

Second Semester B.E./B.Tech. Degree Examination, June/July 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 $\int_{-1}^1 \int_0^z \int_{x-z}^{x+z} (x+y+z) dy dx dz$	7	L3	CO1
	b.	Evaluate $\int_0^1 \int_x^{\sqrt{x}} xy dy dx$ by changing the order of integration.	7	L3	CO1
	c.	Show that $\beta(m,n) = \frac{\Gamma(m) \cdot \Gamma(n)}{\Gamma(m+n)}$	6	L2	CO1

OR

Q.2	a.	Evaluate $\int_0^a \int_0^{\sqrt{a^2-x^2}} (x^2+y^2) dy dx$ by changing into polar coordinates.	7	L3	CO1
	b.	Using double integration find the area bounded between the parabolae $y^2 = 4x$ and $x^2 = 4y$.	7	L3	CO1
	c.	Write a modern mathematical program to evaluate the double integral $\int_0^1 \int_0^x (x^2+y^2) dy dx$	6	L3	CO5

Module – 2

Q.3	a.	Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point (2, -1, 2).	7	L2	CO2
	b.	If $\vec{F} = \nabla(xy^3z^2)$, find $\text{div } \vec{F}$ and $\text{curl } \vec{F}$ at the point (1, -1, 1).	7	L2	CO2
	c.	Show that the vector field $\vec{F} = \frac{x\hat{i} + y\hat{j}}{x^2 + y^2}$ is both solenoidal and irrotational.	6	L2	CO2

OR

Q.4	a.	Find the work done in moving a particle in 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	CO2
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	b.	Use Stoke's Theorem to evaluate $\int_C \vec{F} \cdot d\vec{r}$ where $\vec{F} = (x^2 + y^2)\hat{i} - 2xy\hat{j}$ and C is bounded by the lines $x = \pm a$, $y = 0$, $y = b$.	7	L3	CO2
	c.	Write a modern mathematical program to evaluate $\int_C [(xy + y^2)dx + x^2dy]$, where C is the closed curve made up of the line $y = x$ and the parabola $y = x^2$ by using Green's Theorem.	6	L3	CO5

Module – 3

Q.5	a.	Form the partial differential equation by eliminating the arbitrary function from the relation $z = y^2 + 2f\left(\frac{1}{x} + \log y\right)$.	7	L2	CO3
	b.	Solve $\frac{\partial^2 z}{\partial x^2} = xy$ subject to the conditions $\frac{\partial z}{\partial x} = \log_e(1 + y)$ when $x = 1$ and $z = 0$ when $x = 0$.	7	L3	CO3
	c.	With usual notations, derive the one-dimensional wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$	6	L2	CO3

OR

Q.6	a.	Form the partial differential equation by eliminating the arbitrary constants from the relation $(x - a)^2 + (y - b)^2 + z^2 = 4$.	7	L2	CO3
	b.	Solve $\frac{\partial^2 z}{\partial x^2} = z$ given that $z = 0$ and $\frac{\partial z}{\partial x} = \sin y$ when $x = 0$.	7	L3	CO3
	c.	Solve $x^2(y^2 - z^2)p + y^2(z^2 - x^2)q = z^2(x^2 - y^2)$.	6	L3	CO3

Module – 4

Q.7	a.	Find the real root of the equation $x \log_{10} x = 1.2$ that lies between 2 and 3 by Regula-Falsi method. Carry out FOUR iterations.	7	L3	CO4												
	b.	The area A of a circle corresponding to the diameter D is given below: <table border="1" data-bbox="494 1612 1029 1691"> <tr> <td>D :</td><td>80</td><td>85</td><td>90</td><td>95</td><td>100</td></tr> <tr> <td>A :</td><td>5026</td><td>5674</td><td>6362</td><td>7088</td><td>7854</td></tr> </table> Find the area when the diameter is 105 by using Newton's backward interpolation.	D :	80	85	90	95	100	A :	5026	5674	6362	7088	7854	7	L3	CO4
D :	80	85	90	95	100												
A :	5026	5674	6362	7088	7854												
	c.	Evaluate $\int_4^{5.2} \log_e x \, dx$ using Simpson's $\left(\frac{3}{8}\right)^{th}$ rule by taking 7 ordinates.	6	L3	CO4												

OR

Q.8	a.	Find the real root of the equation $\tan x = x$ near $x = 4.5$ by Newton-Raphson method. Correct to FOUR decimal places.	7	L3	CO4
	b.	Fit a Lagrange's interpolation polynomial which passes through the points $(-1, 0)$, $(1, 2)$, $(2, 9)$ and $(3, 8)$ and hence estimate the value of y when $x = 2.2$	7	L3	CO4
	c.	Evaluate $\int_0^{\pi/2} \sqrt{\cos x} \, dx$ using Trapezoidal rule by taking 7 ordinates.	6	L3	CO4

Module – 5

Q.9	a.	Using Taylor's series method, find $y(0.1)$ given that $\frac{dy}{dx} = x - y^2$ with $y(0) = 1$.	7	L3	CO4
	b.	Using Runge-Kutta method of fourth order, find $y(0.1)$ given that $\frac{dy}{dx} = 3e^x + 2y$, $y(0) = 1$	7	L3	CO4
	c.	Applying Milne's Predictor-Corrector Method, find $y(0.8)$ from $\frac{dy}{dx} = x^3 + y$ with $y(0) = 2$, $y(0.2) = 2.073$, $y(0.4) = 2.452$, $y(0.6) = 3.023$.	6	L3	CO4

OR

Q.10	a.	Using Modified Euler's method, find $y(0.2)$ given that $\frac{dy}{dx} = 3x + \frac{y}{2}$, $y(0) = 1$, taking $h = 0.1$. Perform two iterations at each step.	7	L3	CO4
	b.	Using Runge-Kutta method of order 4, find $y(0.1)$ given $\frac{dy}{dx} = x^2 + y$, $y(0) = -1$	7	L3	CO4
	c.	Write a modern mathematical program to find $y(0.1)$ given $\frac{dy}{dx} = x - y$, $y(0) = 1$ by Taylor's series method.	6	L3	CO5
