Reg. No.																

Question Paper Code	13010

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2024

First Semester

Civil Engineering

(Common to All Branches Except Computer Science and Business Systems)

20BSMA101 - ENGINEERING MATHEMATICS - I

Regulations - 2020

Duration: 3 Hours Max. Marks: 100

PART - A (MCQ) (20 × 1 = 20 Marks)

Answer ALL Questions

	Question	Marks	K – Level	CO
1.	If $A^T = A$ then the matrix A is said to be _______ (a) Orthogonal (b) Symmetric (c) Asymmetric (d) None of the above	1	K1	CO1
2.	Given A= $\begin{pmatrix} -1 & 0 & 0 \\ 2 & -3 & 0 \\ 1 & 4 & 2 \end{pmatrix}$ Then eigenvalues of A^2 are (a)1,9,9 (b)$1,\frac{1}{9},\frac{1}{4}$ (c)-1, -3,2 (d)1,9,4	1	K2	CO1
3.	A square matrix A and its transpose A^T have -------- eigen values (a) Complex (b) Interchange (c) Same (d) Different	1	K1	CO1
4.	If two Eigen values are positive and one is negative then nature of Quadratic Form is _________ (a) Indefinite (b) Positive semi definite (c) Definite (d) Negative semi definite	1	K1	CO1
5.	If u, v are functions of x, y then Jacobian of u, v with respect to x, y is (a) $\frac{\partial(x,y)}{\partial(u,v)}$ (b) $\frac{\partial(u,v)}{\partial(x,y)}$ (c) $\frac{\partial(u,x)}{\partial(v,y)}$ d) $\frac{\partial(u,y)}{\partial(v,x)}$	1	K1	CO2
6.	For the function $f(x, y)$ to have maximum value at (a, b) (a) $rt - s^2 > 0$ and $r < 0$ (b) $rt - s^2 > 0$ and $r > 0$ (c) $rt - s^2 < 0$ and $r < 0$ (d) $rt - s^2 < 0$ and $r > 0$	1	K1	CO2
7.	What is the saddle point? (a) Point where function has maximum value (b) Point where function has minimum value (c) Point where function has zero value (d) Point where function neither have maximum value nor minimum value.	1	K1	CO2
8.	Stationary point is a point where, function $f(x, y)$ have (a) $\frac{\partial f}{\partial x} = 0$ (b) $\frac{\partial f}{\partial y} = 0$ (c) $\frac{\partial f}{\partial x} = 0$ & $\frac{\partial f}{\partial y} = 0$ (d) $\frac{\partial f}{\partial x} > 0$ & $\frac{\partial f}{\partial y} < 0$	1	K1	CO2
9.	The improper integral $\int_1^\infty \frac{1}{x^p}$ is convergent when (a) P =0 (b) P ≠0 (c) P >1 (d) P ≤ 1	1	K1	CO3
10.	$\int_0^1 \frac{dx}{1+x^2}$ = -------------- (a) 1 (b) 0 (c) $\frac{\pi}{2}$ (d) $\frac{\pi}{4}$	1	K2	CO3
11.	$\int_0^{\frac{\pi}{2}} \sin^{10} x dx =$ ------------ (a) $\frac{63\pi}{256}$ (b) $\frac{63\pi}{512}$ (c) $\frac{63\pi}{1024}$ (d) $\frac{63\pi}{286}$	1	K2	CO3
12.	Find $\int xe^x$dx (a) $e^x(x-1) + c$ (b) $e^x(x+1) + c$ (c) $e^x(x-2) + c$ (d) $e^x(x-3) + c$	1	K2	CO3
13.	The area of a circle is (a) πr^2 (b) π (c) r^2 (d) πr	1	K1	CO4

14.	The region of integration $\int_0^1 \int_x^1 dydx$ represents (a) Rectangle (b) Square (c) Circle (d) Triangle	1	K2	CO4
15.	Limits of the integral $\iint_R f(x,y)dydx$ where R is bounded by $y = x^2, x = 1$ and x-axis. (a) $y: 0\ to\ x^2, x: 0\ to\ 1$ (b) $x: 0\ to\ y, y: 0\ to\ 1$ (c) $y: 0\ to\ x^2, x: 1\ to\ 2$ (d) $x: 0\ to\ y, x: 1\ to\ 2$	1	K2	CO4
16.	The value of $\int_0^1\int_0^2\int_0^3 dxdydz$ is _____. (a) 3 (b) 6 (c) 9 (d) 12	1	K2	CO4
17.	What is the Fourier series of the function $f(x) = x$ over the interval $[-L, L]$? (a) Only sine terms (b) Only cosine terms (c) Sine and cosine terms (d) None of the above	1	K1	CO5
18.	If a function f(x) is even in the interval $[-L, L]$, which Fourier coefficients is zero? (a) a_n (b) b_n (c) both a_n and b_n (d) None of the coefficients	1	K1	CO5
19.	The convergence of the Fourier series at a point is guaranteed by: (a) The function being periodic. (b) The function being continuous everywhere. (c) Dirichlet conditions. (d) The function being differentiable	1	K1	CO5
20.	What is the primary purpose of using Fourier series? (a) To solve linear equations (b) To represent periodic functions as a sum of sine and cosine functions (c) To calculate integrals (d) To find the roots of polynomials	1	K1	CO5

PART - B (10 × 2 = 20 Marks)

Answer ALL Questions

21.	If 3 and 15 are the two eigen values of A=$\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$, find | A | without expanding the determinant.	2	K2	CO1
22.	Find the nature of the quadratic form $x_1^2 + 2x_2^2 + x_3^2 - 2x_1x_2 + 2x_2x_3$	2	K2	CO1
23.	If $x = r\cos\theta, y = r\sin\theta$, then find $\frac{\partial(x,y)}{\partial(r,\theta)}$	2	K2	CO2
24.	Find the stationary points of $f(x,y) = x^2 - xy + y^2 - 2x + y$	2	K2	CO2
25.	Evaluate $\int (x+3)(x-2)dx$.	2	K2	CO3
26.	Evaluate $\int e^x sinx\ dx$.	2	K2	CO3
27.	Evaluate $\int_0^1 \int_1^2 x(x+y)dydx$.	2	K2	CO4
28.	Evaluate $\int_0^1 \int_0^2 \int_1^2 x^2yzdxdydz$.	2	K2	CO4
29.	State Dirichlet's conditions for a given function to expand in Fourier series.	2	K1	CO5
30.	State Parseval's identity of Fourier series in $(-\pi, \pi)$.	2	K1	CO5

PART - C (6 × 10 = 60 Marks)

Answer ALL Questions

31.	a)	Verify Cayley -Hamilton theorem for the matrix A=$\begin{bmatrix} 7 & 2 & -2 \\ -6 & -1 & 2 \\ 6 & 2 & -1 \end{bmatrix}$ and hence find A^{-1}.	10	K3	CO1
		OR			
	b)	Reduce the quadratic form $8x_1^2 + 7x_2^2 + 3x_3^2 - 12x_1x_2 - 8x_2x_3 + 4x_3x_1$ to the canonical form through an orthogonal transformation.	10	K3	CO1
32.	a)	Expand $e^x \cos y$ near the point $(0,0)$ by Taylor's series upto third terms.	10	K3	CO2

OR

b) A rectangular box, open at the top, is to have a volume of 32cc. Find the dimensions of box which required least amount of material for its construction. *10* *K3* *CO2*

33. a) Prove that the reduction formula for $I_n = \int \sin^n x\, dx$ is *10* *K3* *CO3*

$$I_n = -\frac{1}{n}\sin^{n-1} x \cos x + \frac{n-1}{n} I_{n-2}.$$

OR

b) Using integration by parts, prove that $\int e^{ax} \sin bx\, dx = \frac{e^{ax}}{a^2+b^2}(a \sin bx - b \cos bx)$. *10* *K3* *CO3*

34. a) Find the volume of sphere $x^2 + y^2 + z^2 = a^2$ using triple integrals. *10* *K3* *CO4*

OR

b) Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)}\, dxdy$ by changing into polar coordinates and hence evaluate $\int_0^\infty e^{-x^2}\, dx$ *10* *K3* *CO4*

35. a) Find the Fourier series for $f(x) = x^2$ in $-\pi \le x \le \pi$ and deduce that *10* *K3* *CO5*

(i) $\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \cdots = \frac{\pi^2}{6}$

(ii) $\frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \cdots = \frac{\pi^2}{12}$

OR

b) Find the cosine series for $f(x) = x$ in $(0, \pi)$ and hence deduce that *10* *K3* *CO5*

$\frac{1}{1^4} + \frac{1}{3^4} + \frac{1}{5^4} + \ \dots = \frac{\pi^4}{96}$

36. a) i) Evaluate $\iint_A r^3 dr d\theta$, where A is the area between the circles $r = 2\cos\theta$ and $r = 4\cos\theta$. *5* *K3* *CO4*

ii) Find the half range cosine series of $f(x) = (x-1)^2$ in $0 \le x \le 1$. *5* *K3* *CO5*

OR

b) i) Find the area bounded by the ellipse, $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$, using double integration. *5* *K3* *CO4*

ii) Find the Fourier series of $f(x) = x$ in $(0, \pi)$. *5* *K3* *CO5*