

Model Question Paper- I with effect from 2022

CBCS SCHEME

First Semester B.E Degree Examination

Mathematics-I for Civil Engineering Stream (BMATC101)

TIME:03 Hours

Max.Marks:100

Note:

1. Answer any **FIVE** full questions, choosing at least **ONE** 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	With usual notations prove that $\tan \phi = r \frac{d\theta}{dr}$.	6	L2	CO1
	b	Find the angle between the curves $r = a(1 - \cos \theta)$ and $r = 2a \cos \theta$.	7	L2	CO1
	c	Show that the radius of curvature for the curve $r^n = a^n \cos n\theta$ varies inversely as r^{n-1} .	7	L3	CO1
OR					
Q.2	a	Derive an expression for the radius of curvature for a Cartesian curve.	7	L2	CO1
	b	Find the pedal equation of the curve $r = 2(1 + \cos \theta)$	8	L2	CO1
	c	Using modern mathematical tool write a program/code to plot the sine and cosine curve.	5	L2	CO5
Module - 2					
Q.3	a	Expand $\log(1 + e^x)$ by Maclaurin's series up to the term containing x^4 .	6	L2	CO2
	b	If $u = f(x - y, y - z, z - x)$, show that $\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} + \frac{\partial u}{\partial z} = 0$.	7	L2	CO2
	c	Examine the function $f(x, y) = xy(a - x - y)$ for extreme values.	7	L3	CO2
OR					
Q.4	a	If $z = f(x + ay) + g(x - ay)$ Prove that $\frac{\partial^2 z}{\partial y^2} = a^2 \frac{\partial^2 z}{\partial x^2}$.	8	L2	CO2
	b	If $u = x + 3y^2 - z^3$, $v = 4x^2yz$, $w = 2z^2 - xy$ find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$ at (1, -1, 0).	7	L2	CO2
	c	Using modern mathematical tool write a program/code to evaluate	5	L3	CO5

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		$\lim_{x \rightarrow \infty} \left(1 + \frac{1}{x}\right)^x$.			
Module – 3					
Q.5	a	Solve $\frac{dy}{dx} + xy = xy^3$.	6	L2	CO3
	b	Find the orthogonal trajectories of the cardioids $r = a(1 - \cos\theta)$.	7	L3	CO3
	c	Solve $p^2 + 2p \cot x = y^3$.	7	L2	CO3
OR					
Q.6	a	Solve $(4xy + 3y^2 - x)dx + x(x + 2y)dy = 0$.	6	L2	CO3
	b	A body originally at 80°C cools down to 60°C in 20 minutes; the temperature of the air being 40°C . What will be the temperature of the body after 40 minutes from the original?	7	L3	CO3
	c	Find the general and singular solution of the equation $x^2(y - px) = p^2y$ reducing into Clairaut's form, using the substitution $X = x^2, Y = y^2$.	7	L2	CO3
Module – 4					
Q.7	a	Solve $(4D^4 - 4D^3 - 23D^2 + 12D + 36)y = 0$.	6	L2	CO3
	b	Solve $(D - 2)^2y = 8(e^{2x} + \sin 2x + x^2)$.	7	L2	CO3
	c	Solve by the method of variation of parameter $y'' - 6y' + 9y = \frac{e^{3x}}{x^2}$.	7	L2	CO3
OR					
Q.8	a	Solve $y'' + 3y' + 2y = 12x^2$.	6	L2	CO3
	b	Solve $\frac{d^2y}{dx^2} - 4y = \cosh(2x - 1) + 3^x$.	7	L2	CO3
	c	Solve $(2x - 1)^2 \frac{d^2y}{dx^2} + (2x - 1) \frac{dy}{dx} - 2y = 8x^2 - 2x + 3$.	7	L2	CO3
Module – 5					
Q.9	a	Find the rank of the matrix $\begin{bmatrix} 4 & 0 & 2 & 1 \\ 2 & 1 & 3 & 4 \\ 2 & 3 & 4 & 7 \\ 2 & 3 & 1 & 4 \end{bmatrix}$.	6	L2	CO4

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	b	Solve the system of equations by Gauss-Jordan method $x + y + z = 9, x - 2y + 3z = 8, 2x + y - z = 3.$	7	L3	CO4
	c	Using Rayleigh's power method find the dominant eigen value and the corresponding eigenvector of $\begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$ by taking $[1 \ 0 \ 0]^T$ as the initial eigenvector [carryout 6 iterations].	7	L3	CO4
OR					
Q.10	a	Find the rank of the matrix $\begin{bmatrix} 11 & 12 & 13 & 14 \\ 12 & 13 & 14 & 15 \\ 13 & 14 & 15 & 16 \\ 14 & 15 & 16 & 17 \end{bmatrix}$.	7	L2	CO4
	b	Solve the system of equations $5x + 2y + z = 12; x + 4y + 2z = 15; x + 2y + 5z = 20$ Using Gauss-Seidel method, taking $(0, 0, 0)$ as an initial approximation. (Carryout 4 iterations).	8	L3	CO4
	c	Using modern mathematical tool write a program/code to test the consistency of the equations, $x + 2y - z = 1, 2x + y + 4z = 2, 3x + 3y + 4z = 1.$	5	L3	CO5