

Second Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026

Mathematics – II for Civil Engineering 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.	Evaluate $\int_{-1}^1 \int_0^{y+2} \int_{x-2}^{y+2} (x+y+z) dy dx dz$.	7	L3	CO1
	b.	Evaluate by changing the order of integration $\int_0^{\infty} \int_x^{\infty} \frac{e^{-y}}{y} dy dx$.	7	L3	CO1
	c.	Derive the relation $\beta(m,n) = \frac{\Gamma m \Gamma n}{\Gamma(m+n)}$.	6	L2	CO1
OR					
Q.2	a.	Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} xy e^{y^2} dy dx$.	7	L3	CO1
	b.	Evaluate $\int_0^a \int_0^{\sqrt{a^2-x^2}} y^2 \sqrt{x^2+y^2} dy dx$ by changing to polar coordinates	7	L3	CO1
	c.	Write a modern mathematical tool program to evaluate the integral, $\int_0^3 \int_0^{3-x} \int_0^{3-x-y} (xyz) dz dy dx$.	6	L3	CO5
Module – 2					
Q.3	a.	If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$, show that (i) $\nabla \cdot \vec{r} = 3$, (ii) $\nabla \times \vec{r} = 0$ (iii) $\nabla r^n = nr^{n-2} \vec{r}$, where $ \vec{r} = r$.	7	L2	CO2
	b.	If $\vec{f} = \text{grad}(x^3 + y^3 + z^3 - 3xyz)$ find $\text{div } \vec{f}$ and $\text{curl } \vec{f}$.	7	L2	CO2
	c.	Define solenoidal vector. If $V = W \times \vec{r}$ and W is a constant vector show that $W = \frac{1}{2} \text{curl } V$.	6	L2	CO2

OR															
Q.4	a.	Find the total work done by the force $\vec{F} = 3x^2\hat{i} + (2xz - y)\hat{j} + z\hat{k}$ in moving a particle along the curve $x^2 = 4y$, $3x^2 = 8z$ from $x = 0$ to $x = 2$.	7 L3 CO2												
	b.	Use Stokes theorem, evaluate $\int_C [(2x - y)dx - yz^2dy - y^2zdz]$ where C is the circle $x^2 + y^2 = 1$ corresponds to the surface of sphere of unit radius.	7 L3 CO2												
	c.	Write the modern mathematical tool program to find the gradient of x^2yz .	6 L2 CO5												
Module – 3															
Q.5	a.	Form the partial differential equation from the relation, $z = ax + by + cxy$ by eliminating arbitrary constants.	7 L2 CO3												
	b.	Solve $(mz - ny)p + (nx - lz)q = ly - mx$.	7 L3 CO3												
	c.	Derive one dimensional wave equation.	6 L2 CO3												
OR															
Q.6	a.	Form a partial differential equation by eliminating the arbitrary functions ϕ and ψ from the relation $z = x\phi(y) + y\psi(x)$.	7 L2 CO3												
	b.	Solve $\frac{\partial^2 z}{\partial x^2} - 2\frac{\partial z}{\partial x} + 5z = 0$ given that $z = e^y$ and $\frac{\partial z}{\partial x} = 0$ when $x = 0$.	7 L3 CO3												
	c.	Derive one dimensional heat equation.	6 L3 CO3												
Module – 4															
Q.7	a.	Find the real root of the equation $\cos x = 3x - 1$ that lies between 0.5 and 1, using Regula-falsi method.	7 L3 CO4												
	b.	The area y of circle for different diameters x are given below : <table border="1"><tr><td>x</td><td>80</td><td>85</td><td>90</td><td>95</td><td>100</td></tr><tr><td>y</td><td>5026</td><td>5674</td><td>6362</td><td>7088</td><td>7854</td></tr></table> Calculate the area when $x = 98$.	x	80	85	90	95	100	y	5026	5674	6362	7088	7854	7 L3 CO4
x	80	85	90	95	100										
y	5026	5674	6362	7088	7854										
	c.	Evaluate $\int_0^1 \frac{x}{1+x^2} dx$ by using Simpson's $\left(\frac{1}{3}\right)^{th}$ rule.	6 L3 CO4												
OR															
Q.8	a.	Find the real root of the equation $x \log_{10}(x) = 1.2$ the approximate root near 2.5, using Newton-Raphson method.	7 L2 CO4												

	b.	Using Lagrange's method to find the value for $x = 6$ from the following table: <table><tr><td>x</td><td>3</td><td>7</td><td>9</td><td>10</td></tr><tr><td>f(x)</td><td>168</td><td>120</td><td>72</td><td>63</td></tr></table>	x	3	7	9	10	f(x)	168	120	72	63	7	L3	CO4						
x	3	7	9	10																	
f(x)	168	120	72	63																	
	c.	Given <table><tr><td>x</td><td>4.0</td><td>4.2</td><td>4.4</td><td>4.6</td><td>4.8</td><td>5.0</td><td>5.2</td></tr><tr><td>logx</td><td>1.3863</td><td>1.4351</td><td>1.4816</td><td>1.5261</td><td>1.5686</td><td>1.5686</td><td>1.6487</td></tr></table> Evaluate $\int_4^{5.2} \log x dx$ by Simpson's $\frac{3}{8}$ rule.	x	4.0	4.2	4.4	4.6	4.8	5.0	5.2	logx	1.3863	1.4351	1.4816	1.5261	1.5686	1.5686	1.6487	6	L3	CO4
x	4.0	4.2	4.4	4.6	4.8	5.0	5.2														
logx	1.3863	1.4351	1.4816	1.5261	1.5686	1.5686	1.6487														
Module – 5																					
Q.9	a.	Find an approximate value of y when $x = 0.2$. If $\frac{dy}{dx} = x^2 + y^2$ and $y = 1$ when $x = 0$ using Taylor's method.	7	L3	CO4																
	b.	By Runge Kutta method of order 4 solve the equation $\frac{dy}{dx} = 3x + \left(\frac{y}{2}\right)$ with $y(0) = 1$ for $y(0.1)$.	7	L3	CO4																
	c.	Given $\frac{dy}{dx} = x^2 + \left(\frac{y}{2}\right)$ for $y(1) = 2$, $y(1.1) = 2.2156$, $y(1.2) = 2.4649$ and $y(1.3) = 2.7514$ find y at 1.4 using Milines predictor-corrector method.	6	L3	CO4																
OR																					
Q.10	a.	Use modified Eulers method to solve $\frac{dy}{dx} = x + \sqrt{y}$ in the range $0.2 \leq x \leq 0.6$ taking $h = 0.2$ given that $y = 1$ at $x = 0$.	7	L3	CO4																
	b.	Using Runge-Kutta method, find the solution of the equation, $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$ at the point $x = 0.1$.	7	L3	CO4																
	c.	Write modern mathematical tool program to solve $\frac{dy}{dx} = x - y^2$, $y(0) = 1$ by Runge-Kutta 4 th order method, find $y(0.1)$.	6	L2	CO5																
