U.S.N.										

B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

February / March 2024 Semester End Main Examinations

Programme: B.E. **Semester: II**
Branch: Civil Engineering **Duration: 3 hrs.**
Course Code: 22MA2BSMCV **Max Marks: 100**
Course: Mathematical Foundation for Civil Engineering-2

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	Evaluate $\iint_R xy\, dydx$ by changing the order of integration, where R is the region bounded by x-axis, ordinate $x = 2a$ and the parabola $x^2 = 4ay$.	CO1	PO1	**6**
	b)	Find the mass of a plate in the form of one loop of the Lemniscate $r^2 = a^2 \cos 2\theta$ if the density at a point varies as the square of its distance from the pole.	CO2	PO1	**7**
	c)	Prove that $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$ using the definition $\Gamma(n) = 2\int_0^\infty e^{-x^2} x^{2n-1} dx$.	CO1	PO1	**7**
		OR			
2	a)	Evaluate $\int_0^a \int_y^a \frac{x^2}{\sqrt{x^2+y^2}} dx\, dy$ by changing into polar coordinates.	CO1	PO1	**6**
	b)	Find the volume of the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$.	CO2	PO1	**7**
	c)	Prove that $\int_0^\infty x^2 e^{-x^4} dx \times \int_0^\infty e^{-x^4} dx = \frac{\pi}{8\sqrt{2}}$.	CO1	PO1	**7**
		UNIT - II			
3	a)	Find the constants a and b so that the surfaces $\phi = ax^2y + z^3$ and $5x^2 - byz = 9x$ intersect orthogonally at the point (1, -1, 2).	CO1	PO1	**6**
	b)	A fluid motion is given by $\vec{F} = (6xy + z^3)\hat{i} + (3x^2 - z)\hat{j} + (3xz^2 - y)\hat{k}$. Show that the motion is irrotational and find its scalar potential.	CO1	PO1	**7**
	c)	Apply Green's theorem to find the work done $\oint_C (3x - 8y^2)dx + (4y - 6xy)dy$, where C is the boundary of the region enclosed by the lines $x = 0, y = 0$ and $x + y = 1$.	CO1	PO1	**7**

UNIT - III

Q.No		Question	CO	PO	Marks
4	a)	Form the partial differential equation by eliminating arbitrary constants from the relation $z = xy + y\sqrt{x^2 - a^2} + b$.	CO1	PO1	**6**
	b)	Apply direct integration method to solve $\frac{\partial^2 z}{\partial x \partial y} = \sin x \sin y$ subjected to the conditions $\frac{\partial z}{\partial y} = -2\sin y$ when $x = 0$ and $z = 0$ when y is an odd multiple of $\pi/2$.	CO1	PO1	**7**
	c)	Derive the one-dimensional heat equation $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$, where $u(x,t)$ denotes the temperature at a point x at time t.	CO1	PO1	**7**

OR

Q.No		Question	CO	PO	Marks
5	a)	Form the partial differential equation by eliminating arbitrary function from $lx + my + nz = \phi\left(x^2 + y^2 + z^2\right)$.	CO1	PO1	**6**
	b)	Solve $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 2(x+y)u$ by the method of separation of variables.	CO1	PO1	**7**
	c)	Solve: $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$.	CO1	PO1	**7**

UNIT - IV

Q.No		Question	CO	PO	Marks
6	a)	Apply Newton-Raphson method to find the root of the equation $x\log_{10} x = 1.2$ in (2,3) correct to four decimal places.	CO1	PO1	**6**
	b)	The following table gives the viscosity of an oil as a function of temperature. Find the viscosity of oil at a temperature of 140^0c using appropriate interpolation formula.	CO2	PO1	**7**

Temp	110	130	160	190
Viscosity	10.8	8.1	5.5	4.8

Q.No		Question	CO	PO	Marks
	c)	A rocket is launched from the ground. Its acceleration is registered during the first 80 seconds and is given in the table below. Using Simpson's 1/3rd rule, find the velocity of the rocket at $t = 80$ sec.	CO2	PO1	**7**

t (sec)	0	10	20	30	40	50	60	70	80
f (cm/sec^2)	30	31.63	33.34	35.47	37.75	40.33	43.25	46.69	50.67

UNIT - V

Q.No		Question	CO	PO	Marks
7	a)	Solve the initial value problem $y' = 2y + 3e^x$, $y(0) = 0$ at $x = 0.1$ and $x = 0.2$ using Taylor series method by considering terms up to fourth degree.	CO1	PO1	**6**
	b)	Apply modified Euler's formula to solve $y' = xy + y^2$, $y(0) = 1$ at $x = 0.2$ by taking $h = 0.2$.	CO1	PO1	**7**
	c)	Apply Runge-Kutta method of fourth-order to solve the differential equation $\frac{dy}{dx} = \frac{2xy + e^x}{x^2 + xe^x}$, with $y(1) = 0$ at $x = 1.1$ by taking $h = 0.1$.	CO1	PO1	**7**

******