CBCS SCHEME

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BMATC201

Second Semester B.E./B.Tech. Degree Examination, June/July 2024
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 $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} xyz\, dzdydx$.	07	L2	CO1
	b.	Evaluate $\int_0^1 \int_{\sqrt{y}}^1 dxdy$ by changing the order of integration.	07	L2	CO1
	c.	Derive the relation $\beta(m,n) = \frac{\lceil m \lceil n}{\lceil m+n}$.	06	L3	CO1
		OR			
Q.2	a.	Evaluate $\int_0^\infty \int_0^\infty e^{-(x^2+y^2)} dxdy$ by changing into polar coordinates.	07	L2	CO1
	b.	Evaluate $\iint xy(x+y)dydx$ taken over the area between $y = x^2$ and $y = x$.	07	L2	CO1
	c.	Write a modern mathematical tool program to evaluate the double integral $\int_0^1 \int_0^x (x^2+y^2)dydx$.	06	L3	CO5
		Module – 2			
Q.3	a.	Find the unit vector normal to the surface $x^2y - 2xz + 2y^2z^4 = 10$ at (2, 1, –1).	07	L2	CO2
	b.	Show that $\vec{F} = (y+z)i + (z+x)j + (x+y)k$ is irrotational. Also find a scalar function ϕ such that $\vec{F} = \nabla\phi$.	07	L2	CO2
	c.	If $\vec{F} = \nabla(x^3 + y^3 + z^3 - 3xyz)$, find div $\vec{F}$ and curl $\vec{F}$.	06	L3	CO2
		OR			
Q.4	a.	Verify Green's theorem in a plane for $\int_C (3x^2 - 8y^2)dx + (4y - 6xy)dy$ where c is the boundary of the region enclosed by $y = \sqrt{x}$ and $y = x^2$.	07	L2	CO2
	b.	Use Stoke's theorem to evaluate $\int_C \vec{F}.d\vec{r}$ where $\vec{F} = (x^2+y^2)i - 2xyj$ and c is bounded by the lines $x = \pm a$, $y = 0$ and $y = b$.	07	L2	CO2
	c.	Write a modern mathematical tool program to evaluate curl of $\vec{F} = xy^2\hat{i} + 2x^2yz\hat{j} - 3yz^2\hat{k}$.	06	L3	CO5
		Module – 3			
Q.5	a.	Form the partial differential equation by eliminating the arbitrary function from the relation $z = y^2 + 2f\left(\frac{1}{x} + \log y\right)$.	07	L2	CO3

<table>
<tr><td></td><td>b.</td><td>Solve $\frac{\partial^2 z}{\partial x^2} = xy$, subject to the conditions that $\frac{\partial z}{\partial x} = \log(1+y)$ when $x = 1$ and $z = 0$ when $x = 0$.</td><td>07</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>06</td><td>L3</td><td>CO3</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.6</td><td>a.</td><td>Form the partial differential equation from $f(xy + z^2, x + y + z) = 0$.</td><td>07</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Solve $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$.</td><td>07</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>With usual notations, derive one dimensional wave equation $\frac{\partial^2 u}{\partial t^2} = c^2 \frac{\partial^2 u}{\partial x^2}$.</td><td>06</td><td>L3</td><td>CO3</td></tr>
<tr><td colspan="6">Module – 4</td></tr>
<tr><td>Q.7</td><td>a.</td><td>Find a real root of the equation $x^3 - 2x - 5 = 0$ by Regula-Falsi method. Correct to three decimal places.</td><td>07</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Find y(1.4) for the given data:
<table>
<tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>y</td><td>10</td><td>26</td><td>58</td><td>112</td><td>194</td></tr>
</table></td><td>07</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>c.</td><td>Evaluate $\int_0^1 \frac{dx}{1+x^2}$ by using Simpson's $\frac{1}{3}^{rd}$ rule taking four equal strips.</td><td>06</td><td>L3</td><td>CO4</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.8</td><td>a.</td><td>Use Newton-Raphson method to find a real root of $x \sin x + \cos x = 0$ near $x = \pi$. Carry out the iterations upto four decimal places of accuracy.</td><td>07</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Determine f(4) for the data given below by using Newton's divided difference formula
<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>07</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>c.</td><td>Evaluate $\int_0^6 3x^2 dx$ dividing the interval [0, 6] into six equal parts by applying Simpson's $\frac{3}{8}^{th}$ rule.</td><td>06</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>Find an approximate value of y when x = 0.1. If $\frac{dy}{dx} = x - y^2$ and y = 1 at x = 0. Using Taylor's series method.</td><td>07</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Use modified Euler's method to find y at x = 0.1, given $\frac{dy}{dx} = 3x + \frac{y}{2}$ with y(0) = 1 taking h = 0.1. Perform three iterations.</td><td>07</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>c.</td><td>Given $\frac{dy}{dx} = x^2 + y^2$, y(0) = 1, y(0.1) = 1.1113, y(0.2) = 1.2507, y(0.3) = 1.426. Compute y(0.4), using Milne's predictor-corrector method.</td><td>06</td><td>L3</td><td>CO4</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.10</td><td>a.</td><td>Using Runge-Kutta method of fourth order to solve $\frac{dy}{dx} = \frac{y-x}{y+x}$ with y(0) = 1 taking h = 0.1 to find y(0.1).</td><td>07</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>Solve by using modified Euler's method $\frac{dy}{dx} = 1 + \frac{y}{x}$, y = 2 at x = 1. Find y at x = 1.2 by taking h = 0.2.</td><td>07</td><td>L2</td><td>CO4</td></tr>
<tr><td></td><td>c.</td><td>Write a modern mathematical tool to solve $\frac{dy}{dx} = e^{-x}$ with y(0) = –1 using Euler's method at x = 0.2 (0.2) 0.6.</td><td>06</td><td>L3</td><td>CO5</td></tr>
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