CBCS SCHEME

USN | | | | | | | | | |

BMATE201

Second Semester B.E./B.Tech. Degree Examination, June/July 2025
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 angle between the surface $xy^2z = 3x + z^2$ and $3x^2 - y^2 + 2z = 1$ at the point (1, -2, 1)	7	L3	CO1
	b.	Evaluate $\text{curl}(\text{curl}\,\vec{F})$ and $\text{div}(\text{curl}\,\vec{F})$ if $\vec{F} = x^2yi + y^2zj + z^2xk$	7	L3	CO1
	c.	Show that the vector $\vec{F} = \dfrac{xi + yj}{x^2 + y^2}$ is both solenoidal and irrotational.	6	L2	CO2
		OR			
Q.2	a.	Find the total work done by the force $\vec{F} = 3xyi - yj + 2zxk$ in moving a particle around the circle $x^2 + y^2 = 4$.	7	L3	CO1
	b.	Using Green's theorem evaluate $\oint_C (xy + y^2)dx + x^2dy$ over the region bounded by the curves $y = x$ and $y = x^2$	7	L2	CO3
	c.	Using modern mathematical tools, write the code to find gradient of $\phi = x^2y + 2xz - 4$.	6	L2	CO5
		Module – 2			
Q.3	a.	Define a Subspace. Show that any plane passing through the origin is a subspace of R^3.	7	L1	CO1
	b.	Let V be the vector space of all real valued continuous functions over R. Show that the set W of solutions of differential equations $5\dfrac{d^2y}{dx^2} - 7\dfrac{dy}{dx} + 2y = 0$ is a subspace of V.	7	L2	CO2
	c.	Define a Inner Product space. Consider $f(t) = 3t - 5$ and $g(t) = t^2$, the inner product $\langle f.g \rangle = \int_0^t f(t)g(t)dt$. Find $\langle f \cdot g \rangle$	6	L2	CO2
		OR			
Q.4	a.	Express the vector (3, 5, 2) as a linear combination of the vectors (1, 1, 0), (2, 3, 0), (0, 0, 1) of $V_3(R)$.	7	L2	CO3

	b.	State Rank-Nullity theorem. Verify the Rank-Nullity theorem for the $T: R^3 \rightarrow R^3$ defined by T(x, y, z) = (x+2y-z, y+z, x+y-2z)	7	L2	CO2
	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	L1	CO4
		Module – 3			
Q.5	a.	Find the Laplace transform of, (i) $e^{-3t}(2\cos 5t - 3\sin 5t)$ (ii) $\dfrac{\cos at - \cos bt}{t}$	7	L3	CO3
	b.	Given $f(t) = \begin{cases} E, & 0 < t < \frac{a}{2} \\ -E, & \frac{a}{2} < t < a \end{cases}$ where f(t+a) = f(t), show that $L[(f(t)] = \dfrac{E}{S}\tanh\left(\dfrac{aS}{4}\right)$.	7	L2	CO2
	c.	Express $f(t) = \begin{cases} \cos t, & 0 < t < \pi \\ \cos 2t, & \pi < t < 2\pi \\ \cos 3t, & t > 2\pi \end{cases}$ in terms of the Heaviside unit step function and hence find L[f(t)].	6	L3	CO4
		OR			
Q.6	a.	Find $L^{-1}\left[\dfrac{2s^2 + 5s - 4}{s^3 + s^2 - 2s}\right]$.	7	L3	CO3
	b.	Using the convolution thorem, find the inverse Laplace Transform of $\dfrac{s}{(s^2 + a^2)^2}$.	7	L3	CO4
	c.	Solve $y''' + 2y'' - y' - 2y = 0$, given $y(0) = y'(0) = 0$ and $y''(0) = 6$ by using Laplace transform method.	6	L2	CO3
		Module – 4			
Q.7	a.	By Newton-Raphson method, find the root of $x\tan x + 1 = 0$ which is near to $x = \pi$.	7	L3	CO2
	b.	Using Newton's forward difference formula find f(38), $\begin{array}{\|c\|c\|c\|c\|c\|c\|c\|} \hline x & 40 & 50 & 60 & 70 & 80 & 90 \\ \hline y & 184 & 204 & 226 & 250 & 276 & 304 \\ \hline \end{array}$	7	L3	CO3
	c.	Use Lagrange's interpolation formula to find y at x = 10, given $\begin{array}{\|c\|c\|c\|c\|c\|} \hline x & 5 & 6 & 9 & 11 \\ \hline y & 12 & 13 & 14 & 16 \\ \hline \end{array}$	6	L3	CO3

<table>
<tr><td colspan="6" align="center">OR</td></tr>
<tr><td>Q.8</td><td>a.</td><td>Find a real root of the equation $x^3 - 2x - 5 = 0$ correct to three decimal places by the method of false position in (2, 3).</td><td>7</td><td>L4</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Find the interpolating polynomial using Newton's dividend difference formula for the following data,
<table>
<tr><td>x</td><td>2</td><td>4</td><td>5</td><td>6</td><td>8</td><td>10</td></tr>
<tr><td>y</td><td>10</td><td>96</td><td>196</td><td>350</td><td>868</td><td>1746</td></tr>
</table></td><td>7</td><td>L3</td><td>CO4</td></tr>
<tr><td></td><td>c.</td><td>Use Simpson's $\frac{3}{8}^{th}$ rule to obtain the approximate value of $\int_0^{0.3} (1-8x^3)^{\frac{1}{2}} dx$ by considering 3 equal intervals.</td><td>6</td><td>L2</td><td>CO2</td></tr>
<tr><td colspan="6" align="center">Module – 5</td></tr>
<tr><td>Q.9</td><td>a.</td><td>Use 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.</td><td>7</td><td>L3</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Given $\frac{dy}{dx} = 3x + \frac{y}{2}$, y(0) = 1. Compute y(0.2) by taking h = 0.2, using Runge-Kutta method of fourth order.</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>Apply Milne's method to compute y(1.4), correct to four decimal places given $\frac{dy}{dx} = x^2 + \frac{y}{2}$ and following the data y(1) = 2, y(1.1) = 2.2156, y(1.2) = 2.4649, y(1.3) = 2.7514</td><td>6</td><td>L2</td><td>CO2</td></tr>
<tr><td colspan="6" align="center">OR</td></tr>
<tr><td>Q.10</td><td>a.</td><td>Using modified Euler's method to find y at x = 0.2 given $\frac{dy}{dx} = x - y^2$ and y(0) = 1 by taking step size h = 0.1.</td><td>7</td><td>L4</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Using the Runge-Kutta method of fourth order find y(0.1) given that $\frac{dy}{dx} = 3e^x + 2y$, y(0) = 0 taking h = 0.1.</td><td>7</td><td>L3</td><td>CO2</td></tr>
<tr><td></td><td>c.</td><td>Using modern mathematical tools, write the code to find the solution of $\frac{dy}{dx} = x - y^2$ at y(0.1), given that y(0) = 1 by Runge-Kutta 4th order method.</td><td>6</td><td>L2</td><td>CO3</td></tr>
</table>

* * * * *