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BMATS201

Second Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Mathematics – II for CSE Stream

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. VTU Formula Hand Book is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	Evaluate $\int_{-c}^{c}\int_{-b}^{b}\int_{-a}^{a}(x^2+y^2+z^2)\,dz\,dy\,dx$	07	L2	CO1
	b.	Prove that $\beta(m,n)=\frac{\lceil m \cdot \lceil n}{\lceil(m+n)}$	07	L2	CO1
	c.	Evaluate $\int_0^{\infty}\int_0^{\infty} e^{-(x^2+y^2)}\,dy\,dx$ by changing to polar coordinates.	06	L3	CO1
		OR			
Q.2	a.	Evaluate $\int_0^{4a}\int_{\frac{x^2}{4a}}^{2\sqrt{ax}} xy\,dy\,dx$ by change the order of integration.	07	L2	CO1
	b.	Show that $\int_0^{\pi/2}\frac{d\theta}{\sqrt{\sin\theta}}\times\int_0^{\pi/2}\sqrt{\sin\theta}\,d\theta=\pi$	07	L2	CO1
	c.	Write a program to find the volume of the tetrahedron bounded by the planes $x=0,\ y=0,\ z=0,\ \frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$.	06	L3	CO5
		Module – 2			
Q.3	a.	Find the directional derivative of $\phi=4xz^3-3x^2y^2z$ at the point (2, –1, 2) along $2\hat{i}-3\hat{j}+6\hat{k}$.	07	L2	CO2
	b.	Find the value of the constants a, b, c such that $\vec{F}=(x+y+az)\hat{i}+(bx+2y-z)\hat{j}+(x+cy+2z)\hat{k}$ is irrotational.	07	L2	CO2
	c.	Show that the cylindrical co-ordinate system is orthogonal.	06	L3	CO2
		OR			
Q.4	a.	Find the value of the constants 'a' such that the vector field, $\vec{F}=(axy-z^3)\hat{i}+(a-2)x^2\hat{j}+(1-a)xz^2\hat{k}$ is irrotational.	07	L2	CO2
	b.	Find the angle between the surfaces $x^2+y^2+z^2=9$ and $z=x^2+y^2-3$ at the point (2, –1, 2).	07	L2	CO2
	c.	Write a program to verify whether the following vectors (2, 1, 5, 4) and (3, 4, 7, 8) are orthogonal.	06	L3	CO5

Module – 3

Q.5 **a.** Express the matrix $A = \begin{bmatrix} 3 & -1 \\ 1 & -2 \end{bmatrix}$ in the vector spaces of 2×2 matrices as a linear combination of $B = \begin{bmatrix} 1 & 1 \\ 0 & -1 \end{bmatrix}$, $C = \begin{bmatrix} 1 & 1 \\ -1 & 0 \end{bmatrix}$, $D = \begin{bmatrix} 1 & -1 \\ 0 & 0 \end{bmatrix}$ — 07 | L2 | CO3

b. Determine whether the vectors $V_1 = (1, 2, 3)$, $V_2 = (3, 1, 7)$ and $V_3 = (2, 5, 8)$ are linearly dependent or linearly independent. — 07 | L2 | CO3

c. Verify the rank nullity theorem for the linear transformation $T : R^3 \to R^3$ defined by $T(x, y, z) = (x + 2y - z, y + z, x + y - 2z)$ — 06 | L3 | CO3

OR

Q.6 **a.** Let W be the subspace of R^5 spanned by
$x_1 = (1, 2, -1, 3, 4)$, $x_2 = (2, 4, -2, 6, 8)$, $x_3 = (1, 3, 2, 2, 6)$,
$x_4 = (1, 4, 5, 1, 8)$ and $x_5 = (2, 7, 3, 3, 9)$.
Find a subset of vectors which forms a basis of W. — 07 | L2 | CO3

b. Consider the following polynomials in p(t) and inner product :

$f(t) = t + 2$, $g(t) = 3t - 2$ $h(t) = t^3 - 2t - 3$ and $\langle f, g\rangle = \int_0^1 f(t)g(t)\,dt$.

(i) Find $\langle f, g\rangle$ and $\langle f, h\rangle$
(ii) Find $\|f\|$ and $\|g\|$ — 07 | L2 | CO3

c. If V is a vector space of polynomials over R. Find a basis and dimension of the subspaces W and V, spanned by the polynomials.
$x_1 = t^3 - 2t^2 + 4t + 1$, $x_2 = 2t^3 - 3t^2 + 9t - 1$
$x_3 = t^3 + 6t - 5$, $x_4 = 2t^3 - 5t^2 + 7t + 5$ — 06 | L2 | CO3

Module – 4

Q.7 **a.** Find the real root of the equation $x \log_{10} x - 1.2 = 0$ by Regular Falsi method. Correct to four decimal places. — 07 | L2 | CO4

b. From the following table find the number of students who have obtained less than 45 marks. — 07 | L2 | CO4

Marks	30 – 40	40 – 50	50 – 60	60 – 70	70 – 80
No. of students	31	42	51	35	31

c. Evaluate $\int_0^1 \frac{dx}{1+x^2}$ by using Simpson's $(1/3)^{rd}$ rule taking four equal strips. — 06 | L3 | CO4

OR

Q.8 **a.** Fit the polynomial for the following data using Newton's divided difference formula and hence find f(3). — 07 | L2 | CO4

x	2	4	5	6	8	10
y	10	96	196	350	868	1746

b. Using Lagrange's interpolation formula find f(4). — 07 | L2 | CO4

x	0	2	3	6
y	- 4	2	14	158

Q.8	c.	Use Simpson's $(3/8)^{th}$ rule to evaluate $\int_1^4 e^{1/x}\,dx$ by taking four ordinates.	06	L3	CO4
		Module – 5			
Q.9	a.	Employ Taylor's series method to solve the initial value problem $\frac{dy}{dx} = x - y^2$; $y(0) = 1$ at the point $x = 0.1$ by considering upto 4^{th} degree terms.	07	L2	CO4
	b.	Apply Milne's method to compute y(1.4) for the differential equation $\frac{dy}{dx} = x^2 + \frac{y}{2}$, given that $y(1) = 2$, $y(1.1) = 2.2156$, $y(1.3) = 2.4649$ and $y(1.3) = 2.7514$ correct to four decimal places.	07	L2	CO4
	c.	Use fourth order Runge Kutta method to find the value of y at x = 0.1, given that $\frac{dy}{dx} = 3e^x + 2y$, $y(0) = 0$ and $h = 0.1$.	06	L2	CO4
		OR			
Q.10	a.	Use Modified Euler's method to compute y(0.1), given that $\frac{dy}{dx} = x^2 + y$; $y(0) = 1$ by taking $h = 0.05$.	07	L2	CO4
	b.	If $\frac{dy}{dx} = 2e^x - y$; $y(0) = 2$, $y(0.1) = 2.010$, $y(0.2) = 2.040$ and $y(0.3) = 2.090$. Find the value of y at $x = 0.4$ correct to four decimal places by applying Milne's predictor and corrector method.	07	L2	CO4
	c.	Write a program to solve : $\frac{dy}{dx} - 2y = 3e^x$ with $y(0) = 0$ using Taylor's series method at $x_1 = 0.1$, $x_2 = 0.2$ and $x_3 = 0.3$.	06	L3	CO5

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