Model Question Paper-I 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	With usual notations prove that $\tan\varphi = r\frac{d\theta}{dr}$	**06**
	b	Find the angle between the curves $r = a(1-\cos\theta)$ and $r = 2a\cos\theta$	**07**
	c	Show that the radius of curvature for the curve $r^n = a^n \cos n\theta$ varies inversely as r^{n-1}.	**07**
		OR	
Q.02	a	Derive an expression for the radius of curvature for a Cartesian curve.	**06**
	b	Find the pedal equation of the curve $r = 2(1+\cos\theta)$	**07**
	c	Find the radius of curvature of the curve $\sqrt{x}+\sqrt{y}=\sqrt{a}$ at the point where it cuts the line $y = x$.	**07**
		Module-2	
Q. 03	a	Expand $\log(1+e^x)$ by Maclaurin's series up to the term containing x^4.	**06**
	b	If $u = f(x-y, y-z, z-x)$, show that $\frac{\partial u}{\partial x}+\frac{\partial u}{\partial y}+\frac{\partial u}{\partial z}=0$.	**07**
	c	Examine the function $f(x,y) = xy(a-x-y)$ for extreme values.	**07**
		OR	
Q.04	a	Evaluate (i) $\lim_{x\to\frac{\pi}{2}}(sinx)^{tanx}$ (ii) $\lim_{x\to 0}(\cot x)^{tanx}$	**06**
	b	If $z = f(x+ay)+g(x-ay)$ prove that $\frac{\partial^2 z}{\partial y^2} = a^2\frac{\partial^2 z}{\partial x^2}$.	**07**
	c	If $u = x+3y^2-z^3,\ v = 4x^2yz,\ w = 2z^2-xy\ find\ \frac{\partial(u,v,w)}{\partial(x,y,z)}\ at\ (1,-1,0)$.	**07**
		Module-3	
Q. 05	a	Solve $\frac{dy}{dx}+xy = xy^3$.	**06**
	b	Find the orthogonal trajectories of the cardioids $r = a(1-cos\theta)$.	**07**
	c	Solve $p^2+2pycotx = y^2$.	**07**
		OR	

Q. 06	a	Solve $(4xy + 3y^2 - x)dx + x(x + 2y)dy = 0$	**06**
	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?	**07**
	c	Find the general and singular solution of the equation $x^2(y - px) = p^2y$ by reducing into Clairaut's form, using the substitution X = x^2 , $Y = y^2$.	**07**
Module-4			
Q. 07	a	Solve $(4D^4 - 4D^3 - 23D^2 + 12D + 36)y = 0$.	**06**
	b	Solve $(D - 2)^2y = 8(e^{2x} + sin2x + x^2)$.	**07**
	c	Solve by the method of variation of parameter $y'' - 6y' + 9y = \frac{e^{3x}}{x^2}$.	**07**
OR			
Q. 08	a	Solve $y'' + 3y' + 2y = 12x^2$.	**06**
	b	Solve $\frac{d^2y}{dx^2} - 4y = \cosh(2x - 1) + 3^x$.	**07**
	c	Solve $(2x - 1)^2 \frac{d^2y}{dx^2} + (2x - 1)\frac{dy}{dx} - 2y = 8x^2 - 2x + 3$.	**07**
Module-5			
Q. 09	a	Find the rank of the matrix $\begin{bmatrix} 4 & 0 & 2 & 1 \\ 2 & 1 & 3 & 4 \\ 2 & 3 & 4 & 7 \\ 2 & 3 & 1 & 4 \end{bmatrix}$	**06**
	b	Solve the system of equations by Gauss-Jordan method $x + y + z = 9,$ $x - 2y + 3z = 8,$ $2x + y - z = 3$	**07**
	c	Using Rayleigh's power method find the dominant eigenvalue and the corresponding eigenvector of $\begin{bmatrix} 25 & 1 & 2 \\ 1 & 3 & 0 \\ 2 & 0 & -4 \end{bmatrix}$ by taking $[1 \quad 0 \quad 0]^T$ as the initial eigenvector [carry out 6 iterations].	**07**
OR			
Q. 10	a	Find the rank of the matrix $\begin{bmatrix} 11 & 12 & 13 & 14 \\ 12 & 13 & 14 & 15 \\ 13 & 14 & 15 & 16 \\ 14 & 15 & 16 & 17 \end{bmatrix}$	06

	b	For what values λ and μ the system of equations $2x + 3y + 5z = 9$, $7x + 3y - 2z = 8$, $2x + 3y + \lambda z = \mu$, has (i) no solution (ii) a unique solution and (iii) infinite number of solutions	**07**
	c	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. (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 02
	b)	L3	CO 03	PO 03
	c)	L2	CO 03	PO 01
Q. 6	a)	L2	CO 03	PO 02
	b)	L3	CO 03	PO 03
	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 01
	c)	L3	CO 05	PO 02
Q. 10	a)	L2	CO 05	PO 01
	b)	L3	CO 05	PO 02
	c)	L3	CO 05	PO 01