U.S.N.										

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

Autonomous Institute Affiliated to VTU

February / March 2025 Semester End Main Examinations

Programme: B.E. **Semester: II**
Branch: Common to all Branches **Duration: 3 hrs.**
Course Code: 18MA2BSEM2 **Max Marks: 100**
Course: Engineering Mathematics -2

Instructions:
1. All units have internal choice, answer one complete question from each unit.
2. Missing data, if any, may be suitably assumed.

				CO	PO	Marks
			UNIT - I			
	1	a)	Find the Laplace transform of the following functions (i) $5^t + \sin(a+bt)$ (ii) $\sin t \sin 2t$.	1	1	**6**
		b)	Express the function $f(t)=\begin{cases} t^2, & 0<t<2 \\ 4t, & 2<t<4 \\ 8, & t>4 \end{cases}$ in terms of unit step function and hence find its Laplace transform.	1	1	**7**
		c)	If $f(t)$ is a periodic function of period T, prove that $L[f(t)] = \frac{1}{1-e^{-sT}}\int_0^T e^{-st}\, f(t)dt$.	1	1	**7**
			OR			
	2	a)	Find the Laplace transform of $f(t) = \frac{\cos bt}{t} + t \sin t$.	1	1	**6**
		b)	Find the Laplace transform of the periodic function $f(t)=\begin{cases} 1+t & 0<t\le 1 \\ 3-t & 1\le t<2 \end{cases}$ having period 2.	1	1	**7**
		c)	Express the following function in terms of unit step function $f(t)=\begin{cases} \cos t & for\ 0<t\le\pi \\ 1 & for\ \pi<t\le 2\pi \\ \sin t & for\ t>2\pi \end{cases}$ and hence find its Laplace transform.	1	1	**7**
			UNIT - II			
	3	a)	Find the inverse Laplace transform of $f(s) = \frac{2s-3}{s^2+4s+13}$.	1	1	**6**
		b)	Find the inverse Laplace transform of $\log\left(\sqrt{\frac{s^2+a^2}{s^2+b^2}}\right)$.	1	1	**7**

		c)	Apply Laplace transform technique to solve $\frac{d^2y}{dt^2} - 5\frac{dy}{dt} + 6y = 0$ with $y(0) = 0$ and $y'(0) = 1$.	*1*	*1*	**7**
			OR			
	4	a)	Find the inverse Laplace transform of $\log\left(\frac{s^2+4}{(s^2-4)(s+5)}\right)$.	*1*	*1*	**6**
		b)	Find the inverse Laplace transform of $F(s) = \frac{s^2+6s+9}{(s-1)(s-2)(s+4)}$.	*1*	*1*	**7**
		c)	Apply Laplace transform technique to solve $\frac{d^2x}{dt^2} - 2\frac{dx}{dt} + x = e^{2t}$ with $x(0) = 0$ and $x'(0) = 1$.	*1*	*1*	**7**
			UNIT - III			
	5	a)	Obtain all possible solution of one-dimensional wave equation $u_{tt} = c^2 u_{xx}$ where c is the constant using separation of variable method.	*1*	*1*	**6**
		b)	Solve the partial differential equation $3\frac{\partial u}{\partial x} + 2\frac{\partial u}{\partial y} = 0$ given $u(x,0) = 4e^{-x}$ by the method of separation of variables.	*1*	*1*	**7**
		c)	Solve $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$.	*1*	*1*	**7**
			OR			
	6	a)	Derive an expression for one dimensional heat equation $u_t = c^2 u_{xx}$.	*1*	*1*	**6**
		b)	Solve $x(y-z)p + y(z-x)q = z(x-y)$.	*1*	*1*	**7**
		c)	Form the partial differential equation of $z = e^{ax+by} f(ax - by)$ by elimination of arbitrary functions.	*1*	*1*	**7**
			UNIT - IV			
	7	a)	If $\vec{F} = (ax+3y+4z)\hat{i} + (x-2y+3z)\hat{j} + (3x+2y-z)\hat{k}$ is solenoidal, then find the value of a.	*1*	*1*	**6**
		b)	Prove that $div(\Phi\, \vec{F}) = \nabla\Phi \cdot \vec{F} + \Phi(\nabla \cdot \vec{F})$.	*1*	*1*	**7**
		c)	Apply Green's theorem to evaluate $\int_c (y - \sin x)dx + \cos x\, dy$ where c is a triangle enclosed by the lines $y = 0, x = \pi/2$ and $y = 2x/\pi$.	*1*	*1*	**7**
			OR			
	8	a)	Prove that the surfaces $4x^2y + z^3 = 4$ and $5x^2 - 2yz = 9x$ intersect orthogonally at the point $(1,-1,2)$.	*1*	*1*	**6**

		b)	A vector field is given by $\vec{F} = (x^2 - y^2 + x)\hat{\imath} - (2yx + y)\hat{\jmath}$, show that the field is irrotational and find its scalar potential.	*1*	*1*	**7**
		c)	If $\vec{F} = xy\hat{i} + y^2z\hat{j} + z^3\hat{k}$, evaluate $\iint_S \vec{F}\cdot\hat{n}\,ds$, where s is the unit cube defined by $0 \le x \le 1, 0 \le y \le 1$ and $0 \le z \le 1$ using Gauss divergence theorem.	*1*	*1*	**7**
			UNIT - V			
	9	a)	Prove that the cylindrical polar coordinate system is orthogonal curvilinear coordinate system.	*1*	*1*	**6**
		b)	Express the vector $\vec{F} = x\hat{\imath} + 2y\hat{\jmath} + yz\hat{k}$ in spherical polar coordinates.	*1*	*1*	**7**
		c)	Derive an expression for gradient of the scalar φ in orthogonal curvilinear coordinates.	*1*	*1*	**7**
			OR			
	10	a)	Prove that spherical polar coordinate system is orthogonal curvilinear coordinate system.	*1*	*1*	**6**
		b)	Express the vector $\overrightarrow{F} = xy\hat{i} + yz\hat{j} + zx\hat{k}$ in cylindrical coordinates.	*1*	*1*	**7**
		c)	Derive an expression for curl of the vector $\vec{A}$ in orthogonal curvilinear coordinates.	*1*	*1*	**7**

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