# 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 $T: R^3 \to R^3$ 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 $T: R^2 \to R^2$ 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), <br> x: 40, 50, 60, 70, 80, 90 <br> y: 184, 204, 226, 250, 276, 304 | 7 | L3 | CO3 |
| | c. | Use Lagrange's interpolation formula to find y at x = 10, given <br> x: 5, 6, 9, 11 <br> y: 12, 13, 14, 16 | 6 | L3 | CO3 |

| | | | | | |
|---|---|---|---|---|---|
| | | **OR** | | | |
| Q.8 | a. | 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). | 7 | L4 | CO4 |
| | b. | Find the interpolating polynomial using Newton's dividend difference formula for the following data,<br>x: 2, 4, 5, 6, 8, 10<br>y: 10, 96, 196, 350, 868, 1746 | 7 | L3 | CO4 |
| | c. | 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. | 6 | L2 | CO2 |
| | | **Module – 5** | | | |
| Q.9 | a. | Use Taylor's series method, find y(0.1) considering upto fourth degree term if y(x) satisfies the equation, $\frac{dy}{dx} = x - y^2$, $y(0) = 1$. | 7 | L3 | CO3 |
| | b. | 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. | 7 | L2 | CO3 |
| | c. | 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 | 6 | L2 | CO2 |
| | | **OR** | | | |
| Q.10 | a. | 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. | 7 | L4 | CO4 |
| | b. | 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. | 7 | L3 | CO2 |
| | c. | 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 $4^{th}$ order method. | 6 | L2 | CO3 |

* * * * *