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BMATS201

Second Semester B.E./B.Tech. Degree Examination, June/July 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 $\int_{-1}^1 \int_0^z \int_{x-z}^{x+z} (x+y+z) dy dx dz$	07	L3	CO1
	b.	Evaluate $\int_0^{\infty} \int_x^{\infty} \frac{e^{-y}}{y} dy dx$ by changing the order of integration.	07	L3	CO1
	c.	Show that $\beta(m,n) = \frac{\Gamma(m) \cdot \Gamma(n)}{\Gamma(m+n)}$	06	L2	CO1
OR					
Q.2	a.	Evaluate $\int_0^1 \int_0^{\sqrt{1-y^2}} (x^2 + y^2) dy dx$ by changing to polar coordinates.	07	L3	CO1
	b.	Using double integration find the area of a plate in the form of a quadrant of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$	07	L3	CO1
	c.	Using mathematical tools, write the code to find the volume of the tetrahedron bounded by the planes $x = 0, y = 0, z = 0$ and $6x + 3y + 2z = 6$.	06	L3	CO5
Module – 2					
Q.3	a.	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
	b.	Evaluate $\text{div } \vec{F}$ and $\text{curl } \vec{F}$ at the point $(1, 2, 3)$, given $\vec{F} = \text{grad}(x^3y + y^3z + z^3x - x^2y^2z^2)$	07	L3	CO2
	c.	Express the vector $\vec{F} = 2x\hat{i} - 3y^2\hat{j} + zx\hat{k}$ in cylindrical form.	06	L3	CO2
OR					
Q.4	a.	Find the directional derivative of $\phi(x, y, z) = x^2yz + yxz^2$ at $(1, -2, 1)$ in the direction of the vector $2\hat{i} - \hat{j} - 2\hat{k}$.	07	L2	CO2
	b.	Show that the vector $\vec{F} = \frac{x\hat{i} + y\hat{j}}{x^2 + y^2}$ is both solenoidal and irrotational.	07	L3	CO2
	c.	Using mathematical tool, write the code to find the gradient of $xy^3 + yz^3$.	06	L3	CO5

Module – 3

Q.5	a.	Show that the set $W = \{(x, y, z) / x + y + 2z = 0\}$ of the vector space $V_3(R)$ is a subspace of $V_3(R)$.	07	L2	CO3
	b.	Find the basis and dimension of the subspace spanned by the vectors $\{(1, -1, 0), (0, 3, 1), (1, 2, 1), (2, 4, 2)\}$ in R^3 .	07	L3	CO3
	c.	Find the matrix of the linear transformation $T : V_2(R) \rightarrow V_3(R)$ such that $T(-1, 1) = (-1, 0, 2)$ and $T(2, 1) = (1, 2, 1)$.	06	L2	CO3

OR

Q.6	a.	Determine whether the following set of vectors in 2×2 matrix space is linearly independent or linearly dependent: $S = \{v_1, v_2, v_3\}$ where $v_1 = \begin{bmatrix} 2 & 1 \\ 0 & 1 \end{bmatrix}$, $v_2 = \begin{bmatrix} 3 & 0 \\ 2 & 1 \end{bmatrix}$ and $v_3 = \begin{bmatrix} 1 & 0 \\ 2 & 0 \end{bmatrix}$	07	L2	CO3
	b.	Prove that $T : R^3 \rightarrow R^2$ defined by $T(x, y, z) = (x + y, y + 2z)$ is a linear transformation.	07	L2	CO3
	c.	Verify the Rank – nullity theorem for the linear transformation $T : R^3 \rightarrow R^2$ defined by $T(x, y, z) = (y - x, y - z)$.	06	L2	CO3

Module – 4

Q.7	a.	Find a real root of the equation $x \log_{10} x = 1.2$ by regula falsi method corrected to 4 decimal places between (2.5, 3). Carry out 4 iterations.	07	L2	CO4												
	b.	From the following table of half yearly premium for policies maturing at different ages, estimate the premium for the policies maturing at the age of 46. <table border="1" data-bbox="346 1685 1369 1795"> <tr> <td>Age :</td><td>45</td><td>50</td><td>55</td><td>60</td><td>65</td></tr> <tr> <td>Premium (in Rs.)</td><td>114.84</td><td>96.16</td><td>83.32</td><td>74.48</td><td>68.48</td></tr> </table>	Age :	45	50	55	60	65	Premium (in Rs.)	114.84	96.16	83.32	74.48	68.48	07	L3	CO4
Age :	45	50	55	60	65												
Premium (in Rs.)	114.84	96.16	83.32	74.48	68.48												
	c.	Use Trapezoidal rule to estimate the integration $\int_0^1 \frac{1}{1+x^2} dx$ by taking 10 equal intervals.	06	L3	CO4												

OR

Q.8	a.	Find by Newton's Raphson method, the root of the equation $\cos x = x e^x$ near to 0.5, corrected to 4 decimal places.	07	L2	CO4												
	b.	Using Newton's divided difference interpolation, find the interpolating polynomial of the given data: <table border="1" data-bbox="352 2320 1056 2433"> <tr> <td>x :</td><td>-4</td><td>-1</td><td>0</td><td>2</td><td>5</td></tr> <tr> <td>f(x) :</td><td>1245</td><td>33</td><td>5</td><td>9</td><td>+1335</td></tr> </table>	x :	-4	-1	0	2	5	f(x) :	1245	33	5	9	+1335	07	L3	CO4
x :	-4	-1	0	2	5												
f(x) :	1245	33	5	9	+1335												
	c.	Evaluate using Simpson's $(1/3)^{th}$ rule, $\int_4^{5.2} \log x \, dx$ by dividing the range (4, 5.2) into seven ordinates.	06	L3	CO4												

Module – 5

Q.9	a.	Solve $y' = 3x + y^2$; $y(0) = 1$ using Taylor's series method at $x = 0.1$ and $x = 0.2$.	07	L3	CO4										
	b.	Given $\frac{dy}{dx} = \frac{y - x}{y + x}$ with $y = 1$ when $x = 0$. Find an approximate y at $x = 0.1$ using Euler's modified method. (Use modified formula twice).	07	L3	CO4										
	c.	From the data given below find y at $x = 1.4$ using Milne's method. Given $\frac{dy}{dx} = x^2 + \frac{y}{2}$. <table border="1"><tr><td>x :</td><td>1</td><td>1.1</td><td>1.2</td><td>1.3</td></tr><tr><td>y :</td><td>2</td><td>2.2156</td><td>2.4549</td><td>2.7514</td></tr></table>	x :	1	1.1	1.2	1.3	y :	2	2.2156	2.4549	2.7514	06	L3	CO4
x :	1	1.1	1.2	1.3											
y :	2	2.2156	2.4549	2.7514											
OR															
Q.10	a.	Using Runge – Kutta method of order 4, find y at $x = 0.2$, given $\frac{dy}{dx} = \frac{x^2 + y^2}{10}$; $y(0) = 1$ taking $h = 0.1$.	07	L3	CO4										
	b.	Using modified Euler's method solve $y' = 3x + \frac{y}{2}$ with $y(0) = 1$ taking $h = 0.2$ at $x = 0.2$. (Use modified Euler's formula twice).	07	L3	CO4										
	c.	Using mathematical tools, write the code to solve $\frac{dy}{dx} = x^2y - 1$; $y(0) = 1$ by Taylor's series method at $x = 0.1 (0.1) 0.3$	06	L3	CO5										
