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BMATM201

Second Semester B.E./B.Tech. Degree Examination, June/July 2026
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 $\int_0^a \int_0^x \int_0^{x+y} e^{x+y+z}\, dz\, dy\, dx$	7	L3	CO1
	b.	By changing the order of integration evaluate $\int_0^a \int_y^a \frac{x}{x^2+y^2}\, dx\, dy$	7	L3	CO1
	c.	Prove that $\beta(m,n) = \frac{\lceil m \lceil n}{\lceil m+n}$	6	L2	CO1
		OR			
Q.2	a.	Evaluate the integral $\int_{-a}^{a} \int_0^{\sqrt{a^2-x^2}} \sqrt{x^2+y^2}\, dy\, dx$ by changing into polar coordinates.	7	L3	CO1
	b.	Find by double integration the area between the parabolas $y^2 = 4ax$ and $x^2 = 4ay$.	7	L3	CO1
	c.	Using modern mathematical tools write a program to evaluate $\int_0^3 \int_0^{3-x} \int_0^{3-x-y} (xyz)\, dz\, dy\, dx$	6	L3	CO5
		Module – 2			
Q.3	a.	If $\vec{F} = \nabla(xy^3z^2)$ find div $\vec{F}$ and curl $\vec{F}$ at (1, -1, 1).	7	L2	CO2
	b.	Find the directional derivative of $\phi = 4xz^3 - 3x^2y^2z$ at (2, -1, 2) along $2i - 3j + 6k$.	7	L2	CO2
	c.	Find constants a and b such that $\vec{F} = (axy + z^3)i + (3x^2 - z)j + (bxz^2 - y)k$ is irrotational.	6	L2	CO2
		OR			

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Q.4	**a.**	Find the angle between the normals to the surface $xy = z^2$ at (4, 1, 2) and (3, 3,-3)	**7**	**L2**	**CO2**
	b.	If $\vec{A} = xz^3i - 2x^2yzj + 2yz^4k$, find $\nabla \cdot \vec{F}$, $\nabla \times \vec{F}$ and $\nabla \cdot (\nabla \times \vec{A})$ at the point (1, - 1, 1)	**7**	**L2**	**CO2**
	c.	Write the modern mathematical tool program to find the divergence of the vector field $\vec{F} = x^2yzi + y^2zxj + z^2xyk$	**6**	**L2**	**CO5**
		Module – 3			
Q.5	**a.**	Form the partial differential equation by eliminating the arbitrary function f from $z = e^{ax+by} f(ax - by)$.	**7**	**L2**	**CO3**
	b.	Solve $\frac{\partial^2 z}{\partial x^2} + 4z = 0$, given that when x = 0, $z = e^{2y}$ and $\frac{\partial z}{\partial x} = 2$.	**7**	**L3**	**CO3**
	c.	Derive one-dimensional heat equation in the standard form as $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$.	**6**	**L2**	**CO3**
		OR			
Q.6	**a.**	Form a partial differential equation from $z = a \log(x^2 + y^2) + b$ by eliminating arbitrary constants.	**7**	**L2**	**CO3**
	b.	Solve $\frac{\partial^2 z}{\partial x \partial t} = e^{-2t} \cos 3x$ subject to the conditions i) z = 0 when x = 0 ii) $\frac{\partial z}{\partial t} = 0$ when x = 0	**7**	**L3**	**CO3**
	c.	Solve $(x^2 - yz)p + (y^2 - zx)q = z^2 - xy$.	**6**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	By using Regula – Falsi method, find an approximate root of the equation $x^4 - x - 10 = 0$ that lies between 1.8 and 2. Carryout 3 approximations.	**7**	**L3**	**CO4**
	b.	The areas y of circles for different diameters x are given below : x: 80, 85, 90, 95, 100 y: 5026, 5674, 6362, 7088, 7854 Calculate the area when x = 98 by using Newton's backward interpolation formula.	**7**	**L3**	**CO4**
	c.	Evaluate $\int_0^{\pi/2} \sqrt{\cos\theta}\, d\theta$ by dividing the interval into eight equal parts, using Simpson's 1/3rd rule.	**6**	**L3**	**CO4**

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		OR			
Q.8	**a.**	Using the Newton – Raphson method find the root that lies near x = 4.5 of the equation tan x = x, correct to four decimal places (x is measured in radians)	**7**	**L3**	**CO4**
	b.	Find the value of y when x = 10 by Lagrange's interpolation formula. x: 5, 6, 9, 11 y: 12, 13, 14, 16	**7**	**L3**	**CO4**
	c.	Evaluate $\int_0^1 \frac{x}{1+x^2}dx$ by using Simpson's $\frac{3}{8}^{th}$ rule, dividing the interval into 3 equal parts. Hence find an approximate value of $\log\sqrt{2}$.	**6**	**L3**	**CO4**
		Module – 5			
Q.9	**a.**	Solve the differential equation $\frac{dy}{dx} = 2y + 3e^x$, given y(0) = 0. Find the value of y(0.1) by using Taylor's series method by taking terms upto 4th order and h = 0.1.	**7**	**L3**	**CO4**
	b.	Apply Runge-Kutta method of 4th order, to find an approximate value of y at x = 0.1, given that $\frac{dy}{dt} = 3x + y^2$, y(0) = 1 and h = 0.1.	**7**	**L3**	**CO4**
	c.	Given $y' = 1 + y^2$ and y(0) = 0, y(0.2) = 0.203, y (0.4) = 0.423, y(0.6) = 0.684, find y(0.8), using Milne's predictor - corrector formula.	**6**	**L3**	**CO4**
		OR			
Q.10	**a.**	Use Euler's modified method to find y(0.1) given $\frac{dy}{dx} = \frac{y-x}{y+x}$, y(0) = 1, taking h = 0.1 (Carry out 3 iterations).	**7**	**L3**	**CO4**
	b.	Use Runge-kutta method of 4th order to find y(1.2) given that $\frac{dy}{dx} = x^2 + y^2$, with y(1) = 1.5 taking h = 0.1.	**7**	**L3**	**CO4**
	c.	Using modern mathematical tools write a program to find y when x = 1.4 given that $\frac{dy}{dx} = x^2 + y/2$, y(1) = 2, y(1.1) = 2.2156, y(1.2) = 2.4649, y (1.3) = 2.7514, using Milne's predictor - corrector method.	**6**	**L3**	**CO5**

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