

USN

--	--	--	--	--	--	--	--	--	--

BMATC101

First Semester B.E./B.Tech. Degree Examination, Jan./Feb. 2023

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. 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 $r = 6\cos\theta$ and $r = 2(1 + \cos\theta)$.	7	L2	CO1
	c.	For the curve $r^m = a^m \cos m\theta$, prove that $\rho = \frac{a^m}{(1+m)r^{m-1}}$.	7	L2	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 $\frac{2a}{r} = 1 + \cos\theta$.	8	L2	CO1
	c.	Using Modern mathematical tool. Write a program / code to plot the sine and cosine curve.	5	L3	CO5
Module – 2					
Q.3	a.	Expand $\sqrt{1 + \sin 2x}$ by using Maclaurin's series up to the term containing x^4 .	6	L2	CO1
	b.	If $u = f(r, s, t)$ and $r = \frac{x}{y}$, $s = \frac{y}{z}$, $t = \frac{z}{x}$. Show that, $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z} = 0$.	7	L2	CO1
	c.	Examine the function $f(x, y) = x^3 + y^3 - 3x - 12y + 20$ for extreme values.	7	L3	CO1
OR					
Q.4	a.	If $z = e^{ax+by} f(ax - by)$ then prove that $b \frac{\partial z}{\partial x} + a \frac{\partial z}{\partial y} = 2abz$.	7	L2	CO1
	b.	If $u = x^2 + y^2 + z^2$, $v = xy + yz + zx$, $w = x + y + z$ find $\frac{\partial(u, v, w)}{\partial(x, y, z)}$.	8	L2	CO1
	c.	Using Modern mathematical tool write a program/code to evaluate $\lim_{x \rightarrow \infty} \left(1 + \frac{1}{x}\right)^x$.	5	L3	CO5
Module – 3					
Q.5	a.	Solve : $\frac{dy}{dx} + y \tan x = y^3 \sec x$.	6	L2	CO2
	b.	Find the orthogonal trajectories of the family of the curves $r^n = a^n \sin n\theta$.	7	L3	CO2
	c.	Solve : $xy \left(\frac{dy}{dx}\right)^2 - (x^2 + y^2) \frac{dy}{dx} + xy = 0$.	7	L2	CO2
OR					
Q.6	a.	Solve : $(y^4 + 2y)dx + (xy^3 + 2y^4 - 4x)dy = 0$.	6	L2	CO3
	b.	A body in air at 25°C cools from 100°C to 75°C in one minute. Find the temperature of the body at the End of 3 minutes.	7	L3	CO2

	c.	Find the general solution of the equation $x^2(y - px) = p^2y$ by reducing into Clairaut's form using the substitution $X = x^2$, $Y = y^2$.	7	L2	CO3
Module – 4					
Q.7	a.	Solve : $(4D^4 - 8D^3 - 7D^2 + 11D + 6)y = 0$.	6	L2	CO3
	b.	Solve : $(D^2 + 5D + 6)y = \cos x + e^{-2x}$.	7	L2	CO3
	c.	Solve by the method of variation of parameters $\frac{d^2y}{dx^2} + a^2y = \sec ax$.	7	L2	CO3
OR					
Q.8	a.	Solve : $\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 5y = 0$ subject to $\frac{dy}{dx} = 2$, $y = 1$ at $x = 0$.	6	L2	CO3
	b.	Solve : $\frac{d^2y}{dx^2} + 4y = x^2 + \cos 2x$.	7	L2	CO3
	c.	Solve : $x^3 \frac{d^3y}{dx^3} + 3x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + 8y = 65 \cos(\log x)$.	7	L2	CO3
Module – 5					
Q.9	a.	Find the 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.	Solve the system of equations by Gauss-Jordan method $x + y + z = 9$, $2x + y - z = 0$, $2x + 5y + 7z = 52$.	7	L2	CO4
	c.	Using Rayleigh's power method find the dominant eigen value and the corresponding eigen vector of $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ by taking $[1 \ 1 \ 1]^T$ as the initial eigen vector. Carryout 6 iterations.	7	L3	CO4
OR					
Q.10	a.	Find the rank of the matrix. $\begin{bmatrix} 91 & 92 & 93 & 94 & 95 \\ 92 & 93 & 94 & 95 & 96 \\ 93 & 94 & 95 & 96 & 97 \\ 94 & 95 & 96 & 97 & 98 \\ 95 & 96 & 97 & 98 & 99 \end{bmatrix}$.	7	L2	CO4
	b.	Solve the system of equations, $20x + y - 2z = 17$, $3x + 20y - z = -18$, $2x - 3y + 20z = 25$. Using Gauss-Seidel method, taking $(0, 0, 0)$ as an initial approximation (carry out 3 iterations).	8	L2	CO4
	c.	Using modern mathematical tool write a program/code to test the consistency of the equations. $x_1 + 2x_2 - x_3 = 1$, $2x_1 + x_2 + 5x_3 = 2$, $3x_1 + 3x_2 + 4x_3 = 1$.	5	L3	CO5
