CBCS SCHEME

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BMATM201

Second Semester B.E./B.Tech. Degree Supplementary Examination, June/July 2024

Mathematics – II for Mechanical 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 $\int_{0}^{3}\int_{0}^{\sqrt{4-y}}(x+y)\,dxdy$ by changing the order of integration.	7	L3	CO1
	c.	Show that $\int_{0}^{\infty}\sqrt{y}\,e^{-y^2}\,dy\times\int_{0}^{\infty}\frac{e-y^2}{\sqrt{y}}dy=\frac{\pi}{2\sqrt{2}}$	6	L2	CO1
		OR			
Q.2	**a.**	Show that $\beta(m,n)=\frac{\Gamma_{(m)}\cdot\Gamma_{(n)}}{\Gamma_{(m+n)}}$	7	L2	CO1
	b.	Evaluate $\int_{0}^{a}\int_{0}^{\sqrt{a^2-y^2}} y\sqrt{x^2+y^2}\,dxdy$ by changing into polars.	7	L3	CO1
	c.	Write a modern mathematical tool program to find the volume of the tetrahedron bounded by the planes x = 0, y = 0 and $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$.	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 (2, -1, 2).	7	L2	CO2
	b.	If $\vec{F}=(3x^2y-z)\hat{i}+(xz^3+y)\hat{j}-2x^3z^2\,k$, find div $\vec{F}$ and curl $\vec{F}$.	7	L2	CO2
	c.	Find the constants a, b and c such that the vector $\vec{F}=(x+y+az)\hat{i}+(bx+2y-z)\hat{j}+(x+cy+2z)\hat{k}$ is irrotational.	6	L2	CO2
		OR			
Q.4	**a.**	Using Grun's theorem, evaluate $\int_C(2x^2-y^2)dx+(x^2+y^2)dy$, where C is the boundary of the region in the xy-plane enclosed by the x-axis and the upper-half of the circle $x^2+y^2=a^2$.	7	L3	CO2

<table>
<tr><td></td><td>b.</td><td>If $\vec{F} = 2xy\hat{i} + yz^2\hat{j} + xz\hat{k}$ and S is the rectangular parallelopiped bounded by $x = 0, y = 0, z = 0, x = 2, y = 1, z = 3$. Find the Flux across S.</td><td>7</td><td>L3</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
$\vec{F} = (3x^2 - 3yz)i + (3y^2 - 3xz)j + (3z^2 - 3xy)k$</td><td>6</td><td>L3</td><td>CO5</td></tr>
<tr><td colspan="6">Module – 3</td></tr>
<tr><td>Q.5</td><td>a.</td><td>Form the partial differential equation by eliminating the arbitrary function ϕ from $\ell x + my + nz = \phi(x^2 + y^2 + z^2)$.</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Solve $\frac{\partial^2 z}{\partial x \partial y} = \frac{x}{y}$, subject to the conditions that $\frac{\partial z}{\partial x} = \log_e x$ when $y = 1$ and $z = 0$ when $x = 1$.</td><td>7</td><td>L3</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>Derive the dimensional heat equation in the standard form $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$.</td><td>6</td><td>L2</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 by eliminating the arbitrary constants a and b from $2z = \frac{x^2}{a^2} + \frac{y^2}{b^2}$.</td><td>7</td><td>L2</td><td>CO3</td></tr>
<tr><td></td><td>b.</td><td>Solve $\frac{\partial^2 z}{\partial x^2} = a^2 z$ given that when $x = 0$, $\frac{\partial z}{\partial x} = a \sin y$ and $\frac{\partial z}{\partial y} = 0$.</td><td>7</td><td>L3</td><td>CO3</td></tr>
<tr><td></td><td>c.</td><td>Solve $(y - z)p + (z - x)q = (x - y)$.</td><td>6</td><td>L2</td><td>CO3</td></tr>
<tr><td colspan="6">Module – 4</td></tr>
<tr><td>Q.7</td><td>a.</td><td>Find an approximate value of the root of the equation $\cos x = 3x - 1$ that lies between 0.5 and 1 correct to three decimal places using Regula false method.</td><td>7</td><td>L3</td><td>CO4</td></tr>
<tr><td></td><td>b.</td><td>The following table gives the distances (in miles) of the visible horizon for the given heights (in feet) above the earth's surface.
<table>
<tr><td>x</td><td>200</td><td>250</td><td>300</td><td>350</td><td>400</td></tr>
<tr><td>F(x)</td><td>15.04</td><td>16.81</td><td>18.42</td><td>19.9</td><td>21.27</td></tr>
</table>
Find y for x = 218.</td><td>7</td><td>L3</td><td>CO4</td></tr>
<tr><td></td><td>c.</td><td>Evaluate $\int_0^{\pi} e^{\sin\theta} d\theta$ by using Simpson's $\left(\frac{1}{3}\right)^{rd}$ rule by taking 7 ordinates.</td><td>6</td><td>L3</td><td>CO4</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>Q.8</td><td>a.</td><td>Using the Newton-Raphson method, find the real root of the equation $e^x \sin x = 1$. (Here x is in radians).</td><td>7</td><td>L3</td><td>CO4</td></tr>
</table>

	b.	Using Newton's divided difference formula, evaluate F(9) from the following table. $\begin{array}{|c|c|c|c|c|c|}\hline x & 5 & 7 & 11 & 13 & 17 \\ \hline F(x) & 150 & 392 & 1452 & 2366 & 5202 \\ \hline \end{array}$	7	L2	CO4
	c.	If y(0) = -12, y(1) = 0, y(3) = 6 and y(4) = 12, find the value of y at x = 2 using Lagranges method.	6	L3	CO4
		Module – 5			
Q.9	**a.**	Find by Taylor's series method the value of y at x = 0.1 to 4 decimal places from $\frac{dy}{dx} = x - y^2$, $y(0) = 1$.	7	L2	CO4
	b.	Using the Runge-Kutta method of fourth order, find y(1.1) given that $\frac{dy}{dx} = xy^{1/3}$ taking $h = 0.1$.	7	L3	CO4
	c.	Given that $\frac{dy}{dx} = 2e^x - y$ and the data y(0) = 2, y(0.1) = 2.010, y(0.2) = 2.040, y(0.3) = 2.090. Compute y at x = 0.4 by applying Milne's method.	6	L3	CO4
		OR			
Q.10	**a.**	Using the modified Euler's method, find y(20.2) given that $\frac{dy}{dx} = \log_{10}(x/y)$ with $y(20) = 5$ taking $h = 0.2$.	7	L3	CO4
	b.	Apply the Runge-Kutta method of fourth order, to find an approximate value of y at x = 0.1, given that $\frac{dy}{dx} = 3e^x + 2y$ with $y(0) = 0$ and $h = 0.1$	7	L3	CO4
	c.	Using modern mathematical tools write a program to find y at 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. Use corrector formula thrice using Milne's method.	6	L3	CO5

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