CBCS SCHEME

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BMATM201

Second Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
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 $\int_{-1}^{1}\int_{0}^{2}\int_{x-2}^{x+2}(x+y+z)\,dy\,dx\,dz$.	7	L3	CO1
	b.	Evaluate $\int_{0}^{1}\int_{\sqrt{y}}^{1}dx\,dy$ by changing the order of integration.	7	L3	CO1
	c.	With usual notation show that $\beta(m,n)=\dfrac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$.	6	L2	CO1
		OR			
Q.2	a.	Evaluate $\int_{0}^{1}\int_{0}^{\sqrt{1-y^2}}x^3y\,dx\,dy$.	7	L3	CO1
	b.	Evaluate $\iint xy(x+y)\,dy\,dx$ taken over the area between $y=x^2$ and $y=x$.	7	L2	CO1
	c.	Write a modern mathematical program to evaluate the integral $\int_{0}^{3}\int_{0}^{3-x}\int_{0}^{3-x-y}(xyz)\,dz\,dy\,dx$.	6	L3	CO5
		Module – 2			
Q.3	a.	Find the angle between the surfaces $xy^2z=3x+z^2$ and $3x^2-y^2+2z=1$ at the point (1, -2, 1).	7	L2	CO2
	b.	If $\vec{F}=\nabla(xy^3z^2)$ find $\text{div}\,\vec{F}$ and $\text{curl}\,\vec{F}$ at the point (1, -1, 1).	7	L2	CO2
	c.	Define solenoidal vector. Find the values of a, b, c such that $\vec{F}=(x+y+az)i+(bx+2y-z)j+(x+cy+2z)k$ is irrotational.	6	L2	CO2
		OR			
Q.4	a.	Apply Green's theorem to evaluate $\int_C (3x-8y^2)dx+(4y-6xy)dy$, where C is the boundary of the region bounded by $x=0$, $y=0$, $x+y=1$.	7	L3	CO2

	b.	Use Stoke's theorem to evaluate $\int_C \vec{F}.dr$, where $\vec{F} = (x^2 + y^2)i - 2xyj$ taken round the rectangle bounded by x = 0, x = a, y = 0 and y = b.	7	L3	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	L3	CO5
		Module – 3			
Q.5	a.	Form the PDE by eliminating the arbitrary function from the relation $f(x+y+z, x^2+y^2-z^2) = 0$.	7	L2	CO3
	b.	Solve $\frac{\partial^2 z}{\partial x \partial y} = \frac{x}{y}$, subject to the conditions $\frac{\partial z}{\partial x} = \log_e x$ when y = 1 and z = 0 when x = 1.	7	L3	CO3
	c.	Derive one-dimensional heat equation.	6	L2	CO3
		OR			
Q.6	a.	Form the PDE by eliminating the arbitrary function from the relation $z = e^y f(x+y)$.	7	L2	CO3
	b.	Solve $\frac{\partial^2 z}{\partial x^2} + z = 0$ given that when x = 0, $z = e^y$ and $\frac{\partial z}{\partial x} = 1$.	7	L3	CO3
	c.	Solve $x(y^2 - z^2)p + y(z^2 - x^2)q = z(x^2 - y^2)$ using Lagrange's multiplier.	6	L3	CO3
		Module – 4			
Q.7	a.	Find a real root of $x^3 - 9x + 1 = 0$ in (2, 3) by the Regula-Falsi method in three iterations.	7	L3	CO4
	b.	Use an appropriate interpolation formula to compute f(42) using the following data: (see table below)	7	L3	CO4
	c.	Using Simpson's $\frac{1}{3}^{rd}$ rule, evaluate $\int_0^{0.6} e^{-x^2} dx$ by considering seven ordinates.	6	L3	CO4
		OR			
Q.8	a.	Find a real root of the equation $x \sin x + \cos x = 0$ near $x = \pi$ correct to four decimal places using Newtons-Raphson method.	7	L3	CO4
	b.	Using Lagrange's interpolation formula. Find f(5) from the following data : (see table below)	7	L3	CO4

Q.7 b. data:

x	40	50	60	70	80	90
f(x)	184	204	226	250	276	304

Q.8 b. data:

x	1	3	4	6	9
f(x)	3	9	30	132	156

	c.	Use Simpson's $\frac{3}{8}^{th}$ rule to obtain the approximate value of $\int_0^{0.3}(1-8x^3)^{\frac{1}{2}}dx$, by considering 3 equal intervals.	6	L3	CO4
		Module – 5			
Q.9	a.	Use Taylor's method to find x = 0.1 considering terms up to the third degree given that $\frac{dy}{dx}=x^2+y^2$ and $y(0)=1$.	7	L2	CO4
	b.	Using Runge-Kutta method of order 4, find y at x = 0.1 given that $\frac{dy}{dx}=3e^x+2y$, $y(0)=1$.	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 modified Euler's method, find y at x = 0.2 given that $\frac{dy}{dx}=3x+\frac{1}{2}y$ with y(0) = 1 taking h = 0.1. Perform three iterations.	7	L3	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.	Using modern mathematical tools write a program to solve $\frac{dy}{dx}=1+\left(\frac{y}{x}\right)$ at y(2) taking h = 0.2. Given that y(1) = 2 by Runge-Kutta method.	6	L3	CO5

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