CBCS SCHEME

C.M.R. INSTITUTE OF TECHNOLOGY, CMR, BANGALORE

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BMATE201

Second Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024
Mathematics-II for EEE 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.	Find the directional derivative of $\phi = xy^3 + yz^3$ at (2, -1, 1) along $i + 2j + 2k$.	7	L2	CO1
	b.	Find div $\vec{F}$ and curl $\vec{F}$, if $\vec{F} = y^3z^2\hat{i} + 3xy^2z^2\hat{j} + 2xy^3z\hat{k}$ at (1, -1, 1).	7	L2	CO1
	c.	If $\vec{V} = 3xy^2z^2\hat{i} + y^3z^2\hat{j} + 2y^2z^3\hat{k}$ and $\vec{F} = (x^2 - yz)\hat{i} + (y^2 - zx)\hat{j} + (z^2 - xy)\hat{k}$, show that $\vec{V}$ is solenoidal and $\vec{F}$ is irrotational.	6	L2	CO1
		OR			
Q.2	a.	Find the workdone in moving a particle by 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	L2	CO1
	b.	Using Green's theorem evaluate $\oint (xy - x^2)dx + x^2y\,dy$ over the region bounded by $y = x$ and $y = x^2$.	7	L3	CO1
	c.	Write the mathematical tool program to find the divergence of the vector field. $\vec{F} = x^2yz\hat{i} + y^2zx\hat{j} + z^2xy\hat{k}$.	6	L3	CO5
		Module – 2			
Q.3	a.	If W is the set of all points in R^3 satisfying the equation $a_1x_1 + a_2x_2 + a_3x_3 = 0$, then prove that W is a subspace of R^3.	7	L2	CO2
	b.	Prove that in $V_3(R)$, the vectors {(1, 2, 1), (2, 1, 0), (1, -1, 2)} are linearly independent.	7	L2	CO2
	c.	Prove that the transformation $T : R^3 \rightarrow R^3$ defined by $T(x_1, x_2, x_3) = (0, x_2, x_3)$ is linear.	6	L2	CO2
		OR			
Q.4	a.	Express the vector (2, -1, -8) as a linear combination of the vectors (1, 2, 1), (1, 1, -1) and (4, 5, -2).	7	L2	CO2
	b.	Find the matrix of the linear transformation $T : V_3(R) \rightarrow V_2(R)$ defined by $T(x, y, z) = (x + y, y + z)$ relative to the bases $B_1 = \{(1, 1, 0), (1, 0, 1), (1, 1, -1)\}$, $B_2 = \{(2, -3), (1, 4)\}$.	7	L2	CO2

			Marks	Level	CO
	c.	Using the modern mathematical tool. Write the code to represent the reflection transformation $T : R^2 \rightarrow R^2$ and to find the image of vector (10, 0) when it is reflected about the y-axis.	6	L3	CO5
		Module – 3			
Q.5	a.	Find the Laplace transform of i) $te^{-t}\sin 3t$ ii) $\frac{e^{at}-e^{bt}}{t}$	7	L2	CO3
	b.	Find the Laplace transform of the square wave function of period 'a' defined by $f(t)=\begin{cases} E, & 0<t<a/2 \\ -E, & a/2<t<a \end{cases}$	7	L3	CO3
	c.	Express $f(t)=\begin{cases} t^2, & 0<t<2 \\ 4t, & 2<t<4 \\ 6, & t>4 \end{cases}$ interms of unit step function and hence find its Laplace transform.	6	L3	CO3
		OR			
Q.6	a.	Find $L^{-1}\left\{\frac{2s-1}{(s-1)(s-3)}\right\}$.	7	L2	CO3
	b.	Find $L^{-1}\left\{\frac{1}{s(s^2+a^2)}\right\}$ using convolution theorem.	7	L2	CO3
	c.	Solve by Laplace transform $\frac{d^2y}{dt^2}-\frac{dy}{dt}=0,\ y(0)=y'(0)=3$.	6	L3	CO3
		Module – 4			
Q.7	a.	Find the real root of the equation x sin x + cosx = 0 near x = π by Newton-Raphson method.	7	L2	CO4
	b.	Using Newton's forward interpolation formula find y at x = 5 for the data: x: 4, 6, 8, 10 y: 1, 3, 8, 16	7	L3	CO4
	c.	Find the interpolating polynomial using Newton's divided difference formula for the data: x: 0, 1, 2, 5 y: 2, 3, 12, 147	6	L2	CO4
		OR			
Q.8	a.	Find the real root of the equation $x\log_{10}x = 1.2$ by Regula Falsi method between 2 and 3 (three iterations).	7	L2	CO4
	b.	Find y at x = 5, if y(1) = +3, y(3) = 9, y(4) = 30, y(6) = 132 using Lagrange's interpolation formula.	7	L2	CO4

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	c.	Evaluate $\int_0^{\pi/2} \sqrt{\cos x}\, dx$ by using Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule by taking 6 equal parts.	6	L3	CO4
		Module – 5			
Q.9	a.	Use Taylor's series method to find y(0.1) by considering upto 3rd degree term, given $\frac{dy}{dx} = x - y^2$, $y(0) = 1$.	7	L3	CO4
	b.	Given $\frac{dy}{dx} = 3e^x + 2y$, $y(0) = 0$, $h = 0.1$ using Runge-Kutta method of 4th order find y at $x = 0.1$.	7	L3	CO4
	c.	Apply Milne's predictor-corrector method, find y(0.4) given $\frac{dy}{dx} = x^2 + y^2$, $y(0) = 1$, $y(0.1) = 1.1113$, $y(0.2) = 1.2507$, $y(0.3) = 1.426$.	6	L2	CO4
		OR			
Q.10	a.	Using modified Euler's method, find y(0.1) given that $\frac{dy}{dx} = x^2 + y$ and $y(0) = 1$, take $h = 0.05$ and perform two iterations in each stage.	7	L2	CO4
	b.	Apply Milne's method to find y(4.4) given that $y(4) = 1$, $y(4.1) = 1.0049$, $y(4.2) = 1.0097$, $y(4.3) = 1.0142$ and $\frac{dy}{dx} = \frac{2 - y^2}{5x}$.	7	L2	CO4
	c.	Write a modern mathematical tool program to solve $\frac{dy}{dx} = x^2 + y^2$, $y(0) = 1$, $h = 0.1$ using R – K method of 4th order. CMRIT LIBRARY BANGALORE - 560 037	6	L3	CO5

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