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BMATM201

Second Semester B.E./B.Tech. Degree Examination, June/July 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 $\int_{-1}^{1}\int_{0}^{z}\int_{x-z}^{x+z}(x+y+z)\,dy\,dx\,dz$	07	L3	CO1
	b.	Evaluate $\int_{0}^{\infty}\int_{0}^{\infty} e^{-(x^2+y^2)}\,dx\,dy$, by changing to polar coordinates.	07	L3	CO1
	c.	Prove that $\int_{0}^{\pi/2}\sqrt{\sin\theta}\,d\theta\cdot\int_{0}^{\pi/2}\frac{d\theta}{\sqrt{\sin\theta}}d\theta=\pi$	06	L2	CO1
		OR			
Q.2	a.	Evaluate $\int_{0}^{1}\int_{x}^{\sqrt{x}} xy\,dy\,dx$, by changing the order of integration.	07	L3	CO1
	b.	A pyramid is bounded by three coordinate planes and the plane $x+2y+3z=6$. Compute the volume by double integration.	07	L3	CO1
	c.	Using Modern Mathematical Tools write a program to evaluate $\int_{-c}^{c}\int_{-b}^{b}\int_{-a}^{a}(x^2+y^2+z^2)\,dz\,dy\,dx$	06	L3	CO5
		Module – 2			
Q.3	a.	Find the angle between the surfaces $x^2+y^2-z^2=4$ and $z=x^2+y^2-13$ at (2, 1, 2).	07	L2	CO2
	b.	Define the Solenoidal Vector. Find the value of 'a' for which $\vec{F}=(x+3y)\hat{i}+(y-2z)\hat{j}+(x+az)\hat{k}$ is solenoidal.	07	L2	CO2
	c.	Find the values of a, b, c such that $\vec{F}=(axy+bz^3)\hat{i}+(3x^2-cz)\hat{j}+(3xz^2-y)\hat{k}$ is irrotational.	06	L2	CO2
		OR			
Q.4	a.	Using Green's theorem, evaluate $\int_{C}(xy+y^2)\,dx+x^2\,dy$, where 'c' is the closed curve of the region bounded by $y=x$ and $y=x^2$.	07	L2	CO2
	b.	Using Stoke's theorem, evaluate $\int_{C}\vec{f}\cdot d\vec{r}$, where $\vec{f}=(y+z-2x)\hat{i}+(z+x-2y)\hat{j}+(x+y-2z)\hat{k}$ and 'c' is triangle with vertices (1, 0, 0) , (0, 2, 0) and (0, 0, 3).	07	L2	CO2
	c.	Write the Modern Mathematical tool program to find the divergence of the vector field $\vec{F}=x^2yz\,\hat{i}+y^2zx\,\hat{j}+z^2xy\,\hat{k}$.	06	L3	CO5

Module – 3

Q.5 a. Form a partial differential equation by eliminating arbitrary function 'f' from the relation $z = y^2 + 2f\left(\frac{1}{x} + \log y\right)$

07	L2	CO3

b. Solve $\frac{\partial^2 z}{\partial x^2} = a^2 z$, given that $x = 0$, $z = 0$ and $\frac{\partial z}{\partial x} = a \sin y$.

07	L3	CO3

c. Solve $x^2(y^2 - z^2)p + y^2(z^2 - x^2)q = z^2(x^2 - y^2)$ using Lagrange's multipliers.

06	L3	CO3

OR

Q.6 a. Form a partial differential equation by eliminating arbitrary constants a and b from the relation $z = e^{ax+by} f(ax - by)$.

07	L2	CO3

b. Solve $\frac{\partial^2 u}{\partial x^2} = x + y$, by direct integration.

07	L2	CO3

c. Derive one-dimensional wave equation in standard form.

06	L2	CO1

Module – 4

Q.7 a. Find the real root of the equation $xe^x - 2 = 0$ in the interval $(0, 1)$ by Regula-Falsi method. Perform three iterations.

07	L2	CO4

b. Using Newton's backward interpolation formula find the interpolating polynomial for the following data:

x	10	11	12	13
f(x)	22	24	28	34

07	L2	CO4

c. Evaluate $\int_0^6 \frac{dx}{1+x^2}$, by taking 7 ordinates using Simpson's 1/3rd rule.

06	L3	CO4

OR

Q.8 a. Find the real root of $x^3 - 2x - 5 = 0$ by Newton-Raphson method. The root is nearer to 2. Correct to 3 decimal places.

07	L2	CO4

b. Use Lagranges interpolation formula to find the value of y when x = 10, for the following data:

x	5	6	9	11
y	12	13	14	16

07	L2	CO4

c. Evaluate $\int_0^5 \frac{dx}{4x+5}$, by Trapezoidal rule, taking 6 ordinates.

06	L3	CO4

Module – 5

Q.9 a. Find by Taylor's series method the value of y at x = 0.1 from $\frac{dy}{dx} = x^2 y - 1$ with $y(0) = 1$, correct to 5 decimal places.

07	L3	CO4

b. Using the modified Euler's method find y(0.1), given $\frac{dy}{dx} = x^2 + y$ and $y(0) = 1$, perform two modifications in each stage. Take $h = 0.05$.

07	L2	CO4

c. Given $\frac{dy}{dx} = x^2 + \frac{y}{2}$ and $y(1) = 2$, $y(1.1) = 2.2156$, $y(1.2) = 2.4649$, $y(1.3) = 2.7514$, find $y(1.4)$ using Milne's predictor and corrector formulae.

06	L2	CO4

OR

			Marks	Level	CO
Q.10	a.	Using the modified Euler's method, solve the initial value problem $\frac{dy}{dx} = \frac{y-x}{y+x}$, y(0) = 1 at the point x = 0.1. Carryout 3 modifications (Take h = 0.1)	07	L3	CO3
	b.	Use the Runge-Kutta method of 4^{th} order to solve $\frac{dy}{dx} = \frac{y^2-x^2}{y^2+x^2}$ with y(0) = 1, at x = 0.2. (Take h = 0.2).	07	L3	CO4
	c.	Using Modern Mathematical Tools write a program to find y when x = 0.8, given $\frac{dy}{dx} = x - y^2$, y(0) = 0, y(0.2) = 0.2, y(0.4) = 0.0795, y(0.6) = 0.01762, using Milne's Predictor-Corrector method.	06	L3	CO5

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