CBCS SCHEME

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BMATC101

First Semester B.E/B.Tech. Degree Examination, June/July 2025
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 Hand Book is permitted.

		Module – 1	M	L	C
1	a.	With usual notation, prove that $\tan\phi = \dfrac{r}{\left(\dfrac{d_r}{d_\theta}\right)}$.	7	L3	CO1
	b.	Find the pedal equation for the curve $r^m = a^m \sec m\theta$.	7	L1	CO1
	c.	Find the radius of curvature for the curve $y = 4\sin x - \sin 2x$ at $x = \pi/2$.	6	L1	CO1
		OR			
2	a.	Find the angle between the curves $r = a\log\theta$ and $r = \dfrac{a}{\log\theta}$.	7	L1	CO1
	b.	Derive an expression for radius of curvature for polar curve $r = f(\theta)$.	7	L1	CO1
	c.	Using modern mathematical tool, write a programme to plot the sine and cosine curves.	6	L3	CO5
		Module – 2			
3	a.	Obtain the Maclaurin's series expansion of $y(x) = \sqrt{1+\sin 2x}$.	7	L3	CO2
	b.	Find $\dfrac{df}{dt}$ by using partial differentiation, given that $f = x^3 + y^3 + z^3$, when $x = e^{-t}$, $y = e^{-t}$ and $z = e^{-t}\cos t$.	7	L2	CO2
	c.	If $u = x + 3y^2 - z^2$, $v = 4x^2yz$, $w = 2z^2 - xy$, find $\dfrac{\partial(u,v,w)}{\partial(x,y,z)}$ at $(1, -1, 0)$.	6	L2	CO2
		OR			
4	a.	Evaluate : i) $\lim\limits_{x\to 0}\left(\dfrac{a^x + b^x + c^x}{3}\right)^{1/x}$ ii) $\lim\limits_{x\to\pi/4}(\tan x)^{\tan 2x}$.	7	L1	CO2
	b.	Find the extreme values of the function : $x^3 + y^3 - 3x - 12y + 20 = 0$.	7	L2	CO2
	c.	Use modern mathematical tool, write a programme to show that $u_{xx} + u_{yy} = 0$, given $u = e^x\{x\cos y - y\sin y\}$	6	L3	CO5
		Module – 3			
5	a.	Solve $x\dfrac{dy}{dx} + y = x^3y^6$.	7	L3	CO3
	b.	Solve that the family of parabolas $y^2 = 4a(x+a)$ are self orthogonal.	7	L3	CO3
	c.	Solve $\dfrac{dy}{dx} - \dfrac{dx}{dy} = \dfrac{x}{y} - \dfrac{y}{x}$.	6	L2	CO3
		OR			
6	a.	Solve $(y\log y)\,dx + (x - \log y)\,dy = 0$.	7	L3	CO3
	b.	A body originally at 80°C cools down to 60°C in 20 minutes in the surrounding temperature 40°C. Find the temperature of the body after 40 minutes.	7	L2	CO3
	c.	Find the general and singular solutions of $p = \log(px - y)$.	6	L2	CO3

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		Module – 4			
7	a.	Solve $(D^3 - 7D^2 + 14D - 8)y = 0$.	7	L2	CO3
	b.	Solve $(D^2 + 1)y = \operatorname{cosec} x . \cot x$ by the method of variation of parameters.	7	L3	CO3
	c.	Solve $x^2y'' + 4xy' + 2y = x^2$.	6	L3	CO3
		OR			
8	a.	Solve $[(D^2 + 6D + 9)D^2]y = 0$.	7	L2	CO3
	b.	Solve $(D^3 + 4D)y = \sin 2x$.	7	L3	CO3
	c.	Solve $(1 + x)^2y'' + (1 + x)y' + y = 2 \sin [\log (1 + x)]$.	6	L3	CO3
		Module – 5			
9	a.	Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 4 \\ -2 & -3 & 1 & 2 \\ -3 & -4 & 5 & 8 \\ 1 & 3 & 10 & 14 \end{bmatrix}$.	7	L1	CO4
	b.	Solve the system of equations : $x + 0y + 2z = 2$ $0x + y + z = 3$ $2x + y + 0z = 1$ By Gauss elimination method.	7	L3	CO4
	c.	Using Rayleigh's power method, find the largest eigen value and the corresponding eigen vector of the matrix $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & 1 & 3 \end{bmatrix}$, taking $x^{(0)} = [1,1,1]^T$.	6	L3	CO4
		OR			
10	a.	Apply Gauss-Seidel method to solve the equations : $10x + 2y + z = 9$ $2x + 20y - 2z = -44$ $-2x + 3y + 10z = 22$.	7	L2	CO4
	b.	Find for what values of α and β, so that the equations : $x + y + z = 6$ $x + 2y + 3z = 10$ $x + 2y + \alpha z = \beta$ have : i) no solution ii) many solutions iii) unique solution.	7	L2	CO4
	c.	Using modern mathematical tools, write a programme to test consistency of the equations : $x + 2y - z = 1$ $2x + y + 4z = 2$ $3x + 3y + 4z = 1$.	6	L3	CO5

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