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BMATS201

Second Semester B.E./B.Tech. Degree Examination, June/July 2026 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. M: Marks, L: Bloom's level, C: Course outcomes.
3. VTU Formula Hand Book is permitted.

Module – 1

			M	L	C
Q.1	a.	Evaluate $\int_{-c}^c \int_{-b}^b \int_{-a}^a (x^2 + y^2 + z^2) dx dy dz$	7	L2	CO1
	b.	Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dx dy$ by changing into polar coordinates.	7	L3	CO1
	c.	Show that $\beta(m, n) = \frac{\Gamma(m) \cdot \Gamma(n)}{\Gamma(m+n)}$.	6	L2	CO1

OR

Q.2	a.	Evaluate $\int_0^a \int_0^a \frac{x}{x^2 + y^2} dx dy$ by changing the order of integration.	7	L3	CO1
	b.	Evaluate $\iint_R xy \, dx \, dy$ where R is the region bounded by the x – axis, ordinate $x = 2a$ and the curve $x^2 = 4a y$.	7	L3	CO1
	c.	Using Mathematical tools, write the code to find the area of an ellipse by double integration $A = 4 \int_0^a \int_0^{\frac{b}{a}\sqrt{a^2-x^2}} dx dy$	6	L3	CO5

Module – 2

Q.3	a.	Find the directional derivative of $\phi = x^2 yz + 4xz^2$ at (1, -2, -1) in the direction of the vector $2\vec{i} - \vec{j} - 2\vec{k}$.	7	L2	CO2
	b.	If $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$ find $\text{div } \vec{F}$ and $\text{curl } \vec{F}$.	7	L2	CO2
	c.	Express the vector $\vec{A} = z\vec{i} - 2x\vec{j} + y\vec{k}$ in cylindrical coordinates.	6	L2	CO2

OR

Q.4	a.	Find the directional derivative of $\phi = 4xz^3 - 3x^2y^2z$ at $(2, +1, +2)$ in the direction of the vector $2\mathbf{i} - 3\mathbf{j} + 6\mathbf{k}$.	7	L3	CO2										
	b.	Show that the vector $\vec{F} = \frac{x\mathbf{i} + y\mathbf{j}}{x^2 + y^2}$ is both solenoidal and irrotational.	7	L2	CO2										
	c.	Using mathematical tools, write the code to find the curl of $\vec{F} = x y^2 \mathbf{i} + 2 x^2 y z \mathbf{j} - 3 y z^2 \mathbf{k}$.	6	L3	CO5										
Module – 3															
Q.5	a.	V is a vector space of polynomials over R. Find a basis and dimension of the subspace W of V, spanned by the polynomial $x_1 = t^3 - 2t^2 + 4t + 1$; $x_2 = 2t^3 - 3t^2 + 9t - 1$; $x_3 = t^3 + 6t - 5$; $x_4 = 2t^3 - 5t^2 + 7t + 5$.	7	L3	CO3										
	b.	Write the vector $V = (4, 2, 1)$ as a linear combination of the vectors $u_1 = (1, -3, 1)$, $u_2 = (0, 1, 2)$, $u_3 = (5, 1, 37)$.	7	L2	CO3										
	c.	Define a Inner product space. Consider $f(t) = 3t - 5$ and $g(t) = t^2$, the inner product $\langle f, g \rangle = \int_0^t f(t)g(t)dt$. Find $\langle f, g \rangle$.	6	L3	CO3										
OR															
Q.6	a.	Express the vector $(3, 5, 2)$ as a linear combination of the vectors $(1, 1, 0)$, $(2, 3, 0)$, $(0, 0, 1)$ of $V_3(R)$.	7	L2	CO3										
	b.	Define a Subspace. Show that any plane passing through the origin is a subspace of R^3 .	7	L2	CO3										
	c.	Show that the function $f(x) = 3x - 2$ and $g(x) = x$ are orthogonal in P_n with inner product $\langle f, g \rangle = \int_0^1 f(x)g(x)dx$	6	L2	CO3										
Module – 4															
Q.7	a.	Find a real root of the equation $x^3 - 2x - 5 = 0$. Correct to three decimal places by the method of false position in $(2, 3)$.	7	L3	CO4										
	b.	Use Lagrange's interpolation formula to find y at $x = 10$, given <table border="1"><tr><td>x</td><td>5</td><td>6</td><td>9</td><td>11</td></tr><tr><td>y</td><td>12</td><td>13</td><td>14</td><td>16</td></tr></table>	x	5	6	9	11	y	12	13	14	16	7	L2	CO4
x	5	6	9	11											
y	12	13	14	16											
	c.	Use Simpson's $3/8^{\text{th}}$ rule to evaluate $\int_1^4 e^{1/x}dx$.	6	L3	CO4										
OR															
Q.8	a.	Find an approximate root of the equation $3x = \cos x + 1$, using the Newton Raphson method, correct to three decimal places near $x = 0.6$.	7	L3	CO4										

	b.	Given $\sin 45^\circ = 0.7071$, $\sin 50^\circ = 0.7660$, $\sin 55^\circ = 0.8192$, $\sin 60^\circ = 0.8660$. Find $\sin 57^\circ$ using Newton's Backward interpolation formula.	7	L4	CO4
	c.	Evaluate $\int_0^1 \frac{dx}{1+x^2}$ by using Simpson's $1/3^{\text{rd}}$ rule taking four equal strips.	6	L3	CO4
Module – 5					
Q.9	a.	Use Taylor's series method to find y at $x = 0.1, 0.2, 0.3$ considering terms upto the third degree. Given that $\frac{dy}{dx} = x^2 + y^2$ and $y(0) = 1$.	7	L4	CO4
	b.	Using Runge – Kutta method of fourth order, find $y(0.2)$ for the equation $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$ taking $h = 0.2$.	7	L3	CO4
	c.	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 $y(0.4)$, correct to four decimal places by using Milne's Predictor - Corrector method.	6	L3	CO4
OR					
Q.10	a.	Using modified Euler's method find an approximate value of y when $x = 0.1$. Given that $\frac{dy}{dx} = x + y$ and $y = 1$ when $x = 0$. Apply three modification.	7	L2	CO4
	b.	Using the Runge – Kutta method of fourth order , find $y(0.1)$ given that $dy = 3e^x + 2y$; $y(0) = 0$, taking $h = 0.1$.	7	L3	CO4
	c.	Using mathematical tool, write a code to find the solution of $\frac{dy}{dx} = 1 + \frac{y}{x}$ at $y(2)$ taking $h = 0.2$. Given that $y(1) = 2$ by Runge – Kutta 4^{th} order method.	6	L2	CO5
