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BMATM201

Second Semester B.E./B.Tech. Degree Examination, June/July 2025
Mathematics-II for ME 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 $\int_0^1\int_x^{\sqrt{x}}(x^2+y^2)dydx$.	7	L3	CO1
	b.	Evaluate $\int_{-1}^{1}\int_0^{z}\int_{x-z}^{x+z}(x+y+z)dydxdz$.	7	L3	CO1
	c.	Show that $\beta(m,n)=\frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$.	6	L2	CO1
		OR			
Q.2	a.	Evaluate by changing into polar coordinates. $\int_0^\infty\int_0^\infty e^{-(x^2+y^2)}dxdy$.	7	L3	CO1
	b.	Find the area of ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$, by double integration.	7	L2	CO1
	c.	Write a modern mathematical tool program to find the volume of the tetrahedron bounded by the planes $x=0$, $y=0$ and $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$.	6	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 $(2,-1,2)$.	7	L2	CO2
	b.	Define a irrotational vector. Find the constants a, b and c such that the vector $\vec{F}=(x+y+az)\hat{i}+(bx+2y-z)\hat{j}+(x+cy+2z)\hat{k}$ is irrotational.	7	L2	CO2
	c.	If $\vec{F}=\nabla(x^3+y^3+z^3-3xyz)$ find $\operatorname{div}\vec{F}$ and $\operatorname{curl}\vec{F}$.	6	L2	CO2
		OR			
Q.4	a.	Find the workdone by a force $\vec{F}=(2y-x^2)\hat{i}+6yz\hat{j}-8xz^2\hat{k}$ from the point (0, 0, 0) to the point (1, 1, 1) along the straight line joining these points.	7	L2	CO2
	b.	Using Green's theorem, evaluate $\int_C(xy+y^2)dx+x^2dy$, where C is the closed curve of the region bounded by $y=x$ and $y=x^2$.	7	L3	CO2

			Marks	L	CO
	c.	Write the modern mathematical tool program to find the divergence of the vector field $\vec{F} = x^2yz\,\hat{i} + y^2zx\,\hat{j} + z^2xy\,\hat{k}$.	6	L3	CO5
Module – 3					
Q.5	a.	From the PDE by eliminating the arbitrary function from $f(x + y + z, x^2 + y^2 z^2) = 0$.	7	L2	CO3
	b.	Solve $\frac{\partial^2 z}{\partial x^2} = a^2 z$ given that when x = 0, z = 0 and $\frac{\partial z}{\partial x} = a \operatorname{Sin} y$.	7	L3	CO3
	c.	Derive one dimensional heat equation in the standard form as $\frac{\partial u}{\partial t} = C^2 \cdot \frac{\partial^2 u}{\partial x^2}$.	6	L2	CO3
OR					
Q.6	a.	Form the PDE by eliminating the arbitrary constants 'a' and 'b' from $(x - a)^2 + (y - b)^2 + z^2 = c^2$.	7	L2	CO3
	b.	Solve $\frac{\partial^2 z}{\partial x \partial y} = \operatorname{Sin}x \operatorname{Sin}y$ for which $\frac{\partial z}{\partial y} = -2 \operatorname{Sin}y$. when x = 0 and z = 0, if 'y' is an odd multiple of $\pi/2$.	7	L3	CO3
	c.	Solve : $x \cdot \frac{\partial z}{\partial x} + y \cdot \frac{\partial z}{\partial y} = z$, using Lagrange's multipliers.	6	L3	CO3
Module – 4					
Q.7	a.	Find the real root of the equation $xe^x - 2 = 0$ correct to three decimal places using the Newton – Rephson method.	7	L3	CO4
	b.	Using Newton's forward interpolation formula, find y at x = 5. <table><tr><td>x</td><td>4</td><td>6</td><td>8</td><td>10</td></tr><tr><td>y</td><td>1</td><td>3</td><td>8</td><td>16</td></tr></table>	7	L3	CO4
	c.	Evaluate $\int_0^1 \frac{1}{1+x^2} dx$ by taking 7 ordinates using the Trapezoidal rule.	6	L3	CO4
OR					
Q.8	a.	Compute the real root of the equation $x \log_{10}^{x} - 1.2 = 0$ lies between 2 and 3 by the Regula Falsi method. Carry out four approximations.	7	L2	CO4
	b.	Using Newton's divided difference formula, evaluate f(4) from the following table : <table><tr><td>x</td><td>0</td><td>2</td><td>3</td><td>6</td></tr><tr><td>f(x)</td><td>−4</td><td>2</td><td>14</td><td>158</td></tr></table>	7	L2	CO4
	c.	Compute the value of y when x = 3. Using Lagrange's interpolation formula given <table><tr><td>x</td><td>−2</td><td>−1</td><td>1</td><td>2</td></tr><tr><td>y</td><td>−7</td><td>2</td><td>0</td><td>11</td></tr></table>	6	L3	CO4

		Module – 5			
Q.9	**a.**	Use Taylor's series method to find y at x = 0.1 considering the terms upto the third degree given that $\frac{dy}{dx} = x^2 + y^2$ and y(0) = 1.	7	L3	CO4
	b.	Apply the Runge – Kutta method of fourth order to find an approximate value of y at x = 0.2, given that $\frac{dy}{dx} = 3x + \frac{y}{2}$ with y(0) = 1, and h = 0.2.	7	L3	CO4
	c.	Given that $\frac{dy}{dx} = x - y^2$ and the data y(0) = 0, y(0.2) = 0.02, y(0.4) = 0.0795, y(0.6) = 0.1762. Compute y at x = 0.8 by applying Milne's method.	6	L3	CO4
		OR			
Q.10	**a.**	Using the modified Euler's method, find y(0.1) given that $\frac{dy}{dx} = x^2 + y$ and y(0) = 1 take step size h = 0.05 and perform two approximations in each stage.	7	L3	CO4
	b.	Using the Runge-Kutta method of fourth order, find y(0.2) given that $\frac{dy}{dx} = \frac{y-x}{y+x}$, y(0) = 1, taking h = 0.2.	7	L3	CO4
	c.	Using modern mathematical tools write a program to find y when x = 2 given that $\frac{dy}{dx} = 1 + \frac{y}{x}$, y(1) = 2, taking h = 0.2 by Runge – Kutta method of 4th order.	6	L3	CO5

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