Reg. No.																

Question Paper Code	14267

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

First Semester

Computer Science and Engineering

(Common to Electrical and Electronics Engineering, Information Technology, Mechanical Engineering & Computer Science and Engineering (Cyber Security))

20BSMA101 - ENGINEERING MATHEMATICS - I

Regulations - 2020

Duration: 3 Hours | Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

No.	Question	Marks	K – Level	CO
1.	If two of the eigen values of $\begin{pmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{pmatrix}$ are 2 and 8, then the third eigen value is ______ (a) 0 (b) 1 (c) 2 (d) 3	1	K2	CO1
2.	The Characteristic equation of $\begin{pmatrix} 1 & 2 \\ 0 & 2 \end{pmatrix}$ is ______ (a) $\lambda^2 - 3\lambda + 2 = 0$ (b) $\lambda^2 + 3\lambda + 2 = 0$ (c) $\lambda^2 - 3\lambda - 2 = 0$ (d) $\lambda^2 + 3\lambda - 2 = 0$	1	K2	CO1
3.	The value of $\lim_{x \to 0} x^2 \sin\left(\frac{1}{x}\right)$ is (a) 0 (b) -1 (c) 1 (d) 2	1	K2	CO2
4.	If $u = (x - y) + (y - z) + (z - x)$, then $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z}$ is (a) 1 (b) -2 (c) 3 (d) 0	1	K2	CO2
5.	The value of $\int_0^1 (4 + 3x^2)\, dx$ is (a) 4 (b) 5 (c) 7 (d) 3	1	K2	CO3
6.	The integral $\int_1^\infty \frac{1}{x} dx$ is (a) convergent (b) divergent (c) oscillate (d) None of these	1	K2	CO3
7.	The value of $\int_0^1 \int_0^1 (x + y)\, dy\, dx$ is (a) 1 (b) 2 (c) 3 (d) 0	1	K2	CO4
8.	The value of $\int_0^1 \int_0^1 \int_0^1 dz dy\, dx$ is (a) 0 (b) 1 (c) 2 (d) 3	1	K2	CO4
9.	The expansion of e^x at x =0 is (a) 0 (b) -1 (c) 2 (d) 1	1	K1	CO5
10.	The half range sine series contains only (a) sine terms (b) cosine terms (c) constant term (d) both sine and cosine terms	1	K1	CO5

K1 – Remember; K2 – Understand; K3 – Apply; K4 – Analyze; K5 – Evaluate; K6 – Create

PART - B (12 × 2 = 24 Marks)
Answer ALL Questions

11.	Compute the sum and product of the eigen values of the matrix $\begin{pmatrix} -1 & 1 & 1 \\ 1 & -1 & 1 \\ 1 & 1 & -1 \end{pmatrix}$	2	K2	CO1
12.	State Cayley Hamilton theorem.	2	K1	CO1
13.	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
14.	Evaluate $\lim_{x\to 3}\left(\frac{x^2-9}{x-3}\right)$.	2	K2	CO2
15.	If $x = r\cos\theta, y = r\sin\theta$, then find $\frac{\partial(x,y)}{\partial(r,\theta)}$.	2	K3	CO2
16.	Find the stationary points of $f(x,y) = x^2 - xy + y^2 - 2x + y$.	2	K2	CO2
17.	Compute $\int_0^1 \sqrt{1-x^2}\,dx$	2	K2	CO3
18.	Find the value of $\int_0^{\frac{\pi}{2}} cos^5 x\,dx$.	2	K2	CO3
19.	Express in to polar coordinates $\int_0^a \int_y^a \frac{x^2}{\sqrt{x^2+y^2}}\,dx\,dy$.	2	K3	CO4
20.	Evaluate $\int_0^1 \int_0^2 \int_0^3 xyz\,dz\,dy\,dx$.	2	K2	CO4
21.	Compute the value a_0, if $f(x) = x$ in $(0, l)$.	2	K2	CO5
22.	State Dirichlet's conditions for a given function to expand in Fourier series.	2	K1	CO5

PART - C (6 × 11 = 66 Marks)
Answer ALL Questions

23 a) Verify Cayley -Hamilton theorem for A= $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and hence find A^{-1}. *11 K3 CO1*

OR

b) Reduce the Quadratic form $6x^2 + 3y^2 + 3z^2 - 4xy - 2yz + 4zx$ in to canonical form by an orthogonal transformation. *11 K3 CO1*

24. a) (i) If $u = \frac{yz}{x}, v = \frac{zx}{y}, w = \frac{xy}{z}$, then show that $\frac{\partial(u,v,w)}{\partial(x,y,z)} = 4$. *6 K3 CO2*

(ii) Expand $e^x \cos y$ near the point $(0,0)$ by Taylor's series upto two terms. *5 K3 CO2*

OR

b) A rectangular box open at the top is to have a volume 32 cc. Determine the dimension of the box that requires the least material for its construction. *11 K3 CO2*

25. a) (i) Calculate $\int_0^{\frac{\pi}{2}} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}}\,dx$ *5 K3 CO3*

(ii) Calculate $\int \frac{6x+1}{(4x-3)(2x+5)}\,dx$ using partial fraction method. *6 K3 CO3*

OR

	b)	Prove that the reduction formula for $I_n = \int \sin^n x\,dx$ is $I_n = -\frac{1}{n}\sin^{n-1} x \cos x + \frac{n-1}{n} I_{n-2}$. Hence find $\int_0^{\frac{\pi}{2}} \sin^n x\,dx$.	11	K3	CO3
26	a)	Determine the volume of sphere $x^2 + y^2 + z^2 = a^2$	11	K3	CO4
		OR			
	b)	Change the order of integration and hence evaluate the value of $\int_0^{4a} \int_{\frac{x^2}{4a}}^{2\sqrt{ax}} xy\ dy\ dx$.	11	K3	CO4
27.	a)	Find the half range cosine series for the function $f(x) = x(\pi - x)\ in\ 0 < x < \pi$. Deduce that $\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \ldots.. = \frac{\pi^4}{90}$.	11	K3	CO5
		OR			
	b)	Find the half range cosine series of $f(x) = (x-1)^2$ in $0 \le x \le 1$ and hence deduce the value of $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots. = \frac{\pi^2}{8}$.	11	K3	CO5
28.	a) (i)	Show that the area between the parabolas $x^2 = 4ay$ and $y^2 = 4ax$ is $\frac{16}{3}a^2$.	6	K3	CO4
	(ii)	Find the cosine series for $f(x) = x$ in $(0, \pi)$.	5	K3	CO5
		OR			
	a) (i)	Evaluate $\iint_A r^3 dr d\theta$, where A is the area between the circles $r = 2\cos\theta$ and $r = 4\cos\theta$.	6	K3	CO4
	(ii)	Find the half range sine series for $f(x) = \pi - x,\ 0 < x < \pi$.	5	K3	CO5