CBCS SCHEME

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BMATM201

Second Semester B.E./B.Tech. Degree Examination, June/July 2024
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. M : Marks , L: Bloom's level , C: Course outcomes.
3. Mathematics hand book is permitted.

		Module – 1	M	L	C
Q.1	a.	Evaluate $\int_0^a\int_0^b\int_0^c (x^2+y^2+z^2)\,dxdydz$.	6	L2	CO1
	b.	Change the order of integration in $\int_0^{4a}\int_{x^2/4a}^{2\sqrt{ax}} dydx$ and hence evaluate the same.	7	L2	CO1
	c.	Derive the relation between Beta and Gamma function.	7	L2	CO1
		OR			
Q.2	a.	Evaluate $\int_0^1\int_0^{\sqrt{1-y^2}} (x^2+y^2)\,dxdy$ by changing to polar coordinates.	7	L2	CO1
	b.	Using double integration, find the volume of the tetrahedron bounded by the planes x = 0, y = 0, z = 0 and $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$.	7	L2	CO1
	c.	Write a modern mathematical program to evaluate the integral $\int_0^3\int_0^{3-x}\int_0^{3-x-y} xyz\,dzdydx$.	6	L3	CO5
		Module – 2			
Q.3	a.	If $\vec{r}=x\hat{i}+y\hat{j}+z\hat{k}$ then show that $\nabla r^n = nr^{n-2}\vec{r}$.	7	L2	CO2
	b.	Find the directional derivative of $\phi = x^2yz+4xz^2$ at (1, -2, -1) along $2\hat{i}-\hat{j}-2\hat{k}$.	7	L2	CO2
	c.	If $\vec{F}=(x+y+az)\hat{i}+(bx+2y-z)\hat{j}+(x+cy+2z)\hat{k}$, find a, b, c such that curl $\vec{F}=\vec{0}$.	6	L2	CO2
		OR			
Q.4	a.	Find the work done in moving a particle in the force field $\vec{F}=3x^2\hat{i}+(2xz-y)\hat{j}+z\hat{k}$ along the straight line from (0, 0, 0) to (2, 1, 3).	7	L3	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 | L2 | CO2]

c. Write a modern mathematical tool program to find the divergence of $\vec{F} = x^2yz\hat{i} + y^2zx\hat{j} + z^2xy\hat{k}$. [6 | L3 | CO2]

Module – 3

Q.5 a. Form the partial differential equation from the relation $z = f(y+2x) + g(y-3x)$. [6 | L1 | CO3]

b. Solve $\frac{\partial^2 z}{\partial x^2} = xy$ subject to the conditions $\frac{\partial z}{\partial x} = \log(1+y)$ when $x = 1$ and $z = 0$ when $x = 0$. [7 | L2 | CO3]

c. Derive one dimensional heat equation. [7 | L2 | CO3]

OR

Q.6 a. Form the partial differential equation from the relation $f(xy+z^2, x+y+z) = 0$ [6 | 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 | L2 | CO3]

c. Solve $(mz - ny)p + (nx - \ell z)q = \ell y - mx$. [7 | L2 | CO3]

Module – 4

Q.7 a. Find the real root of the equation $\cos x - xe^x = 0$ in (0.5, 0.6) using the Regula – Falsi method correct to four decimal places, carryout there interations. [7 | L2 | CO4]

b. The population of a town is given by the table [7 | L2 | CO4]

Year	1951	1961	1971	1981	1991
Population in thousands	19.96	39.65	58.81	77.21	94.61

Using Newton's forward interpolation formula, calculate the population in the year 1955.

c. Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by using Simpson's 1/3rd rule. [Take 6 equal parts]. [6 | L3 | CO4]

OR

Q.8 a. Find a real root of the equation $x^3 + 5x - 11 = 0$ near to $x = 1$ using Newton – Raphson method. Carryout three iterations. [7 | L3 | CO4]

			Marks	Level	CO
	b.	Using Newton's divided difference formula, evaluate f(4) from the following table x: 0, 2, 3, 6 f(x): -4, 2, 14, 158	7	L3	CO4
	c.	Evaluate $\int_0^1 \frac{dx}{1+x}$ taking seven ordinates by applying Simpson's $(3/8)^{th}$ rule.	6	L3	CO4
		Module – 5			
Q.9	a.	Using 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	L2	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.	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 applying Milne's method.	7	L3	CO4
		OR			
Q.10	a.	Using modified Euler's method, compute y(1.1) given that $\frac{dy}{dx} + \frac{y}{x} = \frac{1}{x^2}$ and y = 1 at x = 1 by taking h = 0.1.	7	L3	CO5
	b.	Apply Runge-Kutta fourth order method, to find an approximate value of y when x = 0.2, given that $\frac{dy}{dx} = x + y$ and y = 1 when x = 0.	7	L3	CO5
	c.	Using modern mathematical tools with a program to find y when x = 1.4, given $\frac{dy}{dx} = x^2 + (y/2), y(1) = 2$, y(1.1) = 2.2156, y(1.2) = 2.4649, y(1.3) = 2.7514 using predictor corrector method.	6	L3	CO5

x	0	2	3	6
f(x)	-4	2	14	158

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