CBCS SCHEME

USN | | | | | | | | | | |

BMATC101

First Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024
Mathematics – I 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 handbook is permitted.

		Module – 1	M	L	C
Q.1	a.	With usual notations prove that $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4}\left(\frac{dr}{d\theta}\right)^2$.	6	L2	CO1
	b.	Find the angle between the radius vector and tangent to the curve $r = a(1+\cos\theta)$ at $\theta = \frac{\pi}{3}$.	7	L2	CO1
	c.	Find the radius of curvature of the curve $y = 4\sin x - \sin 2x$ at $x = \pi/2$.	7	L2	CO1
		OR			
Q.2	a.	Find the pedal equation of the curve $r^n \cos n\theta = a^n$.	8	L2	CO1
	b.	Find the radius of curvature of the curve $r = a(1-\cos\theta)$.	7	L2	CO1
	c.	Using modern mathematical tool write α programme to plot the curve $r = 2(\cos 2\theta)$.	5	L2	CO1
		Module – 2			
Q.3	a.	Expand $\sqrt{1+\sin 2x}$ using Maclaurin's series upto the term containing x^4.	6	L2	CO2
	b.	If $Z = f(x+ct) + g(x-ct)$ prove that $\frac{\partial^2 z}{\partial t^2} = c^2\frac{\partial^2 z}{\partial x^2}$.	7	L2	CO2
	c.	Show that $f(x, y) = x^3 + y^3 - 3x - 12y + 20$ has a maximum value at the point (-1, -2) and minimum value at the point (1, 2).	7	L3	CO2
		OR			
Q.4	a.	If $U = f(2x - 3y, 3y - 4z, 4z - 2x)$ then prove that $\frac{1}{2}\frac{\partial u}{\partial x} + \frac{1}{3}\frac{\partial u}{\partial y} + \frac{1}{4}\frac{\partial u}{\partial z} = 0$.	8	L2	CO2
	b.	If $u = x^2 + y^2 + z^2$, $v = xy + yz + zx$, $w = x + y + z$, Find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$.	7	L2	CO2

	c.	Using modern mathematical tool, write a programme to evaluate $\lim_{x\to\infty}(1+1/x)^{1/x}$.	**5**	**L3**	**CO5**
		Module – 3			
Q.5	**a.**	Solve : $\tan y \frac{dy}{dx} + \tan x = \cos y \cos^2 x$.	**6**	**L2**	**CO3**
	b.	Find the orthogonal trajectories of the family of curves $r = 2a \cos\theta$ where 'a' is a parameter.	**7**	**L3**	**CO3**
	c.	Solve $p^2 + p(x + y) + xy = 0$.	**7**	**L2**	**CO3**
		OR			
Q.6	**a.**	Solve $(x^2 + y^3 + bx)\,dx + xy^2\,dy = 0$.	**6**	**L2**	**CO3**
	b.	Water at temperature 10º C takes 5 minutes to warm upto 20º C in a room temperature of 40º C. Find the temperature of the water after 20 minutes.	**7**	**L2**	**CO3**
	c.	Solve $(px - y)(py + x) = 2p$ by reducing into Clairaut's form taking substitution $X = x^2$ and $Y = y^2$.	**7**	**L3**	**CO3**
		Module – 4			
Q.7	**a.**	Solve $\frac{d^3y}{dx^3} + \frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 4y = 0$.	**6**	**L2**	**CO3**
	b.	Solve $(D-2)^2 y = 2(e^{2x} + \sin 2x)$.	**7**	**L2**	**CO3**
	c.	Solve $x^2\frac{d^2y}{dx^2} - 5x\frac{dy}{dx} + 8y = 2\log x$.	**7**	**L2**	**CO3**
		OR			
Q.8	**a.**	Solve $\frac{d^2y}{dx^2} + y = x^2 + 2x + 4$.	**6**	**L2**	**CO3**
	b.	Using method of variation of parameters Solve $\frac{d^2y}{dx^2} + y = \sec x$	**7**	**L2**	**CO3**
	c.	Solve $(1+2x)^2\frac{d^2y}{dx^2} - 6(1+2x)\frac{dy}{dx} + 16y = 8(1+2)x$.	**7**	**L2**	**CO3**
		Module – 5			
Q.9	**a.**	Find the rank of the matrix : $\begin{bmatrix} 21 & 22 & 23 & 24 \\ 22 & 23 & 24 & 25 \\ 23 & 24 & 25 & 26 \\ 24 & 25 & 26 & 27 \end{bmatrix}$.	**6**	**L2**	**CO4**

	b.	Test for consistency and solve the following system of equations : $x + 2y + 3z = 1$, $2x + 3y + 8z = 2$, $x + y + z = 3$.	**7**	**L2**	**CO4**
	c.	Solve the following system of equations using Gauss Jordan method : $x + y + z = 9$, $2x + y - z = 0$, $2x + 5y + 7z = 52$.	**7**	**L3**	**CO4**
		OR			
Q.10	**a.**	Find he rank of the matrix $\begin{bmatrix} -2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & -1 & -1 \end{bmatrix}$	**6**	**L2**	**CO4**
	b.	Use Gauss – Seidel Iteration method to solve the system of equations $5x + 2y + z = 12$, $x + 4y + 2z = 15$, $x + 2y + 5z = 20$ (upto 3 iterations).	**7**	**L3**	**CO4**
	c.	Using modern mathematical tool, write a programme to find the largest eigen vector if $A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$.	**7**	**L3**	**CO5**

* * * * *