CBCS SCHEME

USN

BMATC201

Second Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

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 $\int_0^1 \int_x^{\sqrt{x}} (x^2+y^2)\,dy\,dx$.	7	L2	CO1
	b.	Evaluate $\int_0^a \int_y^a \frac{x}{x^2+y^2}\,dx\,dy$ by changing the order of integration.	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 $\int_{-a}^{a} \int_0^{\sqrt{a^2-x^2}} \sqrt{x^2+y^2}\,dy\,dx$ by changing into polar coordinates.	7	L3	CO1
	b.	Using double integration find the area of a plane in the form of a quadrant of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$.	7	L2	CO1
	c.	Using modern mathematical 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 $\vec{F} = \nabla(xy^3z^2)$, find div $\vec{F}$ and curl $\vec{F}$ at the point (1, -1, 1).	7	L2	CO2
	b.	Define an irrotational vector. Find the constants a, b, c such that $\vec{F} = (x+y+az)i + (bx+2y-z)j + (x+cy+2z)k$ is irrotational.	7	L2	CO2
	c.	Find the directional derivative of $\phi = x^2yz + 4xz^2$ at the point (1, -2, -1) in the direction of the vector $2\hat{i} - j - 2\hat{k}$.	6	L2	CO2

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<tr><td colspan="6" align="center">OR</td></tr>
<tr><td>Q.4</td><td>a.</td><td>Using Green's theorem, evaluate $\oint (3x^2-8y^2)dx+(4y-6xy)dy$, where C is the boundary of the region enclosed by $y=\sqrt{x}$ and $y=x^2$.</td><td>7</td><td>L3</td><td>CO2</td></tr>
<tr><td></td><td>b.</td><td>If $\vec{F}=xyi+yzj+zxk$, evaluate $\int_C \vec{F}\cdot\vec{dr}$ where C is the curve represented by, $x=t,\ y=t^2,\ z=t^3\ -1\le t\le 1$</td><td>7</td><td>L2</td><td>CO2</td></tr>
<tr><td></td><td>c.</td><td>Write the modern mathematical tool program to find the divergence of the vector field, $\vec{F}=x^2yz\hat{i}+y^2zx\hat{j}+z^2xy\hat{k}$.</td><td>6</td><td>L3</td><td>CO5</td></tr>
<tr><td colspan="6" align="center">Module – 3</td></tr>
<tr><td>Q.5</td><td>a.</td><td>Form the partial differential equation by eliminating the arbitrary function from the relation,
$\ell x+my+nz=f(x^2+y^2+z^2)$</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Solve $\frac{\partial^2 z}{\partial y^2}=Z$, given that $y=0$, $z=e^x$ and $\frac{\partial z}{\partial y}=e^{-x}$.</td><td>7</td><td>L3</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>Solve $x(y^2-z^2)p+y(z^2-x^2)q=z(x^2-y^2)$ using Lagrange's multipliers.</td><td>6</td><td>L2</td><td>CO3</td></tr>
<tr><td colspan="6" align="center">OR</td></tr>
<tr><td>Q.6</td><td>a.</td><td>Form the partial differential equation by eliminating the arbitrary constants from $(x-a)^2+(y-b)^2+z^2=C^2$.</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Solve $\frac{\partial^2 z}{\partial x\partial y}=\sin x\sin y$ for which $\frac{\partial z}{\partial y}=-2\sin y$, when $x=0$ and $z=0$ if y is an odd multiple of $\frac{\pi}{2}$.</td><td>7</td><td>L3</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>Derive one dimensional wave equation.</td><td>6</td><td>L2</td><td>CO3</td></tr>
<tr><td colspan="6" align="center">Module – 4</td></tr>
<tr><td>Q.7</td><td>a.</td><td>By Newton's-Raphson method find the root of $x\sin x+\cos x=0$, which is near to $x=\pi$.</td><td>7</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>The population of a town is given by the following table :
<table>
<tr><td>Year</td><td>1951</td><td>1961</td><td>1971</td><td>1981</td><td>1991</td></tr>
<tr><td>Population</td><td>19.96</td><td>39.65</td><td>58.81</td><td>72.21</td><td>94.61</td></tr>
</table>
Using Forward and Backward Newton's interpolation formula, calculate the increase in population between the years 1955 to 1985.</td><td>7</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>c.</td><td>Evaluate $\int_0^{\frac{\pi}{2}}\sqrt{\cos\theta}\,d\theta$ by taking 7 ordinates using Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule.</td><td>6</td><td>L3</td><td>CO4</td></tr>
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<tr><td colspan="6">OR</td></tr>
<tr><td>Q.8</td><td>a.</td><td>Compute the real root of the equation $x\log_{10}x-1.2=0$ by the Regula Falsi method taking Four decimal places.</td><td>7</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Compute the value of y when x = 4, using Lagrange's interpolation formula given,<table><tr><td>x</td><td>0</td><td>2</td><td>3</td><td>6</td></tr><tr><td>f(x)</td><td>-4</td><td>2</td><td>14</td><td>158</td></tr></table></td><td>7</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>c.</td><td>Evaluate $\int_0^{0.3}(1-8x^3)^{\frac{1}{2}}\,dx$ by using Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule, by taking 3 equal parts.</td><td>6</td><td>L3</td><td>CO4</td></tr>
<tr><td colspan="6">Module – 5</td></tr>
<tr><td>Q.9</td><td>a.</td><td>Solve by using modified Euler's method. $\frac{dy}{dx}=x-y^2$, y(0) = 1 taking h = 0.1, find y(0.2).</td><td>7</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Applying Milne's predictor and corrector method, find y(0.8) from $\frac{dy}{dx}=x-y^2$ and given y(0) = 0, y(0.2) = 0.02, y(0.4) = 0.0795, y(0.6) = 0.1762.</td><td>7</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>c.</td><td>Using Runge-Kutta method of order 4, find y at x = 0.1, given that $\frac{dy}{dx}=3e^x+2y$, y(0) = 0 and h = 0.1.</td><td>6</td><td>L3</td><td>CO4</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.10</td><td>a.</td><td>Use Taylor's series method to find y(0.1) from $\frac{dy}{dx}=x-y^2$ and y = 1 at x = 0 upto 4th degree.</td><td>7</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Using the Runge-Kutta method of order 4, solve $\frac{dy}{dx}=\frac{y^2-x^2}{y^2+x^2}$ with y(0) = 1 at h = 0.2, find y(0.2).</td><td>7</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>c.</td><td>Using mathematical tools, write a code to find the solution of $\frac{dy}{dx}=1+\frac{y}{x}$ at y(2) taking h = 0.2 given that y(1) = 2 by Runge-Kutta method of order 4.</td><td>6</td><td>L3</td><td>CO5</td></tr>
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