INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad-500043

FRESHMAN ENGINEERING

TUTORIAL QUESTION BANK

Course Title	**LINEAR ALGEBRA AND CALCULUS (COMMON FOR AE / CSE / IT / ECE / EEE / ME / CE)**			
Course Code	**BSC103**			
Programme	**B.Tech**			
Semester	**I**			
Course Type	**Core**			
Regulation	**IARE - R18**			
Course Structure	**Lectures**	**Tutorials**	**Practical**	**Credits**
	3	1	-	4
Course Coordinator	Ms. L Indira, Associate Professor			
Course Faculty	Dr. M Anita, Professor Dr. S Jagadha, Professor Mr. Ch Somashekar, Associate Professor Mr. V Subba Laxmi, Associate Professor Mr. J Suresh Goud, Associate Professor Ms. P Srilatha, Assistant Professor Ms. C Rachana, Assistant Professor Ms. P Rajani, Assistant Professor Ms. B Praveena, Assistant Professor			

I. COURSE OBJECTIVES (COs):

The course should enable the students to:

I	Analyze and solve linear system of equations by using elementary transformations.
II	Determine the maxima and minima of functions of several variables by using partial differential coefficients.
III	Apply second and higher order linear differential equations to solve electrical circuits.
IV	Apply multiple integration to evaluate mass, area and volume of the plane.
V	Analyze gradient, divergence and curl to evaluate the integration over a vector field.

II. COURSE LEARNING OUTCOMES (CLOs):

Students, who complete the course, will have demonstrated the ability to do the following:

CBSC103.01	Demonstrate knowledge of matrix calculation as an elegant and powerful mathematical language in connection with rank of a matrix.
CBSC103.02	Determine rank by reducing the matrix to Echelon and Normal forms.
CBSC103.03	Determine inverse of the matrix by Gauss Jordon Method.

CBSC103.04	Interpret the Eigen values and Eigen vectors of matrix for a linear transformation and use properties of Eigen values
CBSC103.05	Understand the concept of Eigen values in real-world problems of control field where they are pole of closed loop system.
CBSC103.06	Apply the concept of Eigen values in real-world problems of mechanical systems where Eigen values are natural frequency and mode shape.
CBSC103.07	Use the system of linear equations and matrix to determine the dependency and independency.
CBSC103.08	Determine a modal matrix, and reducing a matrix to diagonal form.
CBSC103.09	Evaluate inverse and powers of matrices by using Cayley-Hamilton theorem.
CBSC103.10	Apply the Mean value theorems for the single variable functions.
CBSC103.11	Find partial derivatives numerically and symbolically and use them to analyze and interpret the way a function varies.
CBSC103.12	Find partial derivatives of and apply chain rule derivative techniques to multivariable functions.
CBSC103.13	Understand the techniques of multidimensional change –of –variables to transform the coordinates by utilizing the Jacobian. Determine Jacobian for the coordinate transformation.
CBSC103.14	Apply maxima and minima for functions of several variable's and Lagrange's method of multipliers.
CBSC103.15	Find the complete solution of a non-homogeneous differential equation as a linear combination of the complementary function and a particular solution..
CBSC103.16	Solving Second and higher order differential equations with constant coefficients
CBSC103.17	Apply the second order differential equations for real world problems of electrical circuits
CBSC103.18	Evaluate double integral and triple integrals.
CBSC103.19	Utilize the concept of change order of integration and change of variables to evaluate double integrals.
CBSC103.20	Determine the area and volume of a given curve.
CBSC103.21	Analyze scalar and vector fields and compute the gradient, divergence and curl.
CBSC103.22	Understand integration of vector function.
CBSC103.23	Evaluate line, surface and volume integral of vectors.
CBSC103.24	Use Vector integral theorems to facilitate vector integration.

TUTORIAL QUESTION BANK

UNIT - I			
THEORY OF MATRICES AND LINEAR TRANSFORMATIONS			
Part - A (Short Answer Questions)			
S No	QUESTIONS	Blooms Taxonomy Level	Course Learning Outcomes (CLOs)
1	Define Orthogonal matrix.	Remember	CBSC103.01
2	State Cayley- Hamilton theorem.	Remember	CBSC103.09
3	Prove that $\frac{1}{2}\begin{bmatrix} 1+i & -1+i \\ 1+i & 1-i \end{bmatrix}$ is a unitary matrix.	Understand	CBSC103.01
4	Find the value of k such that rank of $\begin{bmatrix} 1 & 2 & 3 \\ 2 & k & 7 \\ 3 & 6 & 10 \end{bmatrix}$ is 2	Understand	CBSC103.02
5	Find the Skew-symmetric part of the matrix $\begin{bmatrix} 1 & 1 & 2 \\ -1 & 1 & 1 \\ 3 & -1 & 2 \end{bmatrix}$.	Understand	CBSC103.01
6	Define Rank of a matrix.	Remember	CBSC103.02
7	If $A = \begin{bmatrix} 3 & a & b \\ -2 & 2 & 4 \\ 7 & 4 & 5 \end{bmatrix}$ is symmetric, then find the values of a and b.	Understand	CBSC103.01
8	Prove that A = $\begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ is orthogonal.	Understand	CBSC103.01
9	Define Unitary matrix.	Remember	CBSC103.01
10	Find the sum of Eigen values of the matrix $\begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$	Understand	CBSC103.04
11	Determine the values of a, b, c when the matrix $\begin{bmatrix} 0 & 2b & c \\ a & b & -c \\ a & -b & c \end{bmatrix}$ is orthogonal.	Understand	CBSC103.01
12	Show that the vectors X_1=(1,1,2), X_2=(1,2,5) and X_3=(5,3,4) are linearly dependent.	Understand	CBSC103.07
13	Express the matrix A as sum of symmetric and Skew-symmetric matrices. where A = $\begin{bmatrix} 3 & -2 & 6 \\ 2 & 7 & -1 \\ 5 & 4 & 0 \end{bmatrix}$	Understand	CBSC103.01
14	Define Skew-Hermitian matrix.	Remember	CBSC103.01

15	Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 8 & 7 & 0 & 5 \end{bmatrix}$	Understand	CBSC103.02
16	Find the characteristic equation of the matrix $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$	Understand	CBSC103.07
17	Find the Eigen values of the matrix $\begin{pmatrix} 2 & -1 & -1 \\ -1 & 2 & -1 \\ -1 & -1 & 2 \end{pmatrix}$	Understand	CBSC103.07
18	Find the value of k such that the rank of $\begin{bmatrix} 1 & 1 & -1 & 1 \\ 1 & -1 & k & -1 \\ 3 & 1 & 0 & 1 \end{bmatrix}$ is 2.	Understand	CBSC103.02
19	Show that the vectors X_1=(1,1,1) X_2=(3,1,2) and X_3=(2,1,4) are linearly independent.	Understand	CBSC103.07
20	Define Modal and Spectral matrices.	Remember	CBSC103.08
	Part - B (Long Answer Questions)		
1	By reducing the matrix $\begin{bmatrix} -1 & 2 & 0 \\ 3 & 7 & 1 \\ 5 & 9 & 3 \end{bmatrix}$ into normal form, find its rank.	Understand	CBSC103.02
2	Find the values of 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.	Understand	CBSC103.02
3	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.	Understand	CBSC103.02
4	Find the inverse of a matrix by using Gauss-Jordan method $\begin{bmatrix} -1 & -3 & 3 & 1 \\ 1 & 1 & -1 & 0 \\ 2 & -5 & 2 & -3 \\ -1 & 1 & 0 & 1 \end{bmatrix}$	Apply	CBSC103.03
5	Reduce the matrix to its normal form where $A = \begin{bmatrix} 1 & -2 & 0 & 1 \\ 2 & -1 & 1 & 0 \\ 3 & -3 & 1 & 1 \\ -1 & -1 & -1 & 1 \end{bmatrix}$.	Understand	CBSC103.02

6	Diagonalize the matrix A= $\begin{pmatrix} 1 & 1 & 1 \\ 0 & 2 & 1 \\ -4 & 4 & 3 \end{pmatrix}$ by linear transformation and hence find A^4.	Understand	CBSC103.08
7	For what 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	Understand	CBSC103.02
8	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	CBSC103.09
9	Reduce the matrix A to its normal form where $A = \begin{bmatrix} 0 & 1 & 2 & -2 \\ 4 & 0 & 2 & 6 \\ 2 & 1 & 3 & 1 \end{bmatrix}$ and hence find the rank	Understand	CBSC103.02
10	Express A^5-4A^4-7A^3+11A^2-A-10I as a linear polynomial in A, where $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$	Understand	CBSC103.09
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.	Understand	CBSC103.04
12	Find the inverse of $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$ by elementary row operation.	Understand	CBSC103.03
13	Find a matrix P such that $P^{-1}AP$ is a diagonal matrix, where A= $\begin{bmatrix} -2 & 2 & -3 \\ 2 & 1 & -6 \\ -1 & -2 & 0 \end{bmatrix}$	Understand	CBSC103.09
14	Find the Eigen values and Eigen vectors of the matrix A and its inverse, where A = $\begin{bmatrix} 1 & 3 & 4 \\ 0 & 2 & 5 \\ 0 & 0 & 3 \end{bmatrix}$	Understand	CBSC103.04
15	Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 0 \\ 2 & 4 & 3 & 2 \\ 3 & 2 & 1 & 3 \\ 6 & 8 & 7 & 5 \end{bmatrix}$ by reducing to normal form	Understand	CBSC103.02

16	Find Eigen values and Eigen vectors of the matrix $\begin{bmatrix} 1 & -1 & 1 \\ 1 & 0 & 0 \\ -1 & 1 & -1 \end{bmatrix}$	Understand	CBSC103.04
17	Diagonalize the matrix $\begin{bmatrix} -1 & 2 & -2 \\ 1 & 2 & 1 \\ -1 & -1 & 0 \end{bmatrix}$	Understand	CBSC103.08
18	Verify Cayley-Hamilton theorem and find the inverse of the matrix A= $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$	Understand	CBSC103.09
19	Find the inverse of the matrix A= $\begin{bmatrix} -2 & 1 & 3 \\ 0 & -1 & 1 \\ 1 & 2 & 0 \end{bmatrix}$ using elementary row operations.	Understand	CBSC103.03
20	Find the rank of the matrix, by reducing it to the canonical form $\begin{bmatrix} 2 & -4 & 3 & -1 & 0 \\ 1 & -2 & -1 & -4 & 2 \\ 0 & 1 & -1 & 3 & 1 \\ 4 & -7 & 4 & -4 & 5 \end{bmatrix}$	Understand	CBSC103.02
Part - C (Problem Solving and Critical Thinking Questions)			
1	Use Cayley-Hamilton theorem to find A^3 and A^{-3} if A = $\begin{bmatrix} 2 & 4 \\ 1 & 1 \end{bmatrix}$	Apply	CBSC103.09
2	Find the Inverse of a matrix by using Gauss-Jordan method $A = \begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$.	Understand	CBSC103.03
3	Find the rank of the matrix $\begin{bmatrix} 4 & 0 & 2 & 1 \\ 2 & 1 & 3 & 4 \\ 2 & 3 & 4 & 7 \\ 2 & 3 & 1 & 4 \end{bmatrix}$ by Echelon form.	Understand	CBSC103.02
4	Is the matrix $\begin{bmatrix} 2 & 3 & 4 \\ 0 & 2 & -1 \\ 0 & 0 & 1 \end{bmatrix}$ diagonalizable? Justify your answer.	Understand	CBSC103.08
5	Verify that the Eigen values of A^2 and A^{-1} are respectively the squares and reciprocal of the Eigen values of A if $A = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$	Understand	CBSC103.04

6	Verify Cayley Hamilton theorem and find A^{-1} where A= $\begin{bmatrix} 1 & 0 & 2 \\ 0 & 2 & 1 \\ 2 & 0 & 3 \end{bmatrix}$	Understand	CBSC103.09
7	Examine whether the vectors [2,-1,3,2], [1,3,4,2], [3,5,2,2] is linearly independent or dependent?	Understand	CBSC103.07
8	Find Eigen values and corresponding Eigen vectors of the matrix $\begin{bmatrix} 3 & -1 & 1 \\ -1 & 5 & -1 \\ 1 & -1 & 3 \end{bmatrix}$	Understand	CBSC103.04
9	If $A = \begin{bmatrix} 2 & 1 & 1 \\ 0 & 1 & 0 \\ 1 & 1 & 2 \end{bmatrix}$ Find the value of the matrix $A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 8A^2 - 2A + I$.	Understand	CBSC103.09
10	Find the inverse of the matrix A using elementary operation (i.e., using Gauss-Jordan method).where A= $\begin{bmatrix} -1 & -3 & 3 & -1 \\ 1 & 1 & -1 & 0 \\ 2 & -5 & 2 & -3 \\ -1 & 1 & 0 & 1 \end{bmatrix}$.	Understand	CBSC103.03
UNIT-III			
FUNCTIONS OF SINGLE AND SEVERAL VARIABLES			
Part – A (Short Answer Questions)			
1	Discuss the applicability of Rolle's theorem for any function f(x) in interval [a,b].	Apply	CBSC103.10
2	Discuss the applicability of Lagrange's mean value theorem for any function f(x) in interval [a,b].	Apply	CBSC103.10
3	Discuss the applicability of Cauchy's mean value theorem for any function f(x) in interval [a,b].	Apply	CBSC103.10
4	Interpret Rolle's theorem geometrically.	Remember	CBSC103.10
5	Interpret Lagrange's mean value theorem geometrically.	Understand	CBSC103.10
6	Given an example of function that is continuous on [-1, 1] and for which mean value theorem does not hold.	Understand	CBSC103.10
7	Using Lagrange's mean value theorem, find the value of C for f(x) = log x in (1, e).	Apply	CBSC103.10
8	Explain why mean value theorem does not hold for $f(x) = x^{2/3}$ in [-1,1]	Understand	CBSC103.10
9	Find the region in which $f(x) = 1 - 4x - x^2$ is increasing using mean value theorem.	Understand	CBSC103.10
10	If $f'(x) = 0$ throughout an interval [a, b], using mean value theorem show that f(x) is constant.	Understand	CBSC103.10
11	Define Euler's theorem and homogeneous functions in x and y.	Remember	CBSC103.12

12	Given $u=\sin\left(\frac{x}{y}\right), x=e^{t}$ and $y=t^{2}$. Find $\frac{du}{dt}$ as a function of t.	Understand	CBSC103.12
13	If $x=\frac{u^{2}}{v}, y=\frac{v^{2}}{v}$, find the value of $\frac{\partial(u,v)}{\partial(x,y)}$	Understand	CBSC103.13
14	Analyze the value of c in the interval [3, 7] for the function $f(x)=e^{x}, g(x)=e^{-x}$	Understand	CBSC103.10
15	If $x=u(1-v), y=uv$, find the value of J'.	Understand	CBSC103.13
16	Explain the sufficient condition for the function f(x, y).	Remember	CBSC103.13
17	If $x=u(1+v), y=v(1+u)$ then find the value of $\frac{\partial(x,y)}{\partial(u,v)}$	Understand	CBSC103.13
18	Write the condition for the function f(x,y) to be functionally dependent.	Understand	CBSC103.13
19	Discuss whether the Rolle's theorem can be applied for $f(x)=\tan x$ in $[0,\pi]$	Understand	CBSC103.10
20	Define a saddle point for the function of f(x, y).	Remember	CBSC103.14
Part - B (Long Answer Questions)			
1	Verify Rolle's theorem for the function $f(x)=e^{-x}\sin x$ in the interval $[0,\pi]$.	Understand	CBSC103.10
2	Verify Rolle's theorem for the functions in $\log\left(\frac{x^{2}+ab}{x(a+b)}\right)$ in the interval $[a,b], a>0, b>0$.	Understand	CBSC103.10
3	Verify Lagrange's mean value theorem for $f(x)=x^{3}-x^{2}-5x+3$ in the interval $[0,4]$.	Understand	CBSC103.10
4	If a<b, prove that $\frac{b-a}{1+b^{2}}<Tan^{-1}b-Tan^{-1}a<\frac{b-a}{1+a^{2}}$ using Lagrange's Mean value theorem and hence deduce the following. (i) $\frac{\pi}{4}+\frac{3}{25}<Tan^{-1}\frac{4}{3}<\frac{\pi}{4}+\frac{1}{6}$ (ii) $\frac{5\pi+4}{20}<Tan^{-1}2<\frac{\pi+2}{4}$	Understand	CBSC103.10
5	Using mean value theorem prove that tan x > x in $0 < x < \pi/2$.	Understand	CBSC103.10
6	Find value of the C using Cauchy's mean value theorem for $f(x)=\sqrt{x}$ & $g(x)=\frac{1}{\sqrt{x}}$ in $[a,b]$ where $0<a<b$	Understand	CBSC103.10
7	Verify Cauchy's mean value theorem for $f(x)=x^2$ & $g(x)=x^3$ in [1,2] and find the value of c.	Understand	CBSC103.10
8	Find the maximum value of the function xyz when x + y + z = a.	Understand	CBSC103.14
9	If $u=x^{2}-y^{2}, v=2xy$ where $x=r\cos\theta, y=r\sin\theta$ then show that $\frac{\partial(u,v)}{\partial(r,\theta)}=4r^{3}$	Understand	CBSC103.13

10	If $x = e^r \sec\theta$, $y = e^r \tan\theta$ Prove that $\frac{\partial(x,y)}{\partial(r,\theta)}\frac{\partial(r,\theta)}{\partial(x,y)}$ =1.	Understand	CBSC103.13
11	Find the maxima and minima of the function $f(x, y) = x^3y^2 (1-x-y)$.	Understand	CBSC103.14
12	If $x=\frac{u^2}{v}$, $y=\frac{v^2}{u}$ then find the Jacobian of the function u and v with respect to x and y.	Understand	CBSC103.1
13	i) If x = u(1 - v), y = uv then prove that JJ'=1. ii) If $x + y^2 = u, y + z^2 = v, z + x^2 = w$ find the value of $\frac{\partial(x,y,z)}{\partial(u,v,w)}$.	Understand	CBSC103.13
14	Show that the functions $u = x + y + z, v = x^2 + y^2 + z^2 - 2xy - 2yz - 2xz$ and $w = x^3 + y^3 + z^3 - 3xyz$ are functionally related.	Understand	CBSC103.13
15	If x = u, y = tanv, z = w, then prove that $\frac{\partial(x,y,z)}{\partial(u,v,w)} = u\sec^2 v$	Understand	CBSC103.13
16	Show that the functions $u = e^x \sin y, v = e^x \cos y$ are not functionally related.	Understand	CBSC103.13
17	Find the maximum and minimum of the function $f(x,y) = \sin x + \sin y + \sin(x+y)$	Understand	CBSC103.14
18	Find the maximum and minimum values of $f(x,y) = x^3 + 3xy^2 - 3x^2 - 3y^2 + 4$	Understand	CBSC103.14
19	Prove that $u = x + y + z, v = xy + yz + zx, w = x^2 + y^2 + z^2$ are functionally dependent.	Understand	CBSC103.13
20	Examine the function $\sin x + \sin y + \sin(x + y)$ for extreme values for $0 \le x \le \pi, 0 \le y \le \pi$.	Understand	CBSC103.13
Part - C (Problem Solving and Critical Thinking Questions)			
1	Verify Rolle's theorem for the function $f(x) = (x-a)^m(x-b)^n$ where m, n are positive integers in [a, b].	Understand	CBSC103.10
2	Using mean value theorem, for 0 < a < b, prove that $1 - \frac{a}{b} < \log\frac{b}{a} < \frac{b}{a} - 1$ and hence show that $\frac{1}{6} < \log\frac{6}{5} < \frac{1}{5}$.	Understand	CBSC103.10
3	Find the maxima value of $u = x^2y^3z^4$ with the constrain condition $2x + 3y + 4z = a$	Understand	CBSC103.14
4	Find the point of the plane $x + 2y + 3z = 4$ that is closed to the origin.	Understand	CBSC103.14
5	Find three positive numbers whose sum is 100 and whose product is maximum.	Apply	CBSC103.14
6	A rectangular box open at the top is to have volume of 32 cubic ft . Find the dimensions of the box requiring least material for its construction.	Apply	CBSC103.14
7	Find the value of the largest rectangular parallelepiped that can be inscribed	Understand	CBSC103.14

	in the ellipsoid $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$.		
8	Find the stationary points of $U(x,y)=\sin x \sin y \sin(x+y)$ where $0<x<\pi, 0<y<\pi$ and find the maximum value of the function U.	Understand	CBSC103.14
9	Divide 24 into three parts such that the continued product of the first, square of the second and cube of the third is maximum.	Apply	CBSC103.14
10	If $u=x+3y^2+z^3, v=4x^2yz, w=2z^2-xy$ then find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ at (1,-1,0).	Understand	CBSC103.13

UNIT-III

HIGHER ORDER LINEAR DIFFERENTIAL EQUATIONS AND THEIR APPLICATIONS

Part - A (Short Answer Questions)

1	Write the solution of the $\frac{d^3y}{dx^3}-3\frac{dy}{dx}+2y=0$	Understand	CBSC103.15
2	Write the solution of the $(4D^2-4D+1)y=100$	Understand	CBSC103.16
3	Fine the particular integral of $\frac{1}{(D^2-1)}x$	Understand	CBSC103.16
4	Solve the differential equation $\frac{d^3y}{dx^3}+y=0$	Understand	CBSC103.15
5	Solve the differential equation $(D^2+a^2)y=0$	Remember	CBSC103.15
6	Find the particular value of $\frac{1}{(D-3)}x$	Understand	CBSC103.16
7	Find the particular value of $\frac{1}{(D-2)(D-3)}e^{2x}$	Understand	CBSC103.16
8	Solve the differential equation $(D^4-2D^3-3D^2+4D+4)y=0$	Understand	CBSC103.15
9	Write the particular values of $\frac{1}{D^2+a^2}\cos ax$ and $\frac{1}{D^2+a^2}\sin ax$	Understand	CBSC103.16
10	Find the particular integral of $(D^2-3D+2)y=\cos 3x$	Understand	CBSC103.16
11	Write the particular values of $\frac{1}{D^2+4}x\sin 2x$	Understand	CBSC103.16
12	Find the particular integral of $(1+D)y=xe^x$	Understand	CBSC103.16
13	Find the Wronskian of the differential equation $y''+\omega y=0$	Understand	CBSC103.16
14	Explain the method of variation of parameter.	Understand	CBSC103.16
15	Express the general solution of the differential equation $(D^2+16)y=\sin 4x$ without solving.	Understand	CBSC103.16
16	Find the particular integral of $(D^2+2D)y=x\cos x$	Understand	CBSC103.16

17	The general solution of the differential equation $y'' + y' - 2y = 0$ is $y = c_1 e^{x} + c_2 e^{-2x}$. Then determine the solution by applying the conditions $y(0) = 4, y'(0) = 1$	Understand	CBSC103.16
18	Define Wronskian of the functions.	Understand	CBSC103.16
19	Write the differential equation of LR and LCR circuits.	Apply	CBSC103.17
20	Mention two applications of higher order differential equations.	Understand	CBSC103.17
Part – B (Long Answer Questions)			
1	Solve the differential equation $(D^2 + 3D + 2)y = 2\cos(2x+3) + 2e^{x} + x^2$	Understand	CBSC103.16
2	Solve the differential equation $D^2(D^2 + 4)y = 96x^2 + \sin 2x - k$	Understand	CBSC103.16
3	Solve the differential equation $(D^2 - 2D + 1)y = x^2 - \sin 2x + 3$	Understand	CBSC103.16
4	Solve the differential equation $(D^2 + 2D^2 + 1)y = x^2$	Understand	CBSC103.16
5	Solve the differential equation $(D^3 - 6D^2 + 11D - 6)y = e^{-2x} + e^{-3x}$	Understand	CBSC103.16
6	Solve the differential equation $(D^2 + 1)y = \sin x \sin 2x + e^{x}x^2$	Understand	CBSC103.16
7	Solve the differential equation $(D^3 + 1)y = 3 + 5e^{x}$	Understand	CBSC103.16
8	Solve the differential equation $(D^2 - 3D + 2)y = \cos hx$	Understand	CBSC103.16
9	Solve the differential equation $(D^2 - 4)y = 2\cos^2 x$	Understand	CBSC103.16
10	Solve the differential equation $(D^2 + 9)y = \cos 3x + \sin 2x$	Understand	CBSC103.16
11	By using method of variation of parameters solve $y'' + y = x\cos x$.	Understand	CBSC103.16
12	By using method of variation of parameters solve $(D^2 + 4)y = \sec 2x$	Understand	CBSC103.16
13	Solve the differential equation $(D^3 - 4D^2 - D + 4)y = e^{3x}\cos 2x$	Understand	CBSC103.16
14	Solve the differential equation $(D^2 + 3D + 2)y = e^{x}$ by the method of variation of parameters.	Understand	CBSC103.16
15	Solve the differential equation $(D^2 - 4D + 4)y = x^2 \sin x + e^{2x} + 3$	Understand	CBSC103.16
16	Solve the differential equation $(D^2 + 4)y = x\sin x$	Understand	CBSC103.16
17	Apply the method of variation parameters to solve $(D^2 - 2D)y = e^{x}\sin x$	Understand	CBSC103.16
18	Solve the differential equation $(D^2 + 3D + 2)y = e^{e^{x}}$	Understand	CBSC103.16
19	Solve the differential equation $(D^2 - 5D + 6)y = x\cos x \cos 2x$	Understand	CBSC103.16
20	Solve the differential equation $(D^2 + 1)y = \frac{1}{1 + \sin x}$ by method variation of parameters.	Understand	CBSC103.16
Part – C (Problem Solving and Critical Thinking)			
1	Solve the differential equation $(D^2 + 2D + 2)y = x + \cos x$	Understand	CBSC103.16
2	Solve the differential equation $(D^3 + D^2 + 4D + 4)y = e^{-x}$	Understand	CBSC103.16

3	Solve the differential equation $\left(D^2+9\right)y = \cos 3x$	Understand	CBSC103.16
4	Solve the differential equation $\left(D-1\right)^2\left(D^2+1\right)y = e^x$	Understand	CBSC103.16
5	Solve the differential equation $\left(D^4+1\right)y = \sin x$	Understand	CBSC103.16
06	Apply the method of variation parameters to solve $\left(D^2+a^2\right)y = \tan ax$	Apply	CBSC103.16
07	If a voltage of 20 cos5t is applied to a series circuit consisting of 10 ohm resister and 2 Henry inductor, determine the current at any time t.	Apply	CBSC103.17
08	An inductor of 2 henries, resistor of 16 ohms and capacitor of 0.02m, farads are connected in series with a battery of e.m.f E = 100 sin3t. At t = 0, the charge on the capacitor and current in the circuit are zero. Find the charge and current at t > 0.	Apply	CBSC103.17
09	A Circuit consists of an inductance of 2 henrys, a resistance of 4 ohms and Capacitance of 0.05 farads. If $q = i = 0$ at $t = 0$, (a) find q(i) and i(t) when there is a constant e.m.f of 100 volts (b) find state solutions.	Apply	CBSC103.17
10	A circuit consist of inductance of 0.05 henries, a resistance of 20 ohms, a condenser of capacitance 100 microfarads and an e.m.f of E = 100 volts. Find I and Q, given the initial conditions $Q = 0$, $I = 0$ when $t = 0$.	Apply	CBSC103.17
UNIT-IV			
MULTIPLE INTEGRALS			
Part – A (Short Answer Questions)			
1	Evaluate the double integral $\int_0^2\int_0^x y\,dy\,dx$.	Understand	CBSC103.18
2	Evaluate the double integral $\int_0^{\pi}\int_0^{a\sin\theta} r\,dr\,d\theta$.	Understand	CBSC103.18
3	Evaluate the double integral $\int_0^3\int_0^1 xy\,(x+y)\,dxdy$.	Understand	CBSC103.18
4	Find the value of double integral $\int_1^2\int_1^3 xy^2\,dx\,dy$.	Understand	CBSC103.18
5	Find the value of triple integral $\int_{-1}^{1}\int_{-2}^{2}\int_{-3}^{3} dxdydz$.	Understand	CBSC103.18
6	Evaluate the double integral $\int_0^2\int_0^x y\,dy\,dx$.	Understand	CBSC103.18
7	Evaluate the double integral $\int_0^{\frac{\pi}{2}}\int_{-1}^{1} x^2y^2\,dxdy$.	Understand	CBSC103.18
8	Evaluate the double integral $\int_0^{\pi}\int_0^{a\sin\theta} r\,dr\,d\theta$.	Understand	CBSC103.18
9	Evaluate the double integral $\int_0^{\infty}\int_0^{\pi/2} e^{-r^2}\,r\,d\theta\,dr$.	Understand	CBSC103.18
10	Evaluate the double integral $\int_0^{\pi}\int_0^{a(1+\cos\theta)} r\,dr\,d\theta$.	Understand	CBSC103.18
11	State the formula to find area of the region using double integration in Cartesian form.	Understand	CBSC103.20
12	Find the volume of the tetrahedron bounded by the coordinate planes and	Understand	CBSC103.20

	the plane x+y+z=1.		
13	State the formula to find volume of the region using triple integration in Cartesian form.	Understand	CBSC103.18
14	Find area of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ using double integration.	Understand	CBSC103.20
15	State the formula to find area of the region using double integration in polar form.	Understand	CBSC103.20
16	Find the area of the region bounded by the parabolas $y^2 = 4x$ and $x^2 = 4y$.	Apply	CBSC103.20
17	Find the area of the curve r=2acosθ using double integration in polar coordinates.	Apply	CBSC103.20
18	Find the area enclosed between the parabola $y=x^2$ and the line y=x.	Apply	CBSC103.20
19	Find the area of the curve r=2asinθ.	Apply	CBSC103.20
20	Find area of the circle $x^2+y^2=a^2$.	Apply	CBSC103.20
Part – B (Long Answer Questions)			
1	Evaluate the triple integral $\int_0^1 \int_0^{1-z} \int_0^{1-y-z} xyz\,dx\,dy\,dz$.	Understand	CBSC103.18
2	Evaluate the double integral $\int_0^{\pi} \int_0^{a(1+\cos\theta)} r^2 \cos\theta\, dr\, d\theta$.	Understand	CBSC103.18
3	Evaluate the double integral $\int_0^1 \int_x^{\sqrt{x}} (x^2+y^2)\,dx\,dy$.	Understand	CBSC103.18
4	Evaluate the double integral $\int_0^5 \int_0^{x^2} x\left(x^2+y^2\right)dx\,dy$.	Understand	CBSC103.18
5	Evaluate the double integral $\int_0^1 \int_0^{\pi/2} r \sin\theta\, d\theta\, dr$.	Understand	CBSC103.18
6	By changing the order of integration evaluate the double integral $\int_0^1 \int_{x^2}^{2-x} xy\,dx\,dy$.	Understand	CBSC103.19
7	Evaluate the double integral $\int_0^a \int_0^{\sqrt{a^2-y^2}} (x^2+y^2)\,dy\,dx$.	Understand	CBSC103.18
8	Evaluate the triple integral $\int_0^{\log 2} \int_0^x \int_0^{x+\log y} e^{x+y+z}\,dx\,dy\,dz$.	Understand	CBSC103.18
9	Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} \frac{dxdydz}{\sqrt{1-x^2-y^2-z^2}}$.	Understand	CBSC103.18
10	Find the value of $\iint xy\,dx\,dy$ taken over the positive quadrant of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$.	Understand	CBSC103.18
11	Evaluate the double integral using change of variables $\int_0^{\infty}\int_0^{\infty} e^{-(x^2+y^2)}\,dx\,dy$.	Understand	CBSC103.19

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.	Understand	CBSC103.20
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 $b>a$.	Understand	CBSC103.20
14	Find the area of the region bounded by the parabola $y^2 = 4ax$ and $x^2 = 4ay$.	Understand	CBSC103.20
15	Evaluate $\int\int r^3 drd\theta$ over the area included between the circles $r=2\sin\theta$ and $r=4\sin\theta$.	Understand	CBSC103.18
16	Using triple integration find the volume of the sphere $x^2+y^2+z^2=a^2$.	Apply	CBSC103.18
17	Find the area of the cardioid r = a(1+cosθ).	Understand	CBSC103.20
18	Find the area of the region bounded by the curves $y = x^3$ and y = x.	Understand	CBSC103.20
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.	Understand	CBSC103.20
20	Find the area bounded by curves xy=2,$4y=x^2$ and the line y=4.	Understand	CBSC103.20
Part – C (Problem Solving and Critical Thinking)			
1	Evaluate $\int_0^a \int_{\frac{x}{a}}^{\sqrt{\frac{x}{a}}}(x^2+y^2)dydx$ by changing to polar coordinates.	Understand	CBSC103.18
2	Evaluate $\iiint_R (x+y+z)dzdydx$ where R is the region bounded by the plane $x=0, x=1, y=0, y=1, z=0, z=1$.	Understand	CBSC103.18
3	Evaluate $\iint x^2dxdy$ over the region bounded by hyperbola $xy=4, y=0, x=1, x=4$.	Understand	CBSC103.20
4	Find the area bounded by curves xy=2,$4y=x^2$ and the line y=4.	Understand	CBSC103.20
5	Evaluate the double integral $\int_0^2\int_0^x e^{(x+y)}dydx$.	Understand	CBSC103.18
6	Evaluate by converting $\int_0^a\int_1^{\sqrt{a^2-x^2}}(x^2+y^2)dydx$ to polar co-ordinates.	Understand	CBSC103.18
7	Find the volume of tetrahedron bounded by the co-ordinate planes and the plane $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$.	Understand	CBSC103.20
8	Using double integral, find area of the cardioid r = a(1-cosθ).	Understand	CBSC103.18
9	Evaluate the area of $\iint r^3 drd\theta$ over the region included between the circles $r=\sin\theta, r=4\sin\theta$.	Apply	CBSC103.20
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 $\iiint_R xyzdxdydz$.	Understand	CBSC103.18

UNIT-V			
VECTOR CALCULUS			
Part - A (Short Answer Questions)			
1	Define gradient of scalar point function.	Remember	CBSC103.21
2	Define divergence of vector point function.	Remember	CBSC103.21
3	Define curl of vector point function.	Remember	CBSC103.21
4	State Laplacian operator.	Understand	CBSC103.21
5	Find curl $\bar{f}$ where $\bar{f}$ = grad $(x^3 + y^3 + z^3 - 3xyz)$.	Understand	CBSC103.21
6	Find the angle between the normal to the surface xy= z^2 at the points (4, 1, 2) and (3,3,-3).	Understand	CBSC103.21
7	Find a unit normal vector to the given surface $x^2y+2xz = 4$ at the point (2,-2,3).	Understand	CBSC103.21
8	If $\bar{a}$ is a vector then prove that grad $(\bar{a}.\bar{r}) = \bar{a}$.	Understand	CBSC103.21
9	Define irrotational vector and solenoid vector of vector point function.	Remember	CBSC103.21
10	Show that $\nabla(f(r)) = \frac{\bar{r}}{r} f'(r)$.	Understand	CBSC103.21
11	Prove that f= $yzi + zxj + xyk$ is irrotational vector.	Understand	CBSC103.21
12	Show that (x+3y)i+(y-2z)j+(x-2z)k is solenoid.	Understand	CBSC103.21
13	Show that curl (grad φ) =0 where φ is scalar point function.	Understand	CBSC103.21
14	State Stokes theorem of transformation between line integral and surface integral.	Understand	CBSC103.24
15	Prove that div curl$\bar{f}$=0 where $\bar{f} = f_1\bar{i} + f_2\bar{j} + f_3\bar{k}$.	Understand	CBSC103.21
16	Define line integral on vector point function.	Remember	CBSC103.23
17	Define surface integral of vector point function $\bar{F}$.	Remember	CBSC103.23
18	Define volume integral on closed surface S of volume V.	Remember	CBSC103.23
19	State Green's theorem of transformation between line integral and double integral.	Understand	CBSC103.24
20	State Gauss divergence theorem of transformation between surface integral and volume integral.	Understand	CBSC103.24
Part - B (Long Answer Questions)			
1	Evaluate $\int_c \bar{f}.d\bar{r}$ where $\bar{f} = 3xyi - y^2j$ and C is the parabola $y=2x^2$ from points (0, 0) to (1, 2).	Understand	CBSC103.23
2	Evaluate $\iint_s \bar{F}.d\bar{s}$ if $\bar{F} = yzi + 2y^2j + xz^2k$ and S is the Surface of the cylinder $x^2+y^2=9$ contained in the first octant between the planes z = 0 and z = 2.	Understand	CBSC103.23
3	Find the work done in moving a particle in the force field $\bar{F} = (3x^2)i + (2zx - y)j + zk$ along the straight line from(0,0,0) to (2,1,3).	Understand	CBSC103.23
4	Find the circulation of $\bar{F} = (2x - y + 2z)\bar{i} + (x + y - z)\bar{j} + (3x - 2y - 5z)\bar{k}$ along the circle $x^2 + y^2 = 4$ in the xy plane.	Understand	CBSC103.23

5	Verify Gauss divergence theorem for the vector point function $F = (x^3-yz)i - 2yxj + 2zk$ over the cube bounded by x = y = z = 0 and x = y = z = a.	Understand	CBSC103.24
6	Verify Gauss divergence theorem for $2x^2yi - y^2j + 4xz^2k$ taken over the region of first octant of the cylinder $y^2 + z^2 = 9$ and $x = 2$.	Understand	CBSC103.24
7	Verify Green's theorem in the plane for $\int_C (x^2 - xy^3)dx + (y^2 - 2xy)dy$ where C is a square with vertices (0,0),(2,0),(2,2),(0,2).	Understand	CBSC103.24
8	Applying Green's theorem evaluate $\oint_c (y - \sin x)dx + \cos x\, dy$ where C is the plane triangle enclosed by $y = 0,\ y = \frac{2x}{\pi},\ and\ x = \frac{\pi}{2}$.	Understand	CBSC103.24
9	Apply Green's Theorem in the plane for $\int_c (2x^2 - y^2)dx + (x^2 + y^2)dy$ where C is a is the boundary of the area enclosed by the x-axis and upper half of the circle $x^2 + y^2 = a^2$.	Understand	CBSC103.24
10	Verify Stokes theorem for $f = (2x - y)i - yz^2 j - y^2 zk$ where S is the upper half surface of the sphere $x^2 + y^2 + z^2 = 1$ bounded by the projection of the xy plane.	Understand	CBSC103.24
11	Verify Stokes theorem for $\bar{f} = (x^2 - y^2)\bar{i} + 2xy\bar{j}$ over the box bounded by the planes x=0, x=a, y=0,y=b.	Understand	CBSC103.24
12	Find the directional derivative of the function $\phi = xy^2 + yz^3$ at the point P(1,-2,-1) in the direction to the surface $x\, logz - y^2 = -4\ at\ (-1,2,1)$.	Understand	CBSC103.21
13	If $\bar{F} = 4xz\bar{i} - y^2\bar{j} + yz\bar{k}$ evaluate $\int_s \bar{F}.\bar{n}ds$ where S is the surface of the cube x = 0 , x = a , y = 0, y = a, z = 0 , z = a.	Understand	CBSC103.23
14	If $\bar{f} = (5xy - 6x^2)\bar{i} + (2y - 4x)\bar{j}$ evaluate $\int_c \bar{f}.d\bar{r}$ along the curve C in xy-plane $y = x^3$ from (1,1) to (2,8).	Understand	CBSC103.23
15	Evaluate the line integral $\int_c (x^2 + xy)dx + (x^2 + y^2)dy$ where C is the square formed by lines $x = \pm 1,\ y = \pm 1$.	Understand	CBSC103.23
16	If $\bar{r} = x\bar{i} + y\bar{j} + z\bar{k}$ show that $\nabla r^n = nr^{n-2}\bar{r}$.	Understand	CBSC103.21
17	Evaluate by Stokes theorem $\int_c (e^x dx + 2ydy - dz)$ where c is the curve $x^2+y^2=9$ and z=2.	Understand	CBSC103.24
18	Verify Stokes theorem for the function $x^2\bar{i} + xy\bar{j}$ integrated round the square in the plane z=0 whose sides are along the line x=0,y=0,x=a, y=a.	Understand	CBSC103.24
19	Evaluate by Stokes theorem $\int_c (x + y)dx + (2x - z)dy + (y + z)dz$ where C is the boundary of the triangle with vertices (0,0,0),(1,0,0),(1,1,0).	Understand	CBSC103.24
20	Verify Green's theorem in the plane for $\int_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where C is a region bounded by $y=\sqrt{x}$ and $y = x^2$.	Understand	CBSC103.24

Part – C (Problem Solving and Critical Thinking)			
1	Verify Gauss divergence theorem for $\bar{f} = x^2\bar{i} + y^2\bar{j} + z^2\bar{k}$ taken over the cube bounded by x=0,x=a, y=0,y=b, z=0,z=c.	Understand	CBSC103.24
2	Find the work done in moving a particle in the force field $\overline{F} = (3x^2)i + (2zx - y)j + zk$ along the curve defined by $x^2 = 4y, 3x^3 = 8z$ from x=0 and x=2.	Understand	CBSC103.23
3	Show that the force field given by $\overline{F} = 2xyz^3 i + x^2 z^3 j + 3x^2 yz^2 k$ is conservative. Find the work done in moving a particle from (1,-1,2) to (3,2,-1) in this force field.	Understand	CBSC103.23
4	Show that the vector $(x^2 - yz)i + (y^2 - zx)j + (z^2 - xy)k$ is irrotational and find its scalar potential function.	Understand	CBSC103.21
5	Using Gauss divergence theorem evaluate $\iint_S \bar{F}.d\bar{s}$,for the $\overline{F} = y\vec{i} + x\vec{j} + z^2\vec{k}$ for the cylinder region S given by $x^2 + y^2 = a^2$, z = 0 and z = b.	Understand	CBSC103.24
6	Find the directional derivative of $\phi(x, y, z) = x^2 yz + 4xz^2$ at the point (1,-2,-1) in the direction of the normal to the surface f(x, y, z) = x logz – y^2at (-1,2,1).	Understand	CBSC103.21
7	Using Green's theorem in the plane evaluate $\int_C (2xy - x^2)dx + (x^2 + y^2)dy$ where C is the region bounded by $y = x^2$ and $y^2 = x$.	Apply	CBSC103.24
8	Applying Green's theorem evaluate $\int_c (xy + y^2)dx + x^2 dy$ where C is the region bounded by $y = \sqrt{x}$ and $y = x^2$.	Apply	CBSC103.24
9	Verify Green's Theorem in the plane for $\int_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where C is the region bounded by x=0, y=0 and x + y=1.	Understand	CBSC103.24
10	Verify Stokes theorem for $\overline{F} = (y - z + 2)i + (yz + 4)j - xzk$ where S is the surface of the cube x=0, y=0, z=0 and x=2,y=2,z=2 above the xy-plane.	Understand	CBSC103.24

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