

Model Question Paper-II with effect from 2021 (CBCS Scheme)

USN

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

First Semester B.E Degree Examination Calculus and Differential Equations (21MAT11)

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 $\rho = \frac{(1+y_1^2)^{3/2}}{y_2}$	06
	b	Find the angle between the curves $r = a \log \theta$ and $r = \frac{a}{\log \theta}$	07
	c	Prove that for the cardioids $r = a(1 + \cos \theta)$, $\frac{\rho^2}{r}$ is constant	07
OR			
Q.02	a	Show that the curves $r^n = a^n \cos n\theta$ and $r^n = b^n \sin n\theta$ cut each other orthogonally.	06
	b	Find the pedal equation of the curve $r^n = a^n \cos n\theta$.	07
	c	Show that the radius of curvature at $(a, 0)$ on the curve $y^2 = \frac{a^2(a-x)}{x}$ is $\frac{a}{2}$	07
Module-2			
Q. 03	a	Expand $\sqrt{1 + \sin 2x}$ by Maclaurin's series up to the term containing x^5	06
	b	If $u = \tan^{-1}\left(\frac{y}{x}\right)$, where $x = e^t - e^{-t}$ and $y = e^t + e^{-t}$, find the total derivative $\frac{du}{dt}$ using partial differentiation.	07
	c	If $u = \frac{yz}{x}$, $v = \frac{zx}{y}$, $w = \frac{xy}{z}$, show that $\frac{\partial(u,v,w)}{\partial(x,y,z)} = 4$	07
OR			
Q.04	a	Evaluate (i) $\lim_{x \rightarrow 0} (a^x + x)^{\frac{1}{x}}$ (ii) $\lim_{x \rightarrow \frac{\pi}{2}} (\tan x)^{\tan 2x}$	06
	b	If $u = f\left(\frac{y-x}{xy}, \frac{z-x}{xz}\right)$, show that $x^2 \frac{\partial u}{\partial x} + y^2 \frac{\partial u}{\partial y} + z^2 \frac{\partial u}{\partial z} = 0$.	07
	c	Find the extreme values of $x^3 + y^3 - 3axy$, $a \geq 0$	07
Module-3			
Q. 05	a	Solve $\frac{dy}{dx} + y \tan x = y^3 \sec x$	06
	b	Water at temperature 10°C takes 5 minutes to warm up to 20°C at a room temperature of 40°C . Find the temperature of the water after 20 minutes.	07

	c	Solve $p^3 + 2xp^2 - y^2p^2 - 2xy^2p = 0$	07
OR			
Q. 06	a	Solve $(x^2 + y^3 + 6x)dx + y^2xdy = 0$	06
	b	Prove that the system of parabolas $y^2 = 4a(x + a)$ are self-orthogonal	07
	c	Find the general and singular solutions of $xp^2 + xp - yp + 1 - y = 0$	07
Module-4			
Q. 07	a	Solve $(4D^4 - 8D^3 - 7D^2 + 11D + 6)y = 0$	06
	b	Solve $\frac{d^2y}{dx^2} + \frac{dy}{dx} = x^2 + 2x + 4$	07
	c	Using the method of Variation of parameters, solve $\frac{d^2y}{dx^2} - 6\frac{dy}{dx} + 9y = \frac{e^{3x}}{x^2}$	07
OR			
Q. 08	a	Solve $(\frac{d^3y}{dx^3} - 5\frac{d^2y}{dx^2} + 7\frac{dy}{dx} - 3y) = e^{2x}$	06
	b	Solve $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 3y = \sin x$	07
	c	Solve $(1 + x)^2\frac{d^2y}{dx^2} + (1 + x)\frac{dy}{dx} + y = \sin[2 \log(1 + x)]$	07
Module-5			
Q. 09	a	Find the rank of the matrix $\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$	06
	b	Solve the system of equations by using the Gauss elimination method $3x + y + 2z = 3,$ $2x - 3y - z = -3,$ $x + 2y + z = 4$	07
	c	Using the Gauss-Seidel iteration method, solve the equations $83x + 11y - 4z = 95;$ $3x + 8y + 29z = 71;$ $7x + 52y + 13z = 104,$ Carry out four iterations, starting with the initial approximations $(0, 0, 0)$	07
OR			
Q. 10	a	Test for consistency and solve $5x + 3y + 7z = 4 ; 3x + 26y + 2z = 9 ; 7x + 2y + 10z = 5$	06
	b	Using the Gauss Jordan method, solve	07

		$x + y + z = 11; 3x - y + 2z = 12; 2x + y - z = 3$	
	c	Find the largest eigenvalue and the corresponding eigenvector of $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ with the initial approximate eigenvector $[1 \ 0 \ 0]^T$	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 02
Q.4	(a)	L2	CO 02	PO 01
	(b)	L2	CO 02	PO 01
	(c)	L3	CO 02	PO 03
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 01
	(b)	L3	CO 03	PO 03
	(c)	L2	CO 03	PO 02
Q.7	(a)	L2	CO 04	PO 01

	(b)	L2	CO 04	PO 02
	(c)	L2	CO 04	PO 03
Q.8	(a)	L2	CO 04	PO 01
	(b)	L2	CO 04	PO 02
	(c)	L2	CO 04	PO 03
Q.9	(a)	L2	CO 05	PO 02
	(b)	L3	CO 05	PO 01
	(c)	L3	CO 05	PO 01
Q.10	(a)	L2	CO 05	PO 02
	(b)	L3	CO 05	PO 01
	(c)	L3	CO 05	PO 01
Lower order thinking skills				
Bloom's Taxonomy Levels	Remembering (Knowledge): L ₁		Understanding (Comprehension): L ₂	Applying (Application): L ₃
	Higher-order thinking skills			
	Analyzing (Analysis): L ₄	Valuating (Evaluation): L ₅		Creating (Synthesis): L ₆