U.S.N.										

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

Autonomous Institute Affiliated to VTU

December 2023 Supplementary Examinations

Programme: B.E. **Semester: II**
Branch: ME, IEM, AS, CH **Duration: 3 hrs.**
Course Code: 22MA2BSMME **Max Marks: 100**
Course: Mathematical Foundation for Mechanical Engineering Stream-2

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

		UNIT - I	*CO*	*PO*	Marks
1	a)	Evaluate $\int_0^{\infty}\int_0^{\infty} e^{-(x^2+y^2)}\,dxdy$ by changing in to polar co-ordinates.	CO1	PO1	**6**
	b)	Compute the volume of the tetrahedron bounded by the plane $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$ and the co-ordinate planes using triple integrals.	CO2	PO1	**7**
	c)	Using $\Gamma(n)=2\int_0^{\infty} e^{-x^2}x^{2n-1}dx$, prove that $\Gamma\left(\frac{1}{2}\right)=\sqrt{\pi}$.	CO1	PO1	**7**
		OR			
2	a)	Evaluate $\int_0^1\int_0^{\sqrt{1+x^2}} \frac{dy\,dx}{1+x^2+y^2}$.	CO1	PO1	**6**
	b)	Evaluate $\int_0^{\infty}\int_x^{\infty}\frac{e^{-y}}{y}\,dy\,dx$ by changing the order of integration.	CO2	PO1	**7**
	c)	Show that $\int_0^{\infty} xe^{-x^8}dx \times \int_0^{\infty} x^2e^{-x^4}dx=\frac{\pi\sqrt{2}}{32}$.	CO1	PO1	**7**
		UNIT - II			
3	a)	Find $\nabla\cdot\vec{F}$ and $\nabla\times\vec{F}$ of $\vec{F}=\frac{x\hat{\imath}+y\hat{\jmath}}{(x^2+y^2)}$.	CO1	PO1	**6**
	b)	Show that $\vec{F}=(\sin y+z)\hat{\imath}+(x\cos y-z)\hat{\jmath}+(x-y)\hat{k}$ is irrotational and hence find its scalar potential.	CO1	PO1	**7**
	c)	Apply Green's theorem to evaluate $\int_C (y-\sin x)dx+\cos x dy$, where C is the triangle enclosed by the lines $y=0, x=\frac{\pi}{2}$ and $y=\frac{2}{\pi}x$.	CO2	PO1	**7**

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 - III			
	4	a)	Form a partial differential equation by eliminating the arbitrary function from $z = e^{ax+by} f(ax - by)$.	CO1	PO1	**6**
		b)	Solve $\tan(x)\, p + \tan(y)\, q - 2\cot(z) = 0$.	CO1	PO1	**7**
		c)	Apply the method of separation of variables to solve $\frac{\partial z}{\partial x} = 2\frac{\partial z}{\partial y} + z$ subjected to the condition $z(x,0) = 6e^{-3x}$.	CO1	PO1	**7**
			OR			
	5	a)	Form partial differential equation of all spheres whose center lies on the z −axis.	CO1	PO1	**6**
		b)	Solve $x(y^2 - z^2)\frac{\partial z}{\partial x} + y(z^2 - x^2)\frac{\partial z}{\partial y} = z(x^2 - y^2)$.	CO1	PO1	**7**
		c)	Derive the one-dimensional wave equation in the form $u_{tt} = c^2 u_{xx}$.	CO1	PO1	**7**
			UNIT - IV			
	6	a)	Apply Newton-Raphson method to find a positive real root of the equation $3x^2 - 1 - \sin x = 0$ correct to four decimals places with 0.5 as initial approximation.	CO1	PO1	**6**
		b)	The following data are part of a table for $g(x) = \frac{\sin x}{x^2}$. x: 0.1, 0.2, 0.3, 0.4, 0.5 $g(x)$: 9.9833, 4.9667, 3.2836, 2.4339, 1.9177 Determine $g(0.25)$ using suitable Newton-Gregory interpolation formula.	CO2	PO1	**7**
		c)	Evaluate $\int_0^1 \tan^{-1} x\ dx$ by dividing the interval into six equal subintervals using Simpson's 1/3rd rule.	CO1	PO1	**7**
			UNIT - V			
	7	a)	The dissolved oxygen deficit $'y'$ in a stream due to pollutants is given by Streeter-Phelps equation $10y' + 0.2y = 6e^{-0.05x}$, $y(0) = 3$, where $'x'$ is measured along the length of river. Using Taylor's series method compute $'y'$ for a stretch of $x = 0.2\ km$.	CO2	PO1	**6**
		b)	Apply Runge-Kutta method of 4th order to find an approximate solution of $y' = xy + y^2$, $y(0) = 1$ at $x = 0.1$, with $h = 0.1$.	CO1	PO1	**7**
		c)	Apply the Milne's predictor-corrector method to determine y at $x = 0.8$ from $y' - x + y^2 = 0$ given $y(0) = 0, y(0.2) = 0.02$, $y(0.4) = 0.0795$ and $y(0.6) = 0.1762$.	CO1	PO1	**7**

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