

## Model Question Paper-II with effect from 2022 (CBCS Scheme)

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### First Semester B.E Degree Examination Mathematics-I for Civil Engineering Stream (22MATC11)

**TIME: 03 Hours**

**Max. Marks: 100**

Note: Answer any **FIVE** full questions, choosing at least **ONE** question from each **MODULE**.

Module -1			Marks
Q.01	a	If $p$ be the perpendicular from the pole on the tangent, then show that $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4} \left( \frac{dr}{d\theta} \right)^2.$	06
	b	Find the angle between the curves $r = a(1 + \cos \theta)$ and $r = b(1 - \cos \theta)$ .	07
	c	Show that the radius of curvature of the curve $y = 4\sin x - \sin 2x$ at $x = \frac{\pi}{2}$ is $\frac{5\sqrt{5}}{4}$ .	07
OR			
Q.02	a	Derive an expression for the radius of curvature for a polar curve.	06
	b	Find the pedal equation of the curve $r^n = a^n(\sin n\theta)$ .	07
	c	Show that the radius of curvature at any point of the cycloid $x = a(\theta + \sin\theta), y = a(1 - \cos\theta)$ is $4a \cos \frac{\theta}{2}$ .	07
Module-2			
Q. 03	a	Expand $\log(1 + \cos x)$ by Maclaurin's series up to the term containing $x^4$ .	06
	b	If $u = f\left(\frac{x}{z}, \frac{y}{z}\right)$ then prove that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} + z \frac{\partial u}{\partial z} = 0$ .	07
	c	Examine the function $f(x, y) = 2(x^2 - y^2) - x^4 + y^4$ for extreme values.	07
OR			
Q.04	a	Evaluate (i) $\lim_{x \rightarrow 0} \left( \frac{\sin x}{x} \right)^{1/x^2}$ (ii) $\lim_{x \rightarrow 0} (\tan x)^{\tan x}$ .	06
	b	If $z = e^{ax+by} f(ax - by)$ , show that $b \frac{\partial z}{\partial x} + a \frac{\partial z}{\partial y} = 2abz$ .	07
	c	If $x + y + z = u, y + z = uv$ and $z = uvw$ , find $\frac{\partial(x,y,z)}{\partial(u,v,w)}$	07
Module-3			
Q. 05	a	Solve $x \frac{dy}{dx} + y = x^3 y^6$ .	06
	b	Find the orthogonal trajectories of the family of the curves $r^n \sin n\theta = a^n$ , where $a$ is the parameter.	07
	c	Solve $xyp^2 - (x^2 + y^2)p + xy = 0$ .	07

OR			
Q. 06	a	Solve $(y \log y)dx + (x - \log y)dy = 0$ .	06
	b	If the temperature of the air is $30^\circ\text{C}$ and a metal ball cools from $100^\circ\text{C}$ to $70^\circ\text{C}$ in 15 minutes, find how long will it take for the metal ball to reach the temperature of $40^\circ\text{C}$ ?	07
	c	Find the general solution of the equation $(px - y)(py + x) = a^2 p$ by reducing into Clairaut's form, taking the substitution $X = x^2, Y = y^2$	07
Module-4			
Q. 07	a	Solve $(4D^4 - 8D^3 - 7D^2 + 11D + 6)y = 0$ .	06
	b	Solve $(D^2 + 1)y = \cos(2x - 1)$ .	07
	c	Solve $(1 + x)^2 \frac{d^2y}{dx^2} + (1 + x) \frac{dy}{dx} + y = 2 \sin[\log(1 + x)]$ .	07
OR			
Q. 08	a	Solve $(D^2 + D)y = x^2 + 2x + 4$ .	06
	b	Solve by variation of parameters method $(D^2 + 4)y = \tan 2x$ .	07
	c	Solve $x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = \sin(\log x)$ .	07
Module-5			
Q. 09	a	Find the rank of the matrix $\begin{bmatrix} 91 & 92 & 93 & 94 & 95 \\ 92 & 93 & 94 & 95 & 96 \\ 93 & 94 & 95 & 96 & 97 \\ 94 & 95 & 96 & 97 & 98 \\ 95 & 96 & 97 & 98 & 99 \end{bmatrix}$	06
	b	Using Gauss Jordan method, solve $x + y + z = 11; 3x - y + 2z = 12; 2x + y - z = 3$	07
	c	Using Rayleigh's power method find the dominant eigenvalue and the corresponding eigenvector of $\begin{bmatrix} 1 & -3 & 2 \\ 4 & 4 & -1 \\ 6 & 3 & 5 \end{bmatrix}$ by taking $[1 \ 0 \ 0]^T$ as initial eigenvector [carry out 6 iterations]	07
OR			
Q. 10	a	Find the rank of the matrix $\begin{bmatrix} 1 & 2 & 3 & 1 \\ 2 & 1 & -1 & 0 \\ 3 & 3 & 2 & 1 \\ 2 & 4 & 6 & 2 \end{bmatrix}$	06
	b	Test for consistency and solve $5x + 3y + 7z = 4; 3x + 26y + 2z = 9; 7x + 2y + 10z = 5$	07
	c	Solve the system of equations $2x - 3y + 20z = 25, 20x + y - 2z = 17, 3x + 20y - z = -18$ using Gauss-Seidel method, taking $(0, 0, 0)$ as an initial approximation. (Carry out 4 iterations).	07

Table showing the Bloom's Taxonomy Level, Course Outcome and Program Outcome					
Question		Bloom's Taxonomy Level attached	Course Outcome	Program Outcome	
Q.1	(a)	L1	CO 01	PO 01	
	(b)	L2	CO 01	PO 01	
	(c)	L3	CO 01	PO 02	
Q.2	(a)	L1	CO 01	PO 01	
	(b)	L2	CO 01	PO 01	
	(c)	L3	CO 01	PO 02	
Q.3	(a)	L2	CO 02	PO 01	
	(b)	L2	CO 02	PO 01	
	(c)	L3	CO 02	PO 03	
Q.4	(a)	L2	CO 02	PO 01	
	(b)	L2	CO 02	PO 01	
	(c)	L3	CO 02	PO 02	
Q.5	(a)	L2	CO 03	PO 01	
	(b)	L3	CO 03	PO 02	
	(c)	L2	CO 03	PO 01	
Q.6	(a)	L2	CO 03	PO 01	
	(b)	L3	CO 03	PO 02	
	(c)	L2	CO 03	PO 01	
Q.7	(a)	L2	CO 04	PO 01	
	(b)	L2	CO 04	PO 01	
	(c)	L2	CO 04	PO 02	
Q.8	(a)	L2	CO 04	PO 01	
	(b)	L2	CO 04	PO 01	
	(c)	L2	CO 04	PO 02	
Q.9	(a)	L2	CO 05	PO 01	
	(b)	L3	CO 05	PO 02	
	(c)	L3	CO 05	PO 01	
Q.10	(a)	L2	CO 05	PO 01	
	(b)	L3	CO 05	PO 01	
	(c)	L3	CO 05	PO 02	
<b>Lower-order thinking skills</b>					
<b>Bloom's Taxonomy Levels</b>	Remembering (Knowledge): L <sub>1</sub>		Understanding (Comprehension): L <sub>2</sub>	Applying (Application): L <sub>3</sub>	
	<b>Higher-order thinking skills</b>				
	Analyzing (Analysis): L <sub>4</sub>		Valuating (Evaluation): L <sub>5</sub>	Creating (Synthesis): L <sub>6</sub>	