CBCS SCHEME

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 $\lim_{x\to\infty}\left(1+\frac{1}{x}\right)^x$.	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

* * * * *