CBCS SCHEME

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BMATM201

Second Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Mathematics – II for Mechanical Engineering 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 $\int_{-c}^{c}\int_{-b}^{b}\int_{-a}^{a}(x^2+y^2+z^2)\,dx\,dy\,dz$.	6	L2	CO1
	b.	Evaluate $\int_{0}^{a}\int_{0}^{2\sqrt{ax}} x^2\,dy\,dx$ by changing the order of integration.	7	L2	CO1
	c.	Show that $\gamma\left(\frac{1}{2}\right)=\sqrt{\pi}$.	7	L2	CO1
		OR			
Q.2	a.	Evaluate $\int_{0}^{1}\int_{0}^{\sqrt{1-y^2}} x^3 y\,dx\,dy$.	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.	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 directional derivatives of $\phi = x^2yz + 4xz^2$ at (1, -2, -1) along $\vec{a} = 2i - j - 2k$.	6	L3	CO2
	b.	Show that $\vec{f} = (z+\sin y)i + (x\cos y - z)j + (x-y)k$ is irrotational. Hence find a scalar function ϕ such that $\vec{f} = \nabla\phi$.	7	L2	CO2
	c.	Using Green's theorem, evaluate $\oint (3x^2 - 8y^2)dx + (4y - 6xy)dy$, where c is the boundary of the region enclosed by $y = \sqrt{x}$ and $y = x^2$.	7	L3	CO2

		OR			
Q.4	**a.**	Find the angle between the surface $x\log z = y^2 - 1$ and $x^2 y = 2 - z$ at (1, 1, 1).	**6**	**L2**	**CO2**
	b.	If $\vec{A} = xz^3 i - 2x^2 yzj + 2yz^4 k$, find $\nabla.\vec{A}$, $\nabla \times \vec{A}$ and $\nabla.\left(\nabla \times \vec{A}\right)$	**7**	**L3**	**CO2**
	c.	Verify Stoke's theorem for $\vec{F} = \left(x^2 + y^2\right)i - 2xyj$ taken round the rectangle bounded by the lines $x = \pm a$, y = 0 and y = b	**7**	**L3**	**CO5**
		Module – 3			
Q.5	**a.**	Form the PDE by eliminating the arbitrary function from $z = e^{ax+by} f(ax - by)$.	**6**	**L1**	**CO3**
	b.	Solve $\frac{\partial^2 z}{\partial y^2} = z$, give that when y = 0, $z = e^x$ and $\frac{\partial z}{\partial y} = e^{-x}$.	**7**	**L2**	**CO3**
	c.	Solve : $(y - z)P + (z - x)Q = (x - y)$.	**7**	**L2**	**CO3**
		OR			
Q.6	**a.**	Solve : $\frac{\partial^3 z}{\partial x^2 \partial y} = \cos(2x + 3y)$	**6**	**L2**	**CO3**
	b.	Solve: $\frac{\partial z}{\partial x^2} = a^2 z$ given that when x = 0, $\frac{\partial z}{\partial x} = a\sin y$ and $\frac{\partial z}{\partial y} = 0$	**7**	**L3**	**CO3**
	c.	Derive one-dimensional heat equation.	**7**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Compute real root of the equation $xe^x = 2$ by the Regula-Falsi method. Correct to three decimal places.	**7**	**L2**	**CO4**
	b.	The area A of a circle of diameter d is given for the following values : d: 80, 85, 90, 95, 100 A: 5026, 5674, 6362, 7088, 7854 Calculate the area of circle of diameter 105.	**7**	**L2**	**CO4**
	c.	Using Simpson's one-third rule to find $\int_0^{0.6} e^{x^2}$ by taking 6 sub intervals.	**6**	**L2**	**CO4**
		OR			
Q.8	**a.**	Find a real root of the equation $xe^x - 2 = 0$. Correct to three decimal places using Newton-Raphson method.	**7**	**L2**	**CO4**
	b.	Use Newton's divided difference formula to find f(9) for the following data: x: 5, 7, 11, 13, 17 f(x): 150, 392, 1452, 2366, 5202	**7**	**L2**	**CO4**

	c.	Use Simpson's $\frac{3}{8}^{th}$ rule, evaluate $\int_0^{\frac{\pi}{2}} e^{\sin x} dx$, by dividing interval into three equal parts.	6	L3	CO4
		Module – 5			
Q.9	a.	From Taylor's series method, find y(0.1) considering upto fourth degree term if y(x) satisfies the equation, $\frac{dy}{dx} = x - y^2$, y(0) – 1.	6	L1	CO4
	b.	Use Fourth order Runge-Kutta method to compute y(1.1) given that $\frac{dy}{dx} = xy^{\frac{1}{3}}$, y(1) = 1.	7	L2	CO4
	c.	Apply Milne's method to compute y(1.4). Correct to Four decimal places given $\frac{dy}{dx} = x^2 + \frac{y}{2}$ and following data y(1) = 2, y(1.1) = 2.2156, y(1.2) = 2.4649, y(3) = 2.7514	7	L3	CO4
		OR			
Q.10	a.	Given $\frac{dy}{dx} = 1 + \frac{y}{x}$, y = 2 at x = 1, find the approximate value of y at x = 1.2 by taking step size h = 0.2 applying modified Euler's method.	6	L2	CO4
	b.	Use the Runge-Kutta method of 4^{th} order, find y(0.2) for the equation, $\frac{dy}{dx} = \frac{y-x}{y+x}$, y(0) = 1 taking h = 0.2.	7	L2	CO4
	c.	Using modern mathematical tools write a program to solve $y' + 4y = x^2$ with initial conditions y(0) = 1, using Taylor series method at x = 0.1, 0.2.	7	L3	CO5

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