Reg. No.												

Question Paper Code	12139

14 AUG 2023

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2023

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 ($10 \times 2 = 20$ Marks)

Answer ALL Questions

Marks, K-Level, CO

1. The product of two eigenvalues of the matrix A= $\begin{bmatrix} 6 & 2 & 2 \\ 2 & 3 & 1 \\ 2 & 1 & 3 \end{bmatrix}$ is 16. Find the third eigen value of A. *2,K2,CO1*
2. Write down the matrix of the quadratic form $2x_1^2 - 2x_2^2 + 4x_3^2 + 2x_1x_2 - 6x_1x_3 + 6x_2x_3$. *2,K2,CO1*
3. State Sandwich Theorem. *2,K1,CO2*
4. Find $\lim_{x\to 0} \frac{|x|}{x}$ if it exists. *2,K2,CO2*
5. Evaluate $\int (x+3)(x-2)\,dx$. *2,K2,CO3*
6. Evaluate $\int_0^{\frac{\pi}{2}} \cos^5 x\, dx$. *2,K2,CO3*
7. Evaluate $\int_0^1 \int_1^2 x(x+y)\,dy\,dx$. *2,K2,CO4*
8. Sketch roughly the region of integration for $\int_0^1 \int_0^x f(x,y)\,dy\,dx$. *2,K2,CO4*
9. Find the Taylor's series representation of $f(x) = e^x$ about $x = 0$. *2,K2,CO5*
10. Find the Fourier constant b_n for $x \sin x$ in $(-\pi, \pi)$. *2,K2,CO5*

PART - B ($5 \times 16 = 80$ Marks)

Answer ALL Questions

11. a) Reduce the quadratic form $8{x_1}^2 + 7{x_2}^2 + 3{x_3}^2 - 12x_1x_2 - 8x_2x_3 + 4x_3x_1$ to the canonical form through an orthogonal transformation. Hence find rank, index, signature and nature of the quadratic form. *16,K3,CO1*

OR

b) 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} and A^4. *16,K3,CO1*

12. a) (i) If $u = \frac{yz}{x}, v = \frac{zx}{y}, w = \frac{xy}{z}$, then show that $\frac{\partial(u,v,w)}{\partial(x,y,z)} = 4$. 8,K3,CO2

(ii) Examine $f(x, y) = x^3 + y^3 - 12x - 3y + 20$ for its extreme values. 8,K3,CO2

OR

b) (i) A rectangular box, open at the top, is to have a volume of 32cc. Find dimensions of box which least amount of material for its construction. 8,K3,CO2

(ii) Expand $x^2y + 3y - 2$ in powers of x -1 and y + 2 using Taylor's theorem. 8,K3,CO2

13. a) Prove that the reduction formula for $I_n = \int \sin^n x\, dx$ is 16,K3,CO3

$$I_n = -\frac{1}{n}\sin^{n-1} x \cos x + \frac{n-1}{n} I_{n-2}.$$ Hence find $\int_0^{\frac{\pi}{2}} \sin^n x\, dx$.

OR

b) (i) Evaluate $\int \frac{dx}{x^2\sqrt{x^2-1}}$. 8,K3,CO3

(ii) Evaluate $\int \frac{x}{(1+x)(1+x^2)} dx$. 8,K3,CO3

14. a) (i) Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dxdy$ by changing into polar coordinates. 8,K3,CO4

(ii) Evaluate $\int_0^\infty \int_x^\infty \frac{e^{-y}}{y} dydx$ changing the order of integration 8,K3,CO4

OR

b) (i) Find the volume of sphere $x^2 + y^2 + z^2 = a^2$ using triple integrals 8,K3,CO4

(ii) Evaluate $\iint r^3 dr d\theta$, over the area bounded between the circles $r = 2\sin\theta$ and $r = 4\sin\theta$. 8,K3,CO4

15. a) Find the cosine series for $f(x) = x$ in $(0, \pi)$ and deduce 16,K3,C

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

OR

b) Find the Fourier series for $f(x) = x^2$ in $-\pi \le x \le \pi$ and deduce that 16,K3,CO5

$$\frac{1}{1^2} + \frac{1}{2^2} + \frac{1}{3^2} + \cdots = \frac{\pi^2}{6}.$$