + 3{x_3}^2 + 4x_1x_2$ into canonical form by an orthogonal reduction.	BTL-1	Remembering
18.	Diagonalize the matrix A= $\begin{pmatrix} 1 & 0 & 0 \\ 0 & 3 & -1 \\ 0 & -1 & 3 \end{pmatrix}$ using an orthogonal transformation.	BTL -3	Applying
	PART – C		
1.	Verify Cayley-Hamilton theorem and hence find A^{-1} & A^4 of A= $\begin{pmatrix} 2 & 0 & -1 \\ 0 & 2 & 0 \\ -1 & 0 & 2 \end{pmatrix}$	BTL-6	Creating
2.	Diagonalize the matrix A= $\begin{pmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{pmatrix}$ using an orthogonal transformation.	BTL-6	Creating
3.	Determine the nature of the quadratic form $10{x_1}^2 + 2{x_2}^2 + 5{x_3}^2 - 4x_1x_2 + 6x_2x_3 - 10x_1x_3$ by reducing it into canonical form by orthogonal transformation and hence find rank,index,signature,nature.	BTL-6	Creating
4.	Determine the nature of the quadratic form $2x^2 + 5y^2 + 3z^2 + 4xy$ by reducing it into canonical form by orthogonal transformation and hence find rank,index,signature,nature.	BTL-6	Creating
5.	The Eigen vectors of a $3X3$ real symmetric matrix A corresponding to the eigen values 1,2,4 are $(1, 0, 0)^T, (0, 1, 1)^T, (0, 1, -1)^T$ respectively. Find the matrix A.	BTL-6	Creating

UNIT II DIFFERENTIAL CALCULUS

Limit of a function - Continuity – Differentiability - Differentiation rules – Roll's Theorem and Mean Value Theorem – Taylor's Series - Maxima and Minima of functions of one variable

Q.No.	Question	BT Level	Competence
	PART – A		
1.	Find the domain of a function $y = \sqrt{x+4}$	BTL -1	Remembering
2.	Find $\lim_{x\to 0} \frac{\tan x - x}{x^3}$.	BTL -1	Remembering
3.	Evaluate $\lim_{t\to 1} \frac{t^4-1}{t^3-1}$	BTL -1	Remembering
4.	Check whether $\lim_{x\to -3} \frac{3x+9}{\lvert x+3\rvert}$ exist	BTL -2	Understanding
5.	Show that$\lim_{x\to 0} x^2 \sin\left(\frac{1}{x}\right) = 0$ using Squeeze theorem	BTL -3	Applying
6	Predict the values of a and b so that the function f given by	BTL -3	Applying

	$f(x)=\begin{cases}1 & if\ x\le 3\\ ax+b & if\ 3<x<5\\ 7 & if\ x\ge 5\end{cases}$ is continuous at x=3 and x=5.		
7.	If the function $f(x)=\begin{cases}\frac{x^2-16}{x-4} & if\ x\neq 4\\ c & if\ x=4\end{cases}$ is continuous, what is the value of c?	BTL -2	Understanding
8.	If $f(x)=xe^x$ find $f'(x)$	BTL -2	Understanding
9.	Point out $\frac{dy}{dx}$, $if\ y=\ln\lvert\cos(\ln x)\rvert$.	BTL -3	Applying
10	Calculate $\frac{d}{dx}\left((x)^{\sqrt{x}}\right)$	BTL -2	Understanding
11.	Compute $\frac{d}{dx}\left((x)^{sinx}\right)$	BTL -4	Analyzing
12.	Evaluate $\frac{d}{dx}\left((sinx)^{\ln x}\right)$	BTL -3	Applying
13.	Estimate $\frac{d}{dx}\left((sinx)^{cosx}\right)$	BTL -4	Analyzing
14.	Evaluate $\frac{d}{dx}(sinhx)$	BTL -4	Analyzing
15.	Estimate $\frac{d}{dx}(cosh^{-1}x)$	BTL -3	Applying
16.	Estimate y' if $x^3+y^3=6xy$	BTL -2	Understanding
17.	Using Rolle's theorem find the value of c for the function $f(x)=\sqrt{1-x^2}, -1\le x\le 1$	BTL -4	Analyzing
18.	Verify Lagrange's law for the function $f(x)=\frac{1}{x}$, [1,2]	BTL -1	Remembering
19.	Using Rolle's theorem find the value of c for the function $f(x)=(x-a)(b-x), a\le x\le b, a\neq b$	BTL -4	Analyzing
20.	Verify Lagrange's law for the function $f(x)=x^3, [-2,2]$	BTL -2	Understanding
21.	Find the Taylor's series expansion of the function $f(x)=sinx$ about the point $x=\frac{\pi}{2}$	BTL -4	Analyzing
22.	Find the critical points of $y=5x^3-6x$	BTL -2	Understanding
23.	Find the critical numbers of the function $f(x)=2x^3-3x^2-36x$	BTL -4	Analyzing
24.	Find the critical points of $y=5x^2-6x$	BTL -3	Applying
25.	Does the curve $y=x^4-2x^2+2$ have any horizontal tangents? If so where?	BTL -4	Analyzing
	PART – B		
1.(a)	Point out the domain where the function f is continuous Also find the number at which the function f is discontinuous when $f(x)=\begin{cases}1+x^2 & if\ x\le 0\\ 2-x & if\ 0<x\le 2\\ (x-2)^2 & if\ x>2\end{cases}$	BTL -4	Analyzing
1.(b)	Find $\frac{dy}{dx}$ $if\ y=x^2e^{2x}(x^2+1)^4$.	BTL -3	Applying
2.(a)	For what value of the constant "c" is the function "f" continuous on $(-\infty,\infty)$, $f(x)=\begin{cases}cx^2+2x; x<2\\ x^3-cx; x\ge 2\end{cases}$	BTL -4	Analyzing
2.(b)	Obtain y'' $if\ x^4+y^4=16$	BTL -5	Evaluating
3.(a)	Find $y'$for $cos(xy)=1+siny$.	BTL -3	Applying

3.(b)	Find the derivative of $f(x) = \cos^{-1}\left(\frac{b+a\cos x}{a+b\cos x}\right)$	BTL -5	Evaluating
4.(a)	Find the values of a and b that make f continuous on $(-\infty, \infty)$ $f(x) = \begin{cases} \frac{x^3-8}{x-2} & if\ x < 2 \\ ax^2 - bx + 3 & if\ 2 \le x < 3 \\ 2x - a + b & if \quad x \ge 3 \end{cases}$	BTL -3	Applying
4.(b)	Find y'if $x = a\left(cos\theta + \log \tan\frac{\theta}{2}\right), y = a\ sin\theta.$	BTL -3	Applying
5. (a)	For what value of the constant b, is the function f continuous on $(-\infty, \infty)$ if f(x) = $\begin{cases} bx^2 + 2x & if\ x < 2 \\ x^3 - bx & if\ x \ge 2 \end{cases}$	BTL -3	Applying
5.(b)	Find $\frac{dy}{dx}$,when $y = tan^{-1}\left(\frac{a\ cosx + b\ sinx}{b\ cosx - a\ sinx}\right)$	BTL -5	Evaluating
6.(a)	Find $\frac{dy}{dx}$ for the following functions $e^x + e^y = e^{x+y}$.	BTL -3	Applying
6.(b)	Verify Rolle's theorem for the following $f(x) = 2x^3 - 5x^2 - 4x + 3, x \in \left[\frac{1}{2}, 3\right]$.	BTL -3	Applying
7.	For the function f(x) =2+$2x^2 - x^4$, find the intervals of increase or decrease, local maximum and minimum values, the intervals of concavity and the inflection points.	BTL -1	Remembering
8.(a)	Find the absolute maximum and minimum of f(x)= $x - 2\tan^{-1}x \quad in\ [0,4]$.	BTL -4	Analyzing
8.(b)	Verify Lagrange's law for the following $f(x) = 2x^3 + x^2 - x - 1, x \in [0,2]$.	BTL -3	Applying
9.	Find where the function $f(x) = 3x^4 - 4x^3 - 12x^2 + 5$ is increasing and where it is decreasing. Also find the local maximum, local minimum, concavity and the inflection points of f(x).	BTL -5	Evaluating
10.(a)	Verify Lagrange's law for the following $f(x) = 2x^2 - 4x - 3, x \in [1,4]$.	BTL -6	Creating
10.(b)	Find the tangent line to the equation $x^3 + y^3 = 6xy$ at the point (3,3) and at what point the tangent line is horizontal in the first quadrant	BTL -3	Applying
11.	If $f(x) = 2x^3 + 3x^2 - 36x$, find the intervals on which it is increasing or decreasing, local maximum , local minimum values , concavity and the inflection points of $f(x)$.	BTL -4	Analyzing
12.(a)	Verify mean value theorem for the following $f(x) = x^3 - 5x^2 - 3x, x \in [1,3]$.	BTL -3	Applying
12.(b)	Find the Taylor's series expansion of $f(x) = \frac{1}{1+x}$ about x=0.	BTL -3	Applying
13.	Discuss the curve $y = x^4 - 4x^3$find the intervals on which it is increasing or decreasing, local maximum , local minimum values , concavity and the inflection points of $f(x)$.	BTL -4	Analyzing
14.(a)	Verify Rolle's theorem for the following function	BTL -3	Applying

	$f(x) = sinx, 0 \leq x \leq \boldsymbol{\pi}$		
14.(b)	Find the Taylor's series expansion of $f(x) = tan^{-1}x$ about $x = 0$.	BTL -3	Applying
15.	Use second derivative test to examine the relative maxima for $f(x) = x(12 - 2x)^2$	BTL -4	Analyzing
16.(a)	Examine the local extreme of $f(x) = x^4 + 2x^3 - 3x^2 - 4x + 4$. Also discuss the concavity and find the inflection points	BTL -4	Analyzing
16.(b)	Verify Rolle's theorem for the following $f(x) = x(x-1)(x-2), x \in [0,2]$.	BTL -3	Applying
17.	Find the local maximum and minimum values of $f(x) = \sqrt{x} - \sqrt[4]{x}$ using both first and second derivatives tests.	BTL -4	Analyzing
18.(a)	Of all the right circular cones of given slant length l, find the dimensions and volume of the cone of maximum volume.	BTL -3	Applying
18.(b)	Find the maxima and minima of the function $2x^3 - 3x^2 - 36x + 10$	BTL -3	Applying
	PART – C		
1.	Find the point on the parabola $y^2 = 2x$ that is close to the point (1,4)	BTL -4	Analyzing
2.	Find the equation of tangent at a point (a, b) to the curve $xy = c^2$.	BTL -4	Analyzing
3.(a)	Apply Rolle's theorem to find points on curve $y = -1 + cosx$, where the tangents is parallel to x- axis in $0 \leq x \leq 2\pi$	BTL -2	Understanding
3.(b)	At what points on the curve $x^2 - y^2 = 2$, the slopes of tangents are equal to 2.	BTL -5	Evaluating
4.	A cylindrical hole 4mm in diameter and 12mm deep in a metal block is rebored to increase the diameter to 4.12mm. Estimate the amount of metal removed.	BTL -2	Understanding
5.	A normal window consists of a rectangle surmounted by a semi-circle. Given the perimeter of the window to be k, find its height and breadth, if the quantity of light admitted is to be maximum.	BTL -3	Applying

UNIT III -FUNCTIONS OF SEVERAL VARIABLES

Partial derivatives – Total derivative -Jacobians and properties - Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers

Q.No.	Question	BT Level	Competence
	PART – A		
1.	If $u = \frac{y}{z} + \frac{z}{x} + \frac{x}{y}, then\ find\ x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} + z\frac{\partial u}{\partial z}$.	BTL -1	Remembering
2.	Find $\frac{dy}{dx}$ if $x^3+y^3 = 3ax^2y$	BTL -1	Remembering
3.	If $x^y + y^x = 1$, then find $\frac{dy}{dx}$.	BTL -1	Remembering

4.	Find the value of $\frac{du}{dt}$, given u= log (x + y + z) , x= e^t, $y = sint, z = cost$	BTL -2	Understanding
5.	Find the value of $\frac{du}{dt}$, given $u = x^2 + y^2, x = at^2, y = 2at.$	BTL -3	Applying
6	If $u = x^3y^2 + x^2y^3 where\ x = at^2 and y = 2at, then\ find \frac{du}{dt}$.	BTL -3	Applying
7.	Find $\frac{du}{dt} if u = sin\left(\frac{x}{y}\right), where x = e^t, y = t^2$	BTL -2	Understanding
8	Find $\frac{du}{dt} if u = \frac{x}{y}, where x = e^t, y = log\ t.$	BTL -2	Understanding
9.	Find $\frac{\partial r}{\partial x}, if x = r\ cos\ \theta\ \&\ y = r\ sin\ \theta.$	BTL -3	Applying
10	Find the Jacobian$\frac{\partial(u,v)}{\partial(r,\theta)}, if x = r\ cos\ \theta\ \&y = r\ sin\ \theta,$ $u = 2xy, v = x^2 - y^2$without actual substitution.	BTL -2	Understanding
11.	If $u = \frac{y^2}{2x} and v = \frac{x^2+y^2}{2x}, find\ \frac{\partial(u,v)}{\partial(x,y)}$.	BTL -4	Analyzing
12.	If$x = uv, y = \frac{u}{v}. Find\ \frac{\partial(x,y)}{\partial(u,v)}$.	BTL -3	Applying
13.	If $x = u^2 - v^2, y = 2uv$ find the Jacobian of x, y with respect to u and v	BTL -4	Analyzing
14.	If u = $\frac{x+y}{1-xy} and\ v = tan^{-1}x + tan^{-1}y, find\ \frac{\partial(u,v)}{\partial(x,y)}$	BTL -2	Understanding
15.	Find the Taylor series expansion of x^ynear the point $(1, 1)$ up to first term	BTL -4	Analyzing
16.	Expand$xy + 2x - 3y + 2in\ powers\ of\ (x - 1)\&(y + 2)$, using Taylor's theorem up to first degree form	BTL -1	Remembering
17.	Find the Stationary points of $f(x, y) = x^3 + 3xy^2 - 15x^2 - 15y^2 + 72x.$	BTL -4	Analyzing
18.	Find the Stationary points of $x^2 - xy + y^2 - 2x + y.$	BTL -2	Understanding
19.	State the necessary and sufficient condition for$f(x, y)$to have a relative maximum at a point (a,b).	BTL -4	Analyzing
20.	Find the minimum point of $f(x, y) = x^2 + y^2 + 6x + 12.$	BTL -3	Applying
21.	If u = x+y , y =uv then find $\frac{\partial(x,y)}{\partial(u,v)}$	BTL -2	Understanding
22.	Find the nature of the stationary point (1,1) of the function f(x,y) if f_{yy}= $6x^3$y, f_{xx}= $6y^3$x, f_{xy}= $9x^2$y	BTL -4	Analyzing
23.	Find the minimum value of f = $x^2 + y^2$subject to the constraint x =1.	BTL -3	Applying
24.	If u = x^2+1, v = y^2 -2 then find $\frac{\partial(u,v)}{\partial(x,y)}$.	BTL -2	Understanding
25.	Find the stationary points of $f(x, y) = x^3 + y^3 - 3x - 12y + 20$	BTL -4	Analyzing
	PART – B		
1.	If u = log (x^2 + y^2) + $\tan^{-1}\left(\frac{y}{x}\right)$,then prove that u_{xx}+u_{yy} = 0	BTL -3	Applying
2.(a)	Find $\frac{du}{dx}$ if $u = cos(x^2 + y^2)$ and $a^2x^2 + b^2y^2 = c^2$	BTL -5	Evaluating
2.(b)	Find $\frac{\partial(x,y,z)}{\partial(r,\theta,\varphi)}$ if $x = rsin\theta cos\varphi, y = rsin\theta sin\varphi, z = rcos\theta$	BTL -5	Evaluating
3.	Find the shortest distance from the origin to the hyperbola	BTL -3	Applying

	$x^2 + 8xy + 7y^2 = 225$		
4.(a)	A flat circular plate is heated so that the temperature at any point (x, y) is $u(x, y) = x^2 + 2y^2 - x$.Find the coldest point on the plate	BTL -3	Applying
4.(b)	If$u = \frac{yz}{x}, v = \frac{zx}{y} and w = \frac{xy}{z}, find \frac{\partial(u,v,w)}{\partial(x,y,z)}$.	BTL -3	Applying
5.	If $u = f(x - y, y - z, z - x)$, $then\ show\ \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$	BTL -3	Applying
6.(a)	$If x + y + z = u, y + z = uv, z = uvw$, prove $\frac{\partial(x,y,z)}{\partial(u,v,w)} = u^2v$	BTL -3	Applying
6.(b)	Find the extreme values of$f(x, y) = x^3 + y^3 - 3x - 12y + 20$	BTL -3	Applying
7.	Expand $x^3y^2 + 2x^2y + 3xy^2$ in powers of (x+2) and (y-1) using Taylor's series up to third degree terms	BTL -1	Remembering
8.(a)	If u = log $(x^3 + y^3 + z^3 - 3xyz)$ $then\ prove\ that\ \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = \frac{3}{x+y+z}$	BTL -4	Analyzing
8.(b)	If u = log $(x^3 + y^3 + z^3 - 3xyz)$ $then\ prove\ that$ $\left(\frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z}\right)^2 = \frac{9}{(x+y+z)^2}$	BTL -3	Applying
9.	Discuss the extreme values of $f(x, y) = x^3y^2(1 - x - y)$.	BTL -5	Evaluating
10.(a)	Expand Taylor's series of $x^3 + y^3 + xy^2$ in powers of $(x - 1)$ and $(y - 2)$up to the second-degree terms	BTL -6	Creating
10.(b)	If $u = xyz, v = x^2 + y^2 + z^2\ and\ w = x + y + z$, find $\frac{\partial(x,y,z)}{\partial(u,v,w)}$	BTL -3	Applying
11.	Find the Taylors series expansion of $e^x\ siny$ at the point (-1, $\frac{\pi}{4}$) up to third degree terms	BTL -4	Analyzing
12.(a)	Expand $tan^{-1}\frac{y}{x}$in the neighborhood of (1, 1) as Taylor's series up to second degree terms	BTL -3	Applying
12.(b)	Find the Maximum value of $x^m y^n z^p when\ x + y + z = a$.	BTL -3	Applying
13.	Find the Taylors series expansion of $e^x\ siny$ at the point (1, $\frac{\pi}{4}$) up to third degree terms	BTL -4	Analyzing
14.(a)	Find the extreme value of $x^2 + y^2 + z^2$subject to the condition $x + y + z = 3a$.	BTL -3	Applying
14.(b)	Expand e^{xy}in powers of $(x - 1)$ and $(y - 1)$upto second degree terms by Taylor's series	BTL -3	Applying
15.	Find the shortest and longest distances from the point (1,2,-1) to the sphere $x^2 + y^2 + z^2 = 24$	BTL -4	Analyzing
16.(a)	Examine $f(x, y) = x^3 + 3xy^2 - 15x^2 + 72x$for extreme values	BTL -4	Analyzing
16.(b)	Expand $e^x\ log(1 + y)$in powers of $x\ \&\ y$ up to terms of third-	BTL -3	Applying

	degree using Taylor's series		
17.	Find the dimension of the rectangular box without a top of maximum capacity, whose surface area is 108 sq. cm.	BTL -4	Analyzing
18.(a)	$If u = x + y + z, u^2v = y + z\ , u^3w = z$, prove$\frac{\partial(u,v,w)}{\partial(x,y,z)} = \frac{1}{u^5}$	BTL -3	Applying
18.(b)	Find the minimum value of x^2yz^3 subject to 2x + y +3z = a.	BTL -3	Applying
	PART – C		
1.	Divide the number 24 into three parts such that the continued product of the first, square of the second and the cube of the third may be maximum	BTL -4	Analyzing
2.	The temperature at any point (x, y, z) in space is given by $T = kxyz^2$, where k is constant. Find the height temperature on the surface of the sphere $x^2 + y^2 + z^2 = a^2$	BTL -4	Analyzing
3.	A rectangular box open at the top is to have a volume 32cc. Find the dimensions of the box that requires the least for its construction.	BTL -2	Understanding
4.	Find the volume of the greatest rectangular parallelopiped that can be inscribed in the ellipsoid$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$.	BTL -2	Understanding
5.	In a plane triangle find the maximum value of CosA.cosB.cosC	BTL -3	Applying

UNIT IV -IV INTEGRAL CALCULUS

Definite and Indefinite integrals - Substitution rule - Techniques of Integration - Integration by parts, Trigonometric integrals, Trigonometric substitutions, Integration by partial fraction, - Improper integrals

Q.No.	Question	BT Level	Competence
	PART – A		
1.	Prove that the following integral by interpreting each in terms of areas $\int_a^b x dx = \frac{b^2-a^2}{2}$	BTL -1	Remembering
2.	State fundamental theorem of calculus	BTL -1	Remembering
3.	Evaluate$\int_0^1 \sqrt{1-x^2}dx$ interms of area.	BTL -1	Remembering
4.	If f is continuous and $\int_0^4 f(x)dx = 10,$ find $\int_0^2 f(2x)dx$	BTL -2	Understanding
5.	Evaluate $\int sin^3 x\, dx$	BTL -3	Applying
6	Calculate$\int \frac{x^3}{\sqrt{4+x^2}}$ dx	BTL -3	Applying
7.	Calculate $\int \sqrt{1+x^2}x^5 dx$	BTL -2	Understanding
8	Find $\int \sqrt{2x+1}\, dx$	BTL -2	Understanding
9.	Find $\int \frac{x}{\sqrt{1-4x^2}}$ dx	BTL -3	Applying
10	Evaluate $\int_0^1 \tan^{-1} x\ dx$	BTL -2	Understanding
11.	Calculate $\int \frac{(lnx)^2}{x} dx$	BTL -4	Analyzing
12.	Calculate $\int (\log x)^2\, dx$	BTL -3	Applying
13.	Evaluate $\int \frac{cos\sqrt{x}}{\sqrt{x}}\, dx$	BTL -4	Analyzing

14.	Evaluate $\int_0^{\frac{\pi}{2}} \frac{1}{1+tanx}\, dx$	BTL -2	Understanding
15.	Evaluate $\int_4^{\infty} \frac{1}{\sqrt{x}}\, dx$ and determine whether it is convergent or divergent.	BTL -4	Analyzing
16.	If f (1) = 12,f ´ is continuous and $\int_1^4 f'(x)\, dx = 17$, then find the value of f (4).	BTL -1	Remembering
17.	Estimate $\int_1^3 \sqrt{x^2+3}\, dx$	BTL -4	Analyzing
18.	Evaluate the improper integral $\int_2^3 \frac{dx}{\sqrt{3-x}}$, if possible.	BTL -2	Understanding
19.	Find $\int_2^5 \frac{dx}{\sqrt{x-2}}$	BTL -4	Analyzing
20.	Prove that $\int_1^{\infty} \frac{1}{x}$ dx is divergent.	BTL -3	Applying
21.	Find $\int \sqrt{1+\sin 2x}$ dx	BTL -2	Understanding
22.	Test the convergence of $\int_1^{\infty} \frac{1}{x^2}$ dx	BTL -4	Analyzing
23.	Evaluate $\int (1+tanx)^n sec^2x$ dx	BTL -3	Applying
24.	Evaluate $\int \frac{1}{x(logx)^n}$ dx	BTL -2	Understanding
25.	Evaluate $\int \frac{sin\theta+cos\theta}{sin\theta-cos\theta}$ dθ	BTL -4	Analyzing
	PART – B		
1.	Find $\int x^3 \sqrt{9-x^2}dx$ by trigonometric substitution.	BTL -3	Applying
2.(a)	Evaluate $\int \frac{(lnx)^2}{x^2} dx$	BTL -5	Evaluating
2.(b)	Find $\int \frac{sec^2x}{tan^2x+3tanx+2}\, dx$	BTL -5	Evaluating
3.	Evaluate $\int e^{ax} \cos bx\, dx$ using integration by parts	BTL -3	Applying
4.(a)	Prove that $\int tan^n x\, dx = \frac{tan^{n-1}x}{n-1} - \int tan^{n-2}x\, dx$ $(n \neq 1)$	BTL -3	Applying
4.(b)	Evaluate $\int \frac{\tan x}{\sec x+\cos x}\, dx$	BTL -3	Applying
5.	Calculate using partial fraction $\int \frac{10}{(x-1)(x^2+9)} dx$	BTL -3	Applying
6.(a)	Evaluate $\int \frac{xe^{2x}}{(1+2x)^2} dx$	BTL -3	Applying
6.(b)	Evaluate $\int xtan^{-1}x\, dx$	BTL -3	Applying
7.	Prove the reduction formula $\int sin^n x dx = -\frac{1}{n} sin^{n-1}x\, cosx + \frac{n-1}{n} \int sin^{n-2}x\, dx$	BTL -1	Remembering
8.(a)	Calculate by partial fraction $\int \frac{x^2+1}{(x-3)(x-2)^2}\, dx$	BTL -4	Analyzing
8.(b)	Evaluate $\int sin^6 x cos^3 x\, dx$.	BTL -3	Applying
9.	Prove that $\int sec^n x dx = \frac{tanx\, sec^{n-2}x}{n-1} + \frac{n-2}{n-1} \int sec^{n-2}x dx$ (n≠1)	BTL -5	Evaluating
10.(a)	Evaluate $\int_0^{\pi/2} sin^7 x\, cos^5 x\, dx$	BTL -6	Creating
10.(b)	For what values of p is $\int_1^{\infty} \frac{1}{x^p} dx$ convergent?	BTL -3	Applying
11.	Prove the reduction formula	BTL -4	Analyzing

	$\int cos^n x dx = \frac{1}{n} cos^{n-1} x sinx + \frac{n-1}{n} \int cos^{n-2} x \, dx$		
12.(a)	Evaluate $\int_0^{\frac{\pi}{2}} cos^5 \, x \, dx$	BTL -3	Applying
12.(b)	Evaluate $\int_0^{\frac{\pi}{2}} \sqrt{sin\theta} \; cos^5 \, \theta \, d\theta$	BTL -3	Applying
13.	Evaluate $\int e^{ax} \sin bx \, dx$ using integration by parts.	BTL -4	Analyzing
14.(a)	Evaluate $\int_0^{\frac{\pi}{2}} tan^5 x \, sec^6 x \, dx$	BTL -3	Applying
14.(b)	Find $\int \frac{x^5}{\sqrt{1+x^3}} dx$	BTL -3	Applying
15.	Evaluate $\int_0^{\pi/2} \frac{sinx \, cosx}{cos^2 x + 3cosx + 2} dx$	BTL -4	Analyzing
16.(a)	Evaluate $\int \sqrt{\frac{x^2-1}{x^8}} \; dx$	BTL -4	Analyzing
16.(b)	Find $\int_0^{\pi} sin^4 3t \, dt$	BTL -3	Applying
17.	Evaluate $\int \frac{x^2 + x + 1}{(x-1)^2 (x^2+2)} dx$	BTL -4	Analyzing
18.(a)	Evaluate $\int e^x \sin x \, dx$	BTL -3	Applying
18.(b)	Evaluate $\int e^{\tan^{-1} x} \frac{(1 + x + x^2)}{1 + x^2} \, dx$	BTL -3	Applying
	PART – C		
1.	The region enclosed by the circle $x^2 + y^2 = a^2$ is divided into two segments by the line x = h. Find the area of the smaller segment	BTL -4	Analyzing
2.	Find the area of the region bounded between the parabola $y^2 = 4ax$ and its latus rectum	BTL -4	Analyzing
3.	Find the volume of the solid formed by revolving the region bounded by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, a $> b$ about the major axis.	BTL -2	Understanding
4.	Find the volume of a sphere of radius a units.	BTL -2	Understanding
5.	Evaluate $\int \frac{3x-4}{2x^2-5x+3} dx$	BTL -3	Applying

UNIT V -MULTIPLE INTEGRALS

Double integrals in Cartesian and polar coordinates – Change of order of integration – Area enclosed by plane curves Change of variables in double integrals (Polar coordinates) – Triple integrals – Volume of solids

Q.No.	Question	BT Level	Competence
	PART – A		
1.	Evaluate $\int_2^3 \int_1^2 \frac{dxdy}{xy}$	BTL -1	Remembering
2.	Evaluate $\int_0^2 \int_0^1 4xy \, dx \, dy$	BTL -2	Understanding
3.	Evaluate $\int_0^{\pi} \int_0^{sin\theta} r dr d\theta$	BTL -1	Remembering

4.	Evaluate $\int_0^{\frac{\pi}{2}} \int_0^{\frac{\pi}{2}} \sin(\theta+\varphi)\, d\theta\, d\varphi$	BTL -3	Applying
5.	Find the area bounded by the lines $x = 0, y = 1\ and y = x$	BTL -1	Remembering
6	Evaluate $\int_0^{\pi} \int_0^{a} r dr d\theta$	BTL -2	Understanding
7.	Evaluate $\int_0^5 \int_0^2 (x^2+y^2) dxdy$	BTL -3	Applying
8	Evaluate $\int_0^a \int_0^{\sqrt{a^2-x^2}} dydx$	BTL -3	Applying
9.	Evaluate $\int_1^{ln8} \int_0^{lny} e^{x+y}\, dxdy$	BTL -2	Understanding
10	Evaluate $\int_0^{\pi} \int_0^{5} r^4 sin\theta dr d\theta$	BTL -2	Understanding
11.	Evaluate $\int_0^1 \int_0^{\sqrt{1+y^2}} \frac{dxdy}{1+x^2+y^2}$	BTL -3	Applying
12.	Evaluate $\int_0^2 \int_0^x \frac{dxdy}{x^2+y^2}$	BTL -3	Applying
13.	Evaluate $\int\int dxdy$ over the region bounded by $x = 0, x = 2$, $y = 0\ and y = 2$	BTL -2	Understanding
14.	Change the order of integration $\int_0^1 \int_{y^2}^{y} f(x,y)\, dxdy$	BTL -4	Analyzing
15.	Change the order of integration $\int_0^{\infty} \int_x^{\infty} f(x,y)\, dxdy$	BTL -3	Applying
16.	Find the limits of integration in the double integral $\iint_R f(x,y)dxdy$ where R is in the first quadrant and bounded x=1, y=0, $y^2 = 4x$	BTL -4	Analyzing
17.	Find the limits of integration in the double integral $\iint_R f(x,y)dxdy$ where R is in the first quadrant and bounded x = 0, y = 0, $x + y = 1$	BTL -3	Applying
18.	Find the limits of integration in the double integral $\iint_R f(x,y)dxdy$ where R is in the first quadrant and bounded x = 0, y = 0, $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$.	BTL -3	Applying
19.	Evaluate $\int\int\int (x+y+z)\, dxdydz$ over the region bounded by $x = 0, x = 1$, $y = 0\ and y = 1, z = 0, z = 1$	BTL -2	Understanding
20.	Write down the double integral to find the area of the circles $r = 2sin\theta, r = 4sin\theta$	BTL -4	Analyzing
21.	Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy\,(x+y) dydx$	BTL -1	Remembering
22.	Evaluate $\int_0^1 \int_0^{x^2} (x^2+y^2) dydx$	BTL -4	Analyzing
23.	Evaluate $\int_1^3 \int_3^4 \int_1^4 \int xyz\, dzdydx$	BTL -2	Understanding
24.	Evaluate $\int_0^1 dx \int_0^2 dy \int_0^3 (x+y+z) dz$	BTL -4	Analyzing
25.	Evaluate $\int_a^b \int_c^d \int_f^g e^{x+y+z} dzdydx$	BTL -3	Applying
	PART – B		
1.	Evaluate $\iint xydxdy$ over the positive quadrant of the circle $x^2 + y^2 = a^2$	BTL -4	Applying

2.(a)	Change the order of integration $\int_0^2 \int_0^{\sqrt{4-y^2}} xy\,dxdy$ and hence evaluate it	BTL -2	Understanding
2.(b)	Using double integral find the area of the Ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$.	BTL -4	Applying
3.	Change the order of integration $\int_0^{4a} \int_{\frac{x^2}{4a}}^{2\sqrt{ax}} xydxdy$ and hence evaluate it	BTL -2	Understanding
4.(a)	Change the order of integration $\int_0^1 \int_y^{2-y} xy\,dxdy$ and hence evaluate it	BTL -2	Understanding
4.(b)	Evaluate $\iint xydxdy$ over the positive quadrant bounded by the line 2x + 3y = 6	BTL -3	Analyzing
5.	Change the order of integration $\int_0^a \int_{a-y}^{\sqrt{a^2-y^2}} y\,dxdy$ and hence evaluate it	BTL -3	Analyzing
6.(a)	Change the order of integration $\int_0^\infty \int_0^\infty \frac{e^{-y}}{y} dydx$ and hence evaluate it	BTL -4	Applying
6.(b)	Find the area bounded by parabolas $y = 4 - x$ and $y^2 = x$ by double integration.	BTL -1	Remembering
7.	Change the order of integration $\int_0^a \int_y^a \frac{x\,dx\,dy}{\sqrt{x^2+y^2}}$ and hence evaluate it	BTL -2	Understanding
8.(a)	By changing in to polar Co – ordinates, evaluate $\int_0^a \int_0^x \frac{x^3}{\sqrt{x^2+y^2}} dxdy$.	BTL -3	Analyzing
8.(b)	By change the order of integration and evaluate $\int_0^2 \int_{x^2}^{2-x} xy\,dydx$	BTL -2	Understanding
9.	By changing in to polar Co – ordinates, evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)}\,dxdy$. Hence find the value of $\int_0^\infty e^{-x^2}\,dx$.	BTL -2	Understanding
10.(a)	Find the area included between the curves $y^2 = 4x$ and $x^2 = 4y$	BTL -2	Understanding
10.(b)	Evaluate $\int_1^e \int_1^{logy} \int_1^{e^x} logz\,dzdydx$	BTL -2	Understanding
11.	Change the integral into polar coordinates $\int_0^a \int_0^x \frac{x^3}{\sqrt{x^2+y^2}} dxdy$ and hence evaluate it	BTL -2	Understanding
12.(a)	Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} \frac{dxdydz}{\sqrt{1-x^2-y^2-z^2}}$	BTL -5	Evaluating
12.(b)	Evaluate $\int_0^a \int_0^b \int_0^c (x^2+y^2+z^2)dxdydz$	BTL -6	Creating
13.	Find the area common to the cardioids $r = a(1+cos\theta)$ and $r = a(1-cos\theta)$	BTL -2	Understanding
14.(a)	Evaluate $\int_0^a \int_0^{\sqrt{a^2-x^2}} \int_0^{\sqrt{a^2-y^2-z^2}} x\,dx\,dy\,dz$	BTL -4	Analyzing

14.(b)	Evaluate $\iint (x^2 + y^2)dxdy$ over the area bounded by the parabola $y^2 = 4x$ and its latus rectum.	BTL -3	Applying
15.	Evaluate $\iiint \frac{dx\,dy\,dz}{x^2+y^2+z^2}$, taken throughout the volume of the sphere $x^2 + y^2 + z^2 = a^2$.	BTL -3	Applying
16.(a)	Find the value of $\iiint xyz\,dxdydz$ through the positive spherical octant for which $x^2 + y^2 + z^2 \leq a^2$.	BTL -4	Analyzing
16.(b)	Find the area which is inside the circle $r = 3a\,cos\theta$ and outside the cardioid $r = a\,(1 + cos\theta)$.	BTL -4	Analyzing
17.	Find the volume of the tetrahedron bounded by the coordinate planes and $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$.	BTL -3	Applying
18.(a)	Find the volume bounded by the cylinder $x^2 + y^2 = 1$ and the planes $x + y + z = 3$, $z = 0$	BTL -4	Analyzing
18.(b)	Find the area between the circle $x^2 + y^2 = a^2$ and the line $x + y = a$ lying in the first quadrant, by double integration.	BTL -3	Applying
	PART – C		
1.	Find the area bounded by parabola $y = x^2$ and straight line $2x - y + 3 = 0$.	BTL -4	Analyzing
2.	Find the volume of the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$	BTL -4	Analyzing
3.	Find the volume of finite region of space (tetra-hadron) bounded by the planes $x = 0, y = 0, z = 0\ and\ 2x + 3y + 4z = 12$	BTL -2	Understanding
4.	Find the volume of sphere bounded by $x^2 + y^2 + z^2 = a^2$.	BTL -2	Understanding
5.	Change the order of integration $\int_0^1 \int_{y^2}^{y} \frac{ydx\,dy}{x^2+y^2}$ and hence evaluate it	BTL -3	Applying