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BMATC201

Second Semester B.E/B.Tech. Degree Examination, June/July 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. M : Marks , L: Bloom's level , C: Course outcomes.
3. VTU Formula Hand Book is permitted.

		Module – 1	M	L	C
1	a.	Evaluate $\int_1^2\int_3^4 (xy+e^y)\,dy\,dx$.	6	L2	CO1
	b.	Evaluate $\int_0^1\int_x^{\sqrt{x}} xy\,dy\,dx$ by changing the order of integration.	7	L2	CO1
	c.	Define Gamma function and hence show that $\Gamma\left(\frac{1}{2}\right)=\sqrt{\pi}$.	7	L2	CO1
		OR			
2	a.	Evaluate $\int_{-a}^{a}\int_0^{\sqrt{a^2-x^2}} \sqrt{x^2+y^2}\,dy\,dx$ by changing to polar co-ordinates.	7	L2	CO1
	b.	Show that the area between parabolas $y^2=4ax$ and $x^2=4ay$ is $\frac{16a^2}{3}$.	7	L2	CO1
	c.	Write a modern mathematical program to evaluate the double integral, $\int_0^1\int_0^x (x^2+y^2)\,dydx$.	6	L2	CO5
		Module – 2			
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.	Find the directional derivative of $\phi=xy^3+yz^3$ at the point (2, -1, 1) in the direction of $\hat{i}+2\hat{j}+2\hat{k}$	7	L2	CO2
	c.	Find $\text{div}\,\vec{F}$ and $\text{curl}\,\vec{F}$ where $\vec{F}=\text{grad}(x^3+y^3+z^3-3xyz)$.	6	L2	CO2
		OR			
4	a.	If $\vec{F}=3xy\hat{i}-y^2\hat{j}$, evaluate $\int_C \vec{F}\cdot d\vec{r}$ where C is the curve in the xy plane $y=2x^2$ from (0, 0) to (1, 2)	7	L2	CO2

<table>
<tr><td></td><td>b.</td><td>Apply Stoke's Theorem to evaluate $\int_C \vec{F}.d\vec{r}$, where $\vec{F} = y^2\hat{i} + x^2\hat{j} - (x+z)\hat{k}$, and C is the boundary of the triangle with vertices (0, 0, 0), (1, 0, 0) and (1, 1, 0)</td><td>7</td><td>L2</td><td>CO2</td></tr>
<tr><td></td><td>c.</td><td>Write a modern mathematical tool program to evaluate $\oint_C \left[(xy + y^2)dx + x^2dy\right]$, where C is the closed curve bounded by y = x and y = x^2 by using Green's theorem.</td><td>6</td><td>L3</td><td>CO5</td></tr>
<tr><td colspan="6">Module – 3</td></tr>
<tr><td>5</td><td>a.</td><td>Form the partial differential equation from the relation, $z = f(x+at) + g(x-at)$</td><td>6</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Solve $\frac{\partial^2 u}{\partial x \partial t} = e^{-t}\cos x$, given that u = 0 when t = 0 and $\frac{\partial u}{\partial t} = 0$ at x = 0.</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>Derive one dimensional heat equation.</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>6</td><td>a.</td><td>Form the partial differential equation from the relation, $(x-a)^2 + (y-b)^2 + z^2 = C^2$</td><td>6</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Solve $\frac{\partial^2 z}{\partial x^2} + 3\frac{\partial z}{\partial x} - 4z = 0$ subject to the conditions that z = 1 and $\frac{\partial z}{\partial y} = y$ when x = 0.</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>Solve $x(y^2 - z^2)p + y(z^2 - x^2)q = z(x^2 - y^2)$</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td colspan="6">Module – 4</td></tr>
<tr><td>7</td><td>a.</td><td>Find a real root of the equation $x\log_{10} x = 1.2$ in (2.7, 2.8) by Regula-Falsi method correct to four decimal places. Carry out three iterations.</td><td>7</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>The area of a circle (A) corresponding to diameter (D) is given below. Find the area corresponding to diameter 105 using an appropriate interpolation formula,
<table>
<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></td><td>7</td><td>L3</td><td>CO4</td></tr>
<tr><td></td><td>c.</td><td>Evaluate $\int_0^6 \frac{dx}{1+x^2}$ by using Trapezoidal rule. (Take 6 equal parts).</td><td>6</td><td>L2</td><td>CO4</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>8</td><td>a.</td><td>Find a real root of the equation, $xe^x - 2 = 0$ in (1, 2), correct to three decimal places using Newton-Raphson method. Carry out 4 iterations.</td><td>7</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Determine f(x) as a polynomial in x for the data given below by using Newton's divided difference formula :
<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>f(x)</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>L2</td><td>CO4</td></tr>
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	c.	Find the approximate value of $\int_0^{\frac{\pi}{2}} \sqrt{\cos\theta}\, d\theta$ by Simpson's $\frac{1}{3}^{rd}$ rule by dividing $\left[0, \frac{\pi}{2}\right]$ into 6 equal parts.	6	L2	CO4
Module – 5					
9	a.	Use Taylor's series method to find y at x = 0.1 considering terms upto third degree given that $\frac{dy}{dx} = x^2 + y^2$ and $y(0) = 1$	6	L2	CO4
	b.	Using Runge-Kutta method of fourth order, find y(0.2) for the equation, $\frac{dy}{dx} = \frac{y-x}{y+x}$, $y(0) = 1$ taking $h = 0.2$	7	L2	CO4
	c.	Given $y' = x^2 + \frac{y}{2}$ and $y(1) = 2$, $y(1.1) = 2.2156$, $y(1.2) = 2.4649$, $y(1.3) = 2.7514$, find y(1.4) using Milne's predictor and corrector formulae.	7	L2	CO4
OR					
10	a.	Using modified Euler's Method, solve $\frac{dy}{dx} = x + y$ at $x = 0.2$, given that $y(0) = 1$ by taking $h = 0.2$.	7	L2	CO4
	b.	Use fourth order Runge-Kutta method to find y at x = 0.1 given that $\frac{dy}{dx} = 3e^x + 2y$, $y(0) = 0$ and $h = 0.1$	7	L2	CO4
	c.	Using Modern mathematical tool, write a program to find y when x = 1.4, given $\frac{dy}{dx} = x^2 + \frac{y}{2}$, $y(1) = 2$, $y(1.1) = 2.2156$, $y(1.2) = 2.4649$, $y(1.3) = 2.7514$, using Milne's predictor and corrector formulae	6	L3	CO3

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