INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

CSE (DATA SCIENCE)
QUESTION BANK

Course Title	**MATRICES AND CALCULUS**				
Course Code	AHSD02				
Program	B.Tech				
Semester	I	CSE (DS)			
Course Type	Foundation				
Regulation	BT 23				
Course Structure	Theory			Practical	
	Lecture	Tutorials	Credits	Laboratory	Credits
	3	1	4	-	-
Course Coordinator	Mr. P Shantan Kumar, Assistant Professor				
Course Instructor	Mr. P Shantan Kumar, Assistant Professor				

Course Objectives:
The students will try to learn:

I	The Concept of the rank of a matrix, eigen values, eigen vectors and solution of the system of linear equations.
II	The Geometrical approach to the mean value theorems and applications.
III	The Fourier series expansion in periodic and non-periodic intervals.
IV	The Evaluation of multiple integrals and applications.

Course Outcomes:
After successful completion of the course, students should be able to:

CO 1	**Determine** the rank and solutions of linear equations with elementary operations.
CO 2	**Utilize** the Eigen values, Eigen vectors for developing spectral matrices.
CO 3	**Make use of** Cayley-Hamilton theorem for finding powers of the matrix.
CO 4	**Interpret** the maxima and minima of given functions.
CO 5	**Apply** the Fourier series expansion of periodic functions for harmonic series.
CO 6	**Determine** the volume of solid bounded regions by using the integral calculus.

QUESTION BANK:

MODULE I				
MATRICES				
PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
Q.No	**QUESTION**	**Taxonomy**	**How does this subsume the level**	**CO's**
1	Find the conditions on a,b,c. So that the equations x+2y-3z = a, 3x-y+2z = b, x-5y+8z = c have a solution	Apply	Learner to recall the consistency, understand row and column operations and apply them to find condition.	CO 1
2	For what values of a , b the following equations x + y + z = 6 , x + 2y + 3z = 10, x + 2y + a z = b have unique, infinite and no solutions.	Apply	Learner to recall the consistency, understand row and column operations and apply them to find condition.	CO 1
3	Calculate the rank of $\begin{bmatrix} 2 & -4 & 3 & -1 & 0 \\ 1 & -2 & -1 & -4 & 2 \\ 0 & 1 & -1 & 3 & 1 \\ 4 & -7 & 4 & -4 & 5 \end{bmatrix}$ by reducing to echelon form.	Apply	Learner to recall the echelon form of a square matrix, understand row and column operations and apply them to find unknown values.	CO 1
4	Find the Inverse of a matrix by using Gauss-Jordan method $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$.	Apply	Learner to recall the Gauss-Jordan method of a square matrix, understand row and column operations and apply them to get inverse of the matrix rank.	CO 1
5	Find the rank of $A = \begin{bmatrix} 1 & 2 & 3 & 0 \\ 2 & 4 & 3 & 2 \\ 3 & 2 & 1 & 3 \\ 6 & 8 & 7 & 5 \end{bmatrix}$ by using Echelon form	Apply	Learner to recall the echelon form of a square matrix, understand row and column operations and apply them to find unknown values.	CO 1
6	By reducing the matrix $\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$ into normal form. Find its rank.	Apply	Learner to recall the normal form of a square matrix, understand row and column operations and apply them to get normal and rank.	CO 1

7	Solve the following system of equations: x−2y+z−w=0, x+y-2z+3w = 0, 4x+y-5z+8w=0, 5x-7y+2z-w = 0	Apply	Learner to recall the consistency, understand row and column operations and apply them to find solutions.	CO 1
8	Find the inverse of the matrix $\begin{bmatrix} 4 & -1 & 1 \\ 2 & 0 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ by using Gauss Jordan method.	Apply	Learner to recall the Gauss-Jordan method of a square matrix, understand row and column operations and apply them to get inverse of the matrix rank.	CO 1
9	From the following matrix , find the rank of $$\begin{bmatrix} 4 & 3 & 2 & 1 \\ 5 & 1 & -1 & 2 \\ 0 & 1 & 2 & 3 \\ 1 & -1 & 3 & -2 \end{bmatrix}$$ by using normal form.	Apply	Learner to recall the normal form of a square matrix, understand row and column operations and apply them to get normal and rank.	CO 1
10	Examine the consistency of the system and if consistent, solve the equations x+y+z=6, x+2y+3z=14, x+4y+7z=30	Apply	Learner to recall the consistency, understand row operations and apply them to find the solution.	CO 1
PART B-LONG ANSWER QUESTIONS				
1	For what values of a, b the following equations x + 2y + z = 8, 2x + y + 3z = 13, 3x + 4y − az = b have unique, infinite and no solutions.	Apply	Learner to recall the consistency, understand row and column operations and apply them to find condition.	CO 1
2	Solve the system of equations x - y+2z+t = 2 , 3x+2y+t = 1, 4x+y+2z+2t = 3	Apply	Learner to recall the consistency, understand row and column operations and apply them to find condition.	CO 1
3	By reducing the matrix $\begin{bmatrix} 1 & 0 & -4 & 5 \\ 2 & -1 & 3 & 0 \\ 8 & 1 & 0 & -7 \end{bmatrix}$ into normal form, find its rank.	Apply	Learner to recall the normal form of a square matrix, understand row and column operations and apply them to get normal and rank.	CO 1

4	Determine a and b, such that rank of the matrix $\begin{bmatrix} 1 & -2 & 3 & 1 \\ 2 & 1 & -1 & 2 \\ 6 & -2 & a & b \end{bmatrix}$ is 3.	Apply	Learner to recall the echelon form of a square matrix, understand row operations and apply them to find unknown values.	CO 1
5	For what values of a, b the following equations x + y + z = 3, x + 2y + 2z = 6, x + 9y + az = b have unique, infinite and no solutions.	Apply	Learner to recall the consistency, understand row and column operations and apply them to find condition.	CO 1
6	Determine the value of k, such that the matrix $\begin{pmatrix} 4 & 4 & -3 & 1 \\ 1 & 1 & -1 & 0 \\ k & 2 & 2 & 2 \\ 9 & 9 & k & 3 \end{pmatrix}$ has rank 3.	Apply	Learner to recall the echelon form of a square matrix, understand row and column operations and apply them to find unknown values.	CO 1
7	Find the rank of the matrix $\begin{pmatrix} 2 & -2 & 0 & 6 \\ 4 & 2 & 0 & 2 \\ 1 & -1 & 0 & 3 \\ 1 & -2 & 1 & 2 \end{pmatrix}$ by reducing to Normal form.	Apply	Learner to recall the normal form of a square matrix, understand row and column operations and apply them to get normal and rank.	CO 1
8	Find the real value of λ the following equations: $x + 2y + 3z = \lambda x$, $3x + y + 2z = \lambda y$, $2x + 3y + z = \lambda z$ have a non trivial solution.	Apply	Learner to recall the consistency, understand row and column operations and find the unkown value λ.	CO 1
9	Find the inverse of the matrix A= $\begin{bmatrix} 2 & 3 & 4 \\ 4 & 3 & 1 \\ 1 & 2 & 4 \end{bmatrix}$ by using Gauss-Jordan method.	Apply	Learner to recall the Gauss-Jordan method of a square matrix, understand row and column operations and apply them to get inverse of the matrix rank.	CO 1
10	What is the inverse of $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$ by elementary row operation.	Apply	Learner to recall the Gauss-Jordan method of a square matrix, understand row and column operations and apply them to get inverse of the matrix rank.	CO 1

11	For what values of a, the following equations 3x - y + 4z = 3, x + 2y - 3z = -2, 6x + 5y + az = -3 will have solutions and solve them with that value.	Apply	Learner to recall the consistency, understand row and column operations and apply them to find condition and solve.	CO 1
12	Find the rank of a matrix by reducing to echelon form of $\begin{bmatrix} 1 & 4 & 3 & -2 & 1 \\ -2 & -3 & -1 & 4 & 3 \\ -1 & 6 & 7 & 2 & 9 \\ -3 & 3 & 6 & 6 & 12 \end{bmatrix}$.	Apply	Learner to recall the echelon form of a square matrix, understand row and column operations and apply them to find rank of given matrix.	CO 1
13	For what values of λ the following equations: $(\lambda-1)x+(3\lambda+1)y+2\lambda z=0$, $(\lambda-1)x+(4\lambda-2)y+(\lambda+3)z=0$, $2x+(3\lambda+1)y+3(\lambda-1)z=0$ have a non trivial solution	Apply	Learner to recall the consistency, understand row and column operations and apply them to find the values of λ .	CO 1
14	Find the rank of the matrix A= $\begin{bmatrix} 2 & 1 & 3 & 5 \\ 4 & 2 & 1 & 3 \\ 8 & 4 & 7 & 13 \\ 8 & 4 & -3 & -1 \end{bmatrix}$ by reducing to echelon form.	Apply	Learner to recall the echelon form of a square matrix, understand row operations and apply them to find rank of given matrix.	CO 1
15	Reduce the matrix $A = \begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & -7 \end{bmatrix}$ into the normal form, find its rank.	Apply	Learner to recall the normal form of a square matrix, understand row and column operations and apply them to get normal to find its rank.	CO 1
16	Find the inverse of the matrix A= $\begin{bmatrix} -2 & 1 & 3 \\ 0 & -1 & 1 \\ 1 & 2 & 0 \end{bmatrix}$ using elementary row operations.	Apply	Learner to recall the Gauss-Jordan method of a square matrix, understand row and column operations and apply them to get inverse of the given matrix.	CO 1
17	For what values of a the following equations x + y + z = 1, x + 2y + 4z = a, x + 4y + 10z = a^2 maybe consistent and if possible solve them.	Apply	Learner to recall the consistency, understand row and column operations and apply them to find condition.	CO 1

18	Find the rank of the matrix A= $\begin{bmatrix} 1 & 1 & -3 & -1 \\ 1 & 2 & 1 & 1 \\ 3 & 1 & 3 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$ by reducing to echelon form.	Apply	Learner to recall the echelon form of a square matrix, understand row operations and apply them to find rank of given matrix.	CO 1
19	Solve the rank of the matrix A= $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 2 & 1 & 4 & 5 \\ 1 & 5 & 5 & 7 \\ 8 & 1 & 14 & 17 \end{bmatrix}$ with the help of elementary row operations.	Apply	Learner to recall the echelon form of a square matrix, understand row operations and apply them to find rank of given matrix.	CO 1
20	Solve the following system of equations x + 3y -2z = 0, 2x - y + 4z = 0, x - 11y + 14z = 0	Apply	Learner to recall the consistency, understand row and column operations and apply them to find condition.	CO 1
PART-C - SHORT ANSWER QUESTIONS				
1	Write about Consistency	Remember	Learner to recall the consistency and define it	CO 1
2	State Inconsistency	Remember	Learner to recall the consistency and state it	CO 1
3	Define Trivial solutions	Remember	Learner to recall the consistency and define it	CO 1
4	What is the meaning of Non Trivial solutions	Remember	Learner to recall the consistency and define it	CO 1
5	Define about non homogeneous equations	Remember	Learner to recall the about equations and define it	CO 1
6	Write about the rank of a matrix.	Remember	Learner to recall the matrix and write about rank.	CO 1
7	Explain elementary operations	Understand	Learner to recall the operations and explain it	CO 1
8	Explain about the rank of a matrix in briefly	Understand	Learner to recall the rank and explain it	CO 1
9	State about 2 properties of rank of a matrix	Remember	Learner to recall the rank and state it	CO 1
10	Write about the conditions for normal form of a matrix	Remember	Learner to recall the elementary operations and define it	CO 1
11	Solve the system of equations x + 2y-5z = 0 , 3x+4y+6z = 0, x+y+z = 0	Apply	Learner to recall the consistency and apply them to find solution.	CO 1

12	Solve the system of equations x + y+ w = 0 , y+z = 0, x+y+z+w = 0	Apply	Learner to recall the consistency and apply them to find solution.	CO 1
13	Explain Gauss Jordan method working rule	Understand	Learner to recall the operations and explain it	CO 1
14	Explain about the system of linear equations	Understand	Learner to recall the linear equations and explain it	CO 1
15	Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 8 & 7 & 0 & 5 \end{bmatrix}$.	Apply	Learner to recall the elementary operations and find the rank of the given matrix.	CO 1
16	Calculate the value of k such that the rank of $\begin{bmatrix} 1 & 2 & 3 \\ 2 & k & 7 \\ 3 & 6 & 10 \end{bmatrix}$ is 3	Apply	Learner to recall the square matrix and find given matrix with k value.	CO 1
17	Find the value of k such that rank of $\begin{bmatrix} 1 & 1 & -1 \\ 1 & -1 & k \\ 3 & 1 & 0 \end{bmatrix}$ is 2	Apply	Learner to recall the square matrix and find given matrix with k value.	CO 1
18	For what value of k such that rank of $\begin{bmatrix} 4 & 4 & -3 \\ 1 & 2 & 2 \\ 9 & 9 & k \end{bmatrix}$ is 3	Apply	Learner to recall the square matrix and find given matrix with k value	CO 1
19	If A = $\begin{bmatrix} 4 & 4 & 4 & 4 \\ 1 & 1 & 1 & 1 \\ 2 & 2 & 2 & 2 \\ 9 & 9 & 9 & 9 \end{bmatrix}$, then find the rank	Apply	Learner to recall the square matrix and find given matrix rank	CO 1
20	Find the rank of the matrix $\begin{bmatrix} -3 & 0 & 0 \\ 0 & 5 & 6 \\ 0 & 0 & 7 \end{bmatrix}$.	Apply	Learner to recall the square matrix and find given matrix rank	CO 1

MODULE II				
EIGEN VALUES AND EIGEN VECTORS				
PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
Q.No	**QUESTION**	**Taxonomy**	**How does this subsume the level**	**CO's**
1	Verify Cayley-Hamilton theorem for $\begin{bmatrix} 1 & 2 \\ 2 & 2 \end{bmatrix}$ and evaluate $2A^4 - 5A^3 - 7A - 6I$.	Apply	Learner to recall the concept of Cayley-Hamilton theorem for square matrices and understand that every square matrix satisfy its characteristic equation and apply it to find required linear polynomial in A	CO 2, CO 3
2	Use Cayley-Hamilton theorem to find A^3 and A^{-3} and if A = $\begin{bmatrix} 2 & 4 \\ 1 & 1 \end{bmatrix}$.	Apply	Learner to recall the concept of Cayley-Hamilton theorem for square matrices and understand that every square matrix satisfy its characteristic equation and apply it to find required linear polynomial in A	CO 2, CO 3
3	State the Cayley-Hamilton theorem and find the eigen values and eigen vectors A, if $A = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$.	Apply	Learner to recall the concept of Cayley-Hamilton theorem for square matrices and find eigen values and eigen vectors of A	CO 2, CO 3
4	If$A = \begin{bmatrix} 1 & 2 & -3 \\ 0 & 3 & 2 \\ 0 & 0 & 2 \end{bmatrix}$ then find the Eigen values of $3A^3 + 5A^2 - 6A + 2I$.	Apply	Learner to recall the concept of Cayley-Hamilton theorem for square matrices and understand that every square matrix satisfy its characteristic equation and find eigen values	CO 2, CO 3
5	Is the matrix $$\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$$ diagonalizable or not?	Apply	Learner to recall the concept of diagonalization of the matrix, understand the how to frame the spectral matrix and apply it to find the required diagonal form.	CO 2, CO 3

6	Determine the modal matrix for A= $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 5 & 1 \\ 3 & 1 & 1 \end{bmatrix}$	Apply	Learner to recall the concept of diagonalization of the matrix, understand the how to frame the spectral matrix and apply it to find the required diagonal form.	CO 2, CO 3
7	Determine the Eigen values and Eigen vectors of the matrix $A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$ and find A^{-1} , A^4	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values and apply them to find Eigen vectors.	CO 2, CO 3
8	Verify Cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ And evaluate $A^5 - 4A^4 - 7A^3 + 11A^2 - A - 10I$.	Apply	Learner to recall the concept of Cayley-Hamilton theorem for square matrices and understand that every square matrix satisfy its characteristic equation and apply it to find required linear polynomial in A .	CO 2, CO 3
9	Use Cayley-Hamilton theorem to find A^8 if $A = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$.	Apply	Learner to recall the concept of Cayley-Hamilton theorem for square matrices and understand that every square matrix satisfy its characteristic equation and apply it to find required linear polynomial in A.	CO 2, CO 3
10	Is the matrix $\begin{bmatrix} 2 & 3 & 4 \\ 0 & 2 & -1 \\ 0 & 0 & 1 \end{bmatrix}$ diagonalizable or not?	Apply	Learner to recall the concept of diagonalization of the matrix, understand the how to frame the spectral matrix and apply it to find the required diagonal form.	CO 2, CO 3

PART-B LONG ANSWER QUESTIONS				
1	Diagonalize the matrix A= $\begin{pmatrix} 1 & 1 & 1 \\ 0 & 2 & 1 \\ -4 & 4 & 3 \end{pmatrix}$ and find A^4.	Apply	Learner to recall the concept of diagonalization of the matrix, understand the how to frame the spectral matrix and apply it to find the required diagonal form.	CO 2, CO 3
2	Determine the modal matrix P for $$A = \begin{bmatrix} 11 & -4 & -7 \\ 7 & -2 & -5 \\ 10 & -4 & -6 \end{bmatrix}$$.	Apply	Learner to recall the concept of diagonalization of the matrix, understand the how to frame the spectral matrix and apply it to find the required diagonal form.	CO 2, CO 3
3	Verify Cayley-Hamilton theorem for A= $\begin{pmatrix} 1 & 2 & -1 \\ 2 & 1 & -2 \\ 2 & -2 & 1 \end{pmatrix}$ and find $A^{-1}\&A^4$.	Apply	Learner to recall the concept of Cayley-Hamilton theorem for square matrices and understand that every square matrix satisfy its characteristic equation and apply it to find required linear polynomial in A .	CO 2, CO 3
4	Find Eigen values and Eigen vectors of matrix $A = \begin{bmatrix} 5 & 4 \\ 1 & 2 \end{bmatrix}$.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values and apply them to find Eigen vectors.	CO 2, CO 3
5	Calculate the Eigen values and Eigen vectors of the matrix $\begin{bmatrix} 2 & 3+4i \\ 3-4i & 2 \end{bmatrix}$.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values and apply them to find Eigen vectors.	CO 2, CO 3
6	Verify Cayley-Hamilton theorem to $A = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$ And deduce that $A^8 = 625I$.	Apply	Learner to recall the concept of Cayley-Hamilton theorem for square matrices and understand that every square matrix satisfy its characteristic equation and apply it to find required linear polynomial in A .	CO 2, CO 3

7	Determine the Eigen values and Eigen vectors of the matrix $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values and apply them to find Eigen vectors.	CO 2, CO 3
8	Find the characteristic polynomial of the matrix $A = \begin{bmatrix} 3 & 1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ verify Cayley-Hamilton theorem hence find A^{-1} and A^4.	Apply	Learner to recall the concept of Cayley-Hamilton theorem for square matrices and understand that every square matrix satisfy its characteristic equation and apply it to find required linear polynomial in A.	CO 2, CO 3
9	Diagonalize the matrix $A = \begin{bmatrix} 1 & -8 \\ -5 & 4 \end{bmatrix}$ if possible	Apply	Learner to recall the concept of diagonalization of the matrix, understand the how to frame the spectral matrix and apply it to find the required diagonal form.	CO 2, CO 3
10	If A= $\begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix}$, find the eigen values and corresponding eigen vectors of A	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values and apply them to find Eigen vectors.	CO 2, CO 3
11	Find the characteristic roots of the matrix $\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$ and the corresponding characteristic vectors.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values and apply them to find Eigen vectors.	CO 2, CO 3
12	Show that the matrix $A = \begin{bmatrix} 1 & -2 & 1 \\ 1 & -2 & 3 \\ 0 & -1 & 2 \end{bmatrix}$ satisfies its characteristic equation and find A^{-1}.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values and apply them to find Eigen vectors.	CO 2, CO 3

13	Use Cayley-Hamilton theorem to find $2A^5 - 3A^4 + A^2 - 4I$as linear polynomial of A and I where $A = \begin{bmatrix} 3 & 1 \\ -1 & 2 \end{bmatrix}$.	Apply	Learner to recall the concept of Cayley-Hamilton theorem for square matrices and understand that every square matrix satisfy its characteristic equation and apply it to find negative and positive powers of the matrix.	CO 2, CO 3
14	Diagonalize the matrix $\begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values and apply them to find Eigen vectors.	CO 2, CO 3
15	Find the Eigen values and Eigen vectors of the matrix A and its inverse, where $A = \begin{bmatrix} 1 & 3 & 4 \\ 0 & 2 & 5 \\ 0 & 0 & 3 \end{bmatrix}$.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values and apply them to find Eigen vectors. .	CO 2, CO 3
16	Show that the matrix $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$satisfies its characteristic equation and hence find A^{-1}.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values and apply them to find Eigen vectors.	CO 2, CO 3
17	Verify Cayley-Hamilton theorem and find the inverse of the matrix $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$.	Apply	Learner to recall the concept of Cayley-Hamilton theorem for square matrices and understand that every square matrix satisfy its characteristic equation and apply it to find negative and positive powers of the matrix	CO 2, CO 3

18	Diagonalize the matrix $A = \begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$ by similarity transformation and hence find A^4.	Apply	Learner to recall the concept of diagonalization of the matrix, understand the how to frame the spectral matrix and apply it to find the required diagonal form.	CO 2, CO 3
19	Show that the matrix $\begin{bmatrix} 7 & 2 & -2 \\ -6 & -1 & 2 \\ 6 & 2 & -1 \end{bmatrix}$ satisfies its characteristic equation and hence find A^{-1}.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values and apply them to find Eigen vectors.	CO 2, CO 3
20	Verify Cayley-Hamilton theorem and find the inverse of the matrix $A = \begin{bmatrix} 8 & -8 & 2 \\ 4 & -3 & -2 \\ 3 & -4 & 1 \end{bmatrix}$.	Apply	Learner to recall the concept of Cayley-Hamilton theorem for square matrices and understand that every square matrix satisfy its characteristic equation and apply it to find negative and positive powers of the matrix	CO 2, CO 3
PART-C SHORT ANSWER QUESTIONS				
1	Find the eigen values of the matrix $\begin{bmatrix} 4 & 1-3i \\ 1+3i & 7 \end{bmatrix}$.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values.	CO 2, CO 3
2	State Cayley- Hamilton theorem.	Remember	Learner to recall the concept of characteristic equation of the matrix,Cayley- Hamilton theorem and define it	CO 2, CO 3
3	Find the eigen values of $$A^3 - 2A^2 - A - 5$$, where the given matrix $\begin{bmatrix} 2 & 0 \\ 0 & 1 \end{bmatrix}$.	Apply	Learner to recall the concept of Eigen values of the matrix, understand the characteristic equation to find Eigen values.	CO 2, CO 3

4	Define modal and spectral matrices.	Remember	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, ,modal matrix and spectral matrix.	CO 2, CO 3
5	If 2, 3, 4 are the eigen values of A then find the eigen values of adjA.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values.	CO 2, CO 3
6	Find the sum of eigen values of the matrix $\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values.	CO 2, CO 3
7	Verify Cayley-Hamilton theorem to matrix $A = \begin{bmatrix} 1 & 2 \\ 2 & -1 \end{bmatrix}$.	Apply	Learner to recall the concept of characteristic equation of the matrix,Cayley- Hamilton theorem and define it	CO 2, CO 3
8	Show that the vectors $X_1 = (1, 1, 2)$, $X_2 = (1, 2, 5)$ and $X_3 = (5, 3, 4)$ are linearly dependent.	Apply	Learner to recall the concept of linear dependent and independent and find it	CO 2, CO 3
9	Find the characteristic equation of the matrix $$A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$$.	Apply	Learner to recall the concept of the matrix, understand the characteristic equation to find charactersitc equation.	CO 2, CO 3
10	Define linearly dependent and independent matrix.	Remember	Learner to recall the concept of linear dependent and independent and find it	CO 2, CO 3
11	Find the eigen values of the matrix $$A = \begin{bmatrix} 3i & 2+i \\ -2+i & -i \end{bmatrix}$$.	Apply	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values.	CO 2, CO 3

12	Show that the vectors $X_1 = (2, 2, 1)$, $X_2 = (1, 4, -1)$ and $X_3 = (4, 6, -3)$ are linearly independent.	Apply	Learner to recall the concept of linear dependent and independent and find it	CO 2, CO 3
13	Define characteristic equation of the matrix.	Remember	Learner to recall the concept of the matrix, understand the characteristic equation to define charactersitc equation.	CO 2, CO 3
14	State eigen values and eigen vectors of a matrix.	Remember	Learner to recall the concept of Eigen values and Eigen vectors of the matrix, understand the characteristic equation to find Eigen values.	CO 2, CO 3
15	Find the characteristic values of the matrix $$\begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}.$$	Apply	Learner to recall the concept of Eigen values of the matrix, understand the characteristic equation to find Eigen values.	CO 2, CO 3
16	For the matrix A= $\begin{bmatrix} 3 & 1 \\ 7 & 5 \end{bmatrix}$, find the values of x and y so that $A^2+xI=yA$, where I is an identity matrix. Hence find A^{-1}	Apply	Learner to recall the concept of Eigen values of the matrix, understand the characteristic equation to find unknown values.	CO 2, CO 3
17	Find the eigen values of the matrix $\begin{bmatrix} 1 & 4 \\ 3 & 2 \end{bmatrix}$.	Apply	Learner to recall the concept of Eigen values of the matrix, understand the characteristic equation to find Eigen values.	CO 2, CO 3
18	Show that the vectors $X_1 = (1, 0, 0)$, $X_2 = (0, 1, 0)$ and $X_3 = (0, 0, 1)$ are linearly independent.	Apply	Learner to recall the concept of linear dependent and independent and find it	CO 2, CO 3

19	Find the sum and product of the eigen values of $$\begin{bmatrix} 2 & 5 & 7 \\ 1 & 4 & 6 \\ 2 & -2 & 3 \end{bmatrix}.$$	Apply	Learner to recall the concept of Eigen values properties of the matrix, understand the characteristic equation to find Eigen values.	CO 2, CO 3
20	Determine the characteristic roots of the matrix $$\begin{bmatrix} -2 & 3 & 6 \\ 0 & 3 & 6 \\ 0 & 0 & 1 \end{bmatrix}$$.	Apply	Learner to recall the concept of Eigen values properties of the matrix, understand the characteristic equation to find Eigen values.	CO 2, CO 3
MODULE III				
FUNCTIONS OF SINGLE AND SEVERAL VARIABLES				
PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
Q.No	**QUESTION**	**Taxonomy**	**How does this subsume the level**	**CO's**
1	Summarize the conclusion of Rolles theorem for the function $f(x) = x^3-6x^2+11x-6 \quad in \quad [1,3]$.	Apply	Learner to recall the concept of Rolle's theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4
2	Summarize the conclusion of Rolles theorem for the function$f(x) = \log\left[\frac{x^2+ab}{x(a+b)}\right]$ in the interval $[a, b]$.	Apply	Learner to recall the concept of Rolle's theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4
3	Utilize the Lagrange's mean value theorem to establish the following inequalities $$x \le sin^{-1}x \le \frac{x}{\sqrt{1-x^2}}$$ for $0 \le x \le 1$.	Apply	Learner to recall the concept of Lagrange's theorem, understa nd the existence of the solution in given interval and apply it to deduce the inequality	CO 4

4	Solve approximately the value of $\sqrt[5]{245}$ byusing L.M.V.T.	Apply	Learner to recall the concept of Lagrange's theorem, understand the existence of the solution in given interval and apply it to deduce the inequality	CO 4
5	Select the Cauchy's mean value theorem for $f(x) = x^3, g(x) = 2-x, in[0,9]$ and find the value of c.	Apply	Learner to recall the concept of Cauchy's theorem , understand the existence of the solution in given interval and apply it to find the value c	CO 4
CIE-II				
6	If $u = x + 3y^2 + z^3, v = 4x^2yz,$ $w = 2z^2 - xy$ then apply $\frac{\partial(u,v,w)}{\partial(x,y,z)} at(1,-1,0)$	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4
7	Identify whether the following functions are functionally dependent or not .If functionally dependent, find the relation between them $u = \frac{x+y}{1-xy}$, $v = tan^{-1}x + tan^{-1}y.$	Apply	Learner to recall the concept of functionally dependent, understand the partial differentiation and apply it to find the functional relation	CO 4
8	A rectangular box open at the top is to have volume of 32 cubic . Find the dimensions of the box requiring least material for its construction.	Apply	Learner to recall the concept of Lagrange's multipliers method, understand how to frame the Lagrange's equation and apply it to find the minimum value of the function	CO 4
9	Identify whether the following functions are functionally dependent or not .If functionally dependent, find the relation between them $X = u\sqrt{1-v^2} + v\sqrt{1-u^2}$ and $Y = sin^{-1}u + sin^{-1}v.$	Apply	Learner to recall the concept of functionally dependent, understand the partial differentiation and apply it to find the functional relation	CO 4

10	Find the minimum value of $x^2 + y^2 + z^2$ given that $xyz = a^3$.	Apply	Learner to recall the concept of Lagrange's multipliers method, understand how to frame the Lagrange's equation and apply it to find the minimum value of the function	CO 4
		PART-B LONG ANSWER QUESTIONS		
1	Show that the Rolle's theorem is applicable for the function $f(x) = e^x sinx$ in the interval $[0, \pi]$.	Apply	of Rolle's theorem, understand the existence of the solution in given interval and apply it to solve the function.	CO 4
2	Verify the Rolle's theorem is applicable for the function $f(x) = e^{-x}[sinx - cosx]$ in the interval $[\pi/4, 5\pi/4]$.	Apply	Learner to recall the concept of Rolle's theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4
3	Show that the Lagrange's mean value theorem is applicable for the function $f(x) = x^3 - x^2 - 5x + 3$in the interval $[0, 4]$.	Apply	Learner to recall the concept of Lagrange's theorem, understa nd the existence of the solution in given interval and apply it to deduce the inequality	CO 4
4	If a<b, show that $\frac{b-a}{1+b^2} < tan^{-1}b - tan^{-1}a$ $< \frac{b-a}{1+a^2}$ Select Lagrange's Mean value theorem and hence deduce the following. $(1)\frac{\pi}{4}+\frac{3}{25} < tan^{-1}\frac{4}{3} < \frac{\pi}{4}+\frac{1}{6},$ $(2)\frac{5\pi+4}{20} < tan^{-1}2 < \frac{\pi+2}{4}$.	Apply	Learner to recall the concept of Lagrange's theorem, understa nd the existence of the solution in given interval and apply it to deduce the inequality	CO 4

5	Find the value of c in the interval [3,7] for the function $f(x) = e^x$, $g(x) = e^{-x}$ using CMVT.	Apply	Learner to recall the concept of Cauchy's theorem , understand the existence of the solution in given interval and apply it to find the value c.	CO 4
6	Choose the Cauchy's mean value theorem to find the value of c,for the functions $f(x) = \sqrt{x}$, $g(x) = \frac{1}{\sqrt{x}}$ in [a,b]where 0<a<b	Apply	Learner to recall the concept of Cauchy's theorem , understand the existence of the solution in given interval and apply it to find the value c.	CO 4
7	Select Cauchy's mean value theorem for the functions $f(x) = x^2, g(x) = x^3$ in [1 , 2] to find the value of c.	Apply	Learner to recall the concept of Cauchy's theorem , understand the existence of the solution in given interval and apply it to find the value c.	CO 4
8	Choose the Rolle's theorem to find c value,for the function $f(x) = (x-a)^m(x-b)^n$ where m,n are positive integers in [a,b].	Apply	Learner to recall the concept of Rolle's theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4
9	Select the mean value theorem, for 0 < a < b, show that $$1 - \frac{a}{b} < \log\frac{b}{a} < \frac{b}{a} - 1$$ and hence deduce $$\frac{1}{6} < \log\frac{6}{5} < \frac{1}{5}$$.	Apply	Learner to recall the concept of Lagrange's theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4
10	Find all values of c between a and b ,which satisfies Lagrange's mean value theorem ,for the following function $$f(x) = (x-1)(x-2)(x-3)$$ in [0 , 4].	Apply	Learner to recall the concept of Lagrange's theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4

CIE-II				
11	If $x = u(1-v), y = uv$, then show that $JJ^1 = 1$. if $x + y^2 = u, y + z^2 = v$, $z + x^2 = w$, find the value of $\frac{\partial(x,y,z)}{\partial(u,v,w)}$.	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4
12	If $u = x^2 - y^2, v = 2xy$ where $x = rcos\theta, y = rsin\theta$ then show that $\frac{\partial(u,v)}{\partial(r,\theta)} = 4r^3$.	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4
13	If $x = e^r \sec\theta, y = e^r \tan\theta$ then prove that $\frac{\partial(x,y)}{\partial(r,\theta)} \frac{\partial(r,\theta)}{\partial(x,y)} = 1$.	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4
14	If ux=yz,vy=zx,wz=xy then find the jacobian $\frac{\partial(x,y,z)}{\partial(u,v,w)}$.	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4
15	Make use of Lagrange's multipliers method to find the minimum value of the function $x^2 + y^2$, subject to the condition $ax + by = c$.	Apply	Learner to recall the concept of Lagrange's multipliers method, understand how to frame the Lagrange's equation and apply it to find the minimum value of the function.	CO 4
16	Find the maximum volume of a rectangular parallelepiped that can be inscribed in a sphere using lagranges multipliers method.	Apply	Learner to recall the concept of Lagrange's multipliers method, understand how to frame the Lagrange's equation and apply it to find the minimum value of the function.	CO 4

17	Find the volume of the largest(maxima) rectangular parallelepiped that can be inscribed in the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$.	Apply	Learner to recall the concept of Lagrange's multipliers method, understand how to frame the Lagrange's equation and apply it to find the minimum value of the function.	CO 4
18	Show the stationary points of $u(x, y) = Sinx.Siny.Sin(x + y)$ where $0 < x < \pi$,$0 < y < \pi$ and find the maximum value of the function U.	Apply	Learner to recall the concept of Lagrange's multipliers method, understand how to frame the Lagrange's equation and apply it to find the minimum value of the function.	CO 4
19	Calculate the stationary points of $f(x, y) = Sinx + Siny + Sin(x + y)$ where $0 < x < \pi$,$0 < y < \pi$ and find the maximum value of the function f.	Apply	Learner to recall the concept of Lagrange's multipliers method, understand how to frame the Lagrange's equation and apply it to find the minimum value of the function.	CO 4
20	Find the points on the plane $3x + 2y + z - 12 = 0$ nearest to the origin.	Apply	Learner to recall the concept of Lagrange's multipliers method, understand how to frame the Lagrange's equation and apply it to find the minimum value of the function.	CO 4
PART-C SHORT ANSWER QUESTIONS				
1	How Rolle's theorem is applicable for any function f(x) in the interval [a,b].	Understand	Learner to recall the concept of Rolle's theorem and define it	CO 4
2	How Lagrange's mean value theorem is applicable for any function f(x) in the interval [a, b].	Understand	Learner to recall the concept of Lagrange's theorem and define it	CO 4

3	How Cauchy's mean value theorem is applicable for any function f(x) in interval [a, b].	Understand	Learner to recall the concept of Cauchys mean value theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4
4	Explain Rolle's theorem geometrically.	Understand	Learner to recall the concept of Rolle's theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4
5	Explain Lagrange's mean value theorem geometrically.	Understand	Learner to recall the concept of Lagrange's theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4
6	Illustrate an example of function that is continuous on [-1, 1] and for which mean value theorem does not hold.	Apply	Learner to recall the concept of mean value theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4
7	Make use of Lagrange's mean value theorem, to find the value of c for the function f(x) = log x in $(1, e)$.	Apply	Learner to recall the concept of Lagrange's theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4
8	Explain why mean value theorem does not hold for $f(x) = x^{\frac{2}{3}}$ in [-1,1]	Apply	Learner to recall the concept of Lagrange's theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4
9	Identify the region in which is increasing $f(x) = 1 - 4x - x^2$, using mean value theorem	Apply	Learner to recall the concept of Lagrange's theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4

10	If $f^1(x) = 0$ throughout an interval [a, b], using mean value theorem, show that f(x) is constant.	Apply	Learner to recall the concept of Lagrange's theorem, understand the existence of the solution in given interval and apply it to solve the function	CO 4
CIE-II				
11	If $x = \frac{u^2}{v}, x = \frac{v^2}{v}$, find the value of $\frac{\partial(u,v)}{\partial(x,y)}$	Apply	Learner to recall the concept of partial differentiation and apply it to find the given function.	CO 4
12	Find the stationary point of the function $f(x, y) = x^2 + y^2 + xy + x - 4y + 5$	Apply	Learner to recall the concept of partial differentiation and apply it to find the given function.	CO 4
13	If $x = u(1 - v), y = uv$ find the value of J^1	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4
14	Find $$\frac{\partial(x, y, z)}{\partial(u, v, w)}$$ if $u = \frac{2yz}{x}$,$v = \frac{3zx}{y}$,$w = \frac{4xy}{z}$	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4
15	If $x = u(1 + v), y = v(1 + u)$ then find the value of $\frac{\partial(x,y)}{\partial(u,v)}$	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4
16	If $X = rcos\theta, Y = rsin\theta$ then find J.	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4

17	If $X = rcos\theta, Y = rsin\theta$ then find J^1.	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4
18	If $x = uv, y = u/v$ then find $Jacobian$.	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4
19	If $u = x^2, v = y^2$ then find J.	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4
20	If $u = 2axy, v = a(x^2 - y^2)$ then find Jacobian	Apply	Learner to recall the concept of Jacobian transformation between two fields, understand the partial differentiation and apply it to find the Jacobian value.	CO 4
MODULE IV				
FOURIER SERIES				
PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
Q.No	**QUESTION**	**Taxonomy**	**How does this subsume the level**	**CO's**
1	Find the Fourier Series of the periodic function defined as f(x)=$\begin{cases} x, & 0 < x < \frac{\pi}{2} \\ \pi - x, & \frac{\pi}{2} < x < \pi \end{cases}$, then prove that $f(x) = \frac{4}{\pi}(Sinx - \frac{1}{3^2}Sin3x + \frac{1}{5^2}Sin5x - --)$	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5

2	If f(x)=$\begin{cases} -\pi, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases}$ Hence deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + ------ = \frac{\pi^2}{8}$	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
3	If f(x)=$\begin{cases} 1 + \frac{2x}{\pi}, & -\pi \leq x \leq 0 \\ 1 - \frac{2x}{\pi}, & 0 \leq x \leq \pi \end{cases}$ Then find the values of a_0, a_n, b_n?	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
4	Find the Fourier series of the periodic function defined as f(x)=$\begin{cases} -k, & -\pi \leq x \leq 0 \\ k, & 0 \leq x \leq \pi \end{cases}$ and hence show that $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + ... = \frac{\pi}{4}$	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
5	Determine the Fourier Series representation of the half wave rectifier signal x(t)=$\begin{cases} sint, & 0 \leq t < \pi \\ 0, & \pi \leq t < 2\pi \end{cases}$.	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
6	Let f(x)=$\begin{cases} t, & 0 \leq t \leq 1 \\ 2 - t, & 1 \leq t \leq 2 \end{cases}$ be a periodic signal with fundamental period T=2, Find the Fourier coefficients a_0, a_n, b_n?	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
7	In the expansion of $f(x) = (\frac{\pi - x}{2})^2$, 0 < x < 2π, find the value of a_n, b_n?	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
8	Determine the Fourier Series representation of the half wave rectifier signal x(t)=$\begin{cases} t, & 0 \leq t < \pi \\ 2\pi - t, \pi \leq t < 2\pi \end{cases}$.	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5

9	Find the Fourier Series of the periodic function defined as f(x)= $\begin{cases} 0, & -\pi < x < 0 \\ x^2, & 0 < x < \pi \end{cases}$.	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
10	Find the Fourier Series of the periodic function defined as f(x)= $\begin{cases} \frac{-1}{2}(\pi + x), -\pi < x < 0 \\ \frac{1}{2}(\pi - x), 0 < x < \pi \end{cases}$	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
PART B- LONG ANSWER QUESTIONS				
1	Obtain the Fourier Series expansion of f(x) given that f(x)= $(\pi - x)^2$ in $0 < x < 2\pi$ and deduce the value of $\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + ... = \frac{\pi^2}{6}$	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
2	Find the Fourier Series to represent the function f(x)= x^3 , in -π< x < π.	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
3	If f(x) = x , in (-π,π) , Find the Fourier Series expansion for the function .	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
4	Find the Fourier Series to represent the function $f(x) = e^{ax}$ in $0 < x < 2\pi$.	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
5	Determine the half range Fourier Sine Series for the function f(x) = cos x for 0 < x < π.	Apply	Learner to recall the concept of half- range Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5

6	Find the Fourier Series expansion for the function f(x) = x^2 , 0 < x < 2π.	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
7	If f(x)= Cosx , expand f(x) as a Fourier Series in the interval (-π,π).	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
8	Express the function $f(x) = x - \pi$ as Fourier Series in the interval (-π,π).	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
9	Find the Fourier Series to represent the function $f(x) = e^{-ax}$ from $x = (-\pi, \pi)$. And hence deduce that $\frac{\pi}{sinh\pi} = 2[\frac{1}{2^2+1} - \frac{1}{3^2+1} + \frac{1}{4^2+1} - --]$	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
10	Expand the function f(x)=$(\frac{\pi-x}{2})^2$ as a Fourier Series in the interval $0 < x < 2\pi$, hence deduce that $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - .....=\frac{\pi^2}{12}$.	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function	CO 5
11	Find the Fourier Series to represent the function $f(x) = x - x^2$ in (-π,π)	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
12	Determine the Half Range Sine Series for $f(x) = x(\pi - x), 0 < x < \pi$. Deduce that $\frac{1}{1^3} - \frac{1}{3^3} + \frac{1}{5^3} - ..... = \frac{\pi^3}{32}$.	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5

13	Express f(x)= e^{-x} as a Fourier Series in the interval $(-l, l)$.	Apply	Learner to recall the concept of Fourier series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
14	Find the Fourier Series of periodicity 3 for the function $f(x) = 2x - x^2, \quad in \quad (0, 3)$.	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
15	Find the half – Range Fourier Cosine Series for the function f(x)= $Sin\frac{\pi x}{l}$ in the range $(0, l)$.	Apply	Learner to recall the concept of Half Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
16	If f(x)= $\frac{e^{ax}-e^{-ax}}{e^{a\pi}-e^{-a\pi}}$, in (0,π), Find the Half- Range Fourier Sine Series for the function.	Apply	Learner to recall the concept of Half range Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
17	Find the Fourier Series expansion for the function f(x) = | x | , in $(-\pi, \pi)$.	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
18	From the following function, find the fourier series of $f(x) = x + x^2$. , in (-π,π)	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
19	Find the Fourier Series of periodicity 5 for the function $f(x) = 2x - x^2, \quad in$ (0,5).	Apply	Learner to recall the concept of Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5

20	Find the Half Range Fourier Cosine Series for the function $f(x) = Sinx, \quad 0 < x < \pi.$	Apply	Learner to recall the concept of Half- Range Fourier Series, understand its relation and apply it to obtain the Fourier Series of the given function.	CO 5
		PART C- SHORT ANSWER QUESTIONS		
1	Define a Periodic Function for f(x) and give example.	Remember	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
2	State Even and Odd function the function f(x).	Remember	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
3	Find whether the following functions are Even or Odd (i) x Sinx+Cosx+$x^2 Coshx$ (ii) x Coshx+$x^3 Sinhx$.	Apply	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
4	Find the Primitive Periods of the functions $Sin3x, Tan5x, Sec4x$.	Apply	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
5	Explain the Euler's formulae in the interval (α, α+2π).	Understand	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
6	Write the Half- Range Fourier Sin and Cosine Series in (0,l).	Remember	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
7	Write the examples of Periodic Function.	Remember	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
8	Explain the Dirichlet's Conditions for the existence of Fourier Series of a function f(x) in the interval (α, α+2π).	Understand	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
9	What are the conditions for expansion of a function in Fourier Series?	Remember	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
10	If f(x) is an Odd function in the interval (-l,l) then what are the value of a_0, a_n?	Apply	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
11	If f(x) = x^2 in $(-l, l)$ then find b_1?.	Apply	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5

12	What is the Fourier Sine Series for f(x) = x in (0,π)?.	Apply	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
13	State Fourier Series of a function f(x) in the interval (C, C +2π)?	Remember	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
14	Define Fourier Series of a function f(x) in the interval (-l,l)?	Understand	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
15	If f(x) = $x^2 - x$ in (-π,π) then what is a_0?	Apply	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
16	Explain the Fourier Series for Even Function?	Understand	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
17	Write about the Fourier Series for odd function?	Understand	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
18	If f(x) = x in (0,π) then find the Fourier Coefficient a_0?	Apply	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
19	If f(x) = Cosx in $(-\pi, \pi)$ then find the Fourier Coefficient a_0?	Apply	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
20	If f(x) = x^3 in (-π,π) then what is a_0?	Apply	Learner to recall the concept of Fourier Series, Periodic Function for f(x).	CO 5
MODULE V				
MULTIPLE INTEGRALS				
PART A - PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS				
1	Solve the double integral $$\int_{-1}^{2}\int_{2}^{x+2} dydx$$	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
2	Evaluate where R is the region bounded by the plane $$\iiint_R x+y+zdxdydz$$ ..	Apply	Learner to recall basic integral formulae ,explain triple integration and apply it to the given Cartesian form function.	CO 6

3	Evaluate $$\iint x^2 dxdy$$ over the region bounded by hyperbola xy=4,y=0,x=1,x=4	Apply	Learner to recall basic integral formulae, explain double integration and apply the double integration to get the area inCartesian form.	CO 6
4	Find the area bounded by curves xy=2,4$y = x^2$ and the line y=4.	Apply	Learner to recall basic integral formulae, explain the double integration and apply it to obtain the area in Cartesian form.	CO 6
5	Calculate the double integral $$\int_0^2 \int_0^x \exp^{[x+y]} dydx$$.	Apply	Learner to recall basic integral formulae, explain double integral and apply it to the given Cartesian form function.	CO 6
6	Evaluate by converting to polar co-ordinates $$\int_0^a \int_0^{\sqrt{a^2+x^2}} y\sqrt{x^2+y^2} dydx$$.	Apply	Learner to recall basic integral formulae, explain the double integration apply it to convert Cartesian form as Polar form.	CO 6
7	Find the volume of tetrahedron bounded by the co-ordinate planes and the plane $$\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1.$$	Apply	Learner to recall basic integral formulae, explain triple integration and apply it to obtain the volume in Cartesian form.	CO 6
8	Using double integral, find area of the cardioid r = a(1 + cosθ) .	Apply	Learner to recall basic integral formulae, explain and apply the double integration to obtain the area in Polar form.	CO 6
9	Determine the area of $$\iint r^3 drd\theta$$ over the region included between the circles r=sin$\theta, r = 4cos\theta$	Apply	Learner to recall basic integral formulae, explain the double integration and apply it to obtain the area in Polar form.	CO 6

10	If R is the region bounded by the planes x=0, y=0, z=1 and the cylinder $$x^2 + y^2 = 1,$$ evaluate $$\iiint_R xyzdxdydz$$	Apply	Learner to recall basic integral formulae, explain the triple integration and apply the volume integration to the Cartesian form of bounded region.	CO 6
		PART-B LONG ANSWER QUESTIONS		
1	Evaluate the triple integral $\int_0^1 \int_0^{1-z} \int_0^{1-y-z} xyzdxdydz.$	Apply	Learner to recall basic integral formulae, explain triple integration and apply it to the given Cartesian form function.	CO 6
2	Solve the double integral $\int_0^\pi \int_0^{a[1+cos\theta]} r^2 cos\theta drd\theta.$	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given polar form function.	CO 6
3	Calculate the double integral $\int_0^1 \int_x^{\sqrt{x}} [x^2 + y^2]dxdy.$	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
4	Solve the double integral $\int_0^5 \int_0^{x^2} x[x^2 + y^2]dxdy.$	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
5	Evaluate the double integral $\int_0^1 \int_0^{\frac{\pi}{2}} rsin\theta drd\theta.$	Apply	Learner to recall basic integral formulae, explain triple integration and apply it to the given polar form function.	CO 6
6	By changing the order of integration evaluate the double integral $\int_0^1 \int_{x^2}^{2-x} xydxdy.$	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6

7	Evaluate the double integral $\int_0^a \int_0^{\sqrt{a^2-y^2}} (x^2y^2)dydx$.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
8	Solve the triple integral $\int_0^{\log 2} \int_0^x \int_0^{x+\log y} e^{[x+y+z]}dxdydz$.	Apply	Learner to recall basic integral formulae, explain triple integration and apply it to the given Cartesian form function.	CO 6
9	Evaluate the triple integral $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} \frac{dxdydz}{\sqrt{1-x^2-y^2-z^2}}$.	Apply	Learner to recall basic integral formulae, explain triple integration and apply it to the given Cartesian form function.	CO 6
10	Find the value of $\iint xydxdy$ taken over the positive quadrant of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to obtain the area in Cartesian form.	CO 6
11	Evaluate the double integral using change of variables $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)}dxdy$	Apply	Learner to recall basic integral formulas, explain double integration and apply change of variable to the given function.	CO 6
12	Find the volume of the tetrahedron bounded by the plane $\frac{x}{a} + \frac{y}{b} + \frac{z}{c} = 1$ and the coordinate planes by triple integration.	Apply	Learner to recall basic integral formulae, explain and apply the triple integration to value the volume in Cartesian form.	CO 6
13	By transforming into polar coordinates Evaluate $\iint \frac{x^2y^2}{x^2+y^2}dxdy$ over the annular region between the circles $x^2 + y^2 = a^2$ and $x^2 + y^2 = b^2$ with b >a .	Apply	Learner to recall basic integral formulae, explain double integration and apply it to convert Cartesian form as Polar form.	CO 6
14	Find the area of the region bounded by the parabola $y^2 = 8ax$ and $x^2 = 8ay$.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to value the area in Cartesian form.	CO 6

15	Evaluate $\iint r^3 dr d\theta$ over the area included between the circles $r = 2sin\theta$ and $r = 4sin\theta$	Apply	Learner to recall basic integral formulae, explain the double integration and apply it to obtain the area in Polar form.	CO 6
16	Using triple integration find the volume of the sphere $x^2 + y^2 + z^2 = a^2$.	Apply	Learner to recall basic integral formulae, explain triple integration and apply the triple integration to value the volume in Cartesian form.	CO 6
17	Find the area of the cardioid $r = a(1cos\theta)$.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to value the area in Polar form.	CO 6
18	Calculate the area of the region bounded by the curves $y = x^3$ and y = x.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to obtain the area in Cartesian form.	CO 6
19	Evaluate$\iiint_V dxdydz$ where v is the finite region of space formed by the planes x=0, y=0, z=0 and 2x+3y+4z=12.	Apply	Learner to recall basic integral formulae, explain triple integration and apply it to obtain the area in Cartesian form.	CO 6
20	Find the area bounded by curves $xy = 2, 4y = x^2$ and the line y=4.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to obtain the area in Cartesian form.	CO 6
PART-C SHORT ANSWER QUESTIONS				
1	Evaluate the double integral $$\int_0^2 \int_2^x ydxdy$$	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
2	Solve the double integral $$\int_0^\pi \int_2^{acos\theta} rdrd\theta$$ ..	Apply	Learner to recall basic integral formulae ,explain double integration and apply it to the given function in polar form.	CO 6

3	Evaluate the double integral $$\int_0^3 \int_0^1 xy(x+y)dxdy$$.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
4	Find the value of double integral $$\int_1^2 \int_1^3 xy^2 dxdy$$.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
5	Find the value of triple integral $$\int_{-1}^1 \int_{-2}^2 \int_{-3}^3 dxdydz$$.	Apply	Learner to recall basic integral formulae, explain triple integration and apply it to the given Cartesian form function.	CO 6
6	Evaluate the double integral $$\int_0^2 \int_0^x ydydx$$	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
7	Determine the double integral $$\int_0^{\frac{\pi}{2}} \int_{-1}^1 x^2y^2 dxdy$$.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
8	Evaluate the double integral $$\int_0^{\pi} \int_2^{asin\theta} rdrd\theta$$.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given polar form function.	CO 6
9	Solve the double integral $$\int_0^{\infty} \int_0^{\frac{\pi}{2}} e^{-r^2} rdrd\theta$$	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given polar form function.	CO 6
10	Evaluate the double integral $$\int_0^{\pi} \int_2^{a(1+cos\theta)} rdrd\theta$$	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6

11	State the formula to find area of the region using double integration in Cartesian form	Remember	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
12	Find the volume of the tetrahedron bounded by the coordinate planes and the plane x+y+z=1	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
13	State the formula to find volume of the region using triple integration in Cartesian form.	Remember	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
14	Find area of the ellipse using double integration $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
15	State the formula to find area of the region using double integration in polar form.	Remember	Learner to recall basic integral formulae, explain double integration and apply it to the given polar form function.	CO 6
16	Find the area of the region bounded by the parabolas $y^2 = 4x$ and $x^2 = 4y$	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6
17	Find the area of the curve $r = 2acos\theta$ using double integration in polar coordinates.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given polar form function.	CO 6
18	Determine the area enclosed between the parabola $y = x^2$ and the line y = x .	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6

19	Find the area of the curve $r = 2asin\theta$.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given polar form function.	CO 6
20	Calculate the area of the circle $x^2 + y^2 = a^2$.	Apply	Learner to recall basic integral formulae, explain double integration and apply it to the given Cartesian form function.	CO 6

Course Coordinator: **HOD**
Mr. P Shantan Kumar, Assistant Professor