

Model Question Paper-I with effect from 2025

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1BMATE101

First Semester B.E./B.Tech. Degree Examination Differential Calculus & Linear Algebra

TIME: 03Hours

Max.Marks:100

- Note: 1. Answer any **FIVE** full questions, choosing at least **ONE** 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	1
	b	Show that the angle of intersection of the curves $r = a \log \theta$ and $r = a/\log \theta$ is $\tan^{-1} \left[\frac{2e}{(1-e^2)} \right]$.	7	L2	1
	c	Show that the radius of curvature at $x = \frac{\pi}{2}$ of the curve $y = 4\sin x - \sin 2x$ is $\frac{5\sqrt{5}}{4}$.	7	L2	1
OR					
Q 2.	a	With usual notations, prove that $\frac{1}{p^2} = \frac{1}{r^2} + \frac{1}{r^4} \left(\frac{dr}{d\theta} \right)^2$.	6	L2	1
	b	Find the angle of intersection of the curves $r^2 \sin 2\theta = 4$ and $r^2 = 16 \sin 2\theta$	7	L2	1
	c	Find the radius of curvature using pedal form for the curves, $r^2 \sec 2\theta = a^2$	7	L2	1
Module-2					
Q 3.	a	Expand $\log(\sec x)$ in powers of x as far as the term in x^4 .	6	L2	1
	b	If $u = f\left(\frac{y-x}{xy}, \frac{z-x}{xz}\right)$ prove that $x^2 \frac{\partial u}{\partial x} + y^2 \frac{\partial u}{\partial y} + z^2 \frac{\partial u}{\partial z} = 0$.	7	L2	1
	c	Examine the function for extreme values $f(x, y) = x^3 y^2 (1 - x - y)$.	7	L2	1
OR					
Q 4.	a	Evaluate $\lim_{x \rightarrow a} \left(2 - \frac{x}{a} \right)^{\tan(\pi x/2a)}$	6	L2	1
	b	If $x + y + z = u$; $y + z = v$; $z = uvw$ then find $\frac{\partial(x,y,z)}{\partial(u,v,w)}$	7	L2	1
	c	Show that a differential equation for the current i in an electrical circuit containing an inductance L and resistance R in series and acted on by an electromotive force $E \sin \omega t$, satisfies the equation $L \frac{di}{dt} + Ri = E \sin \omega t$. Find the value of the current at any time t, if initially there is no current in the circuit.	7	L3	1
Module-3					
Q 5.	a	Solve $(xy^2 - e^{1/x^3}) dx - x^2 y dy = 0$	6	L2	1
	b	Solve for p. $\frac{dy}{dx} - \frac{dx}{dy} = \frac{x}{y} - \frac{y}{x}$.	7	L2	1

	c	A rectangular box open at the top is to have volume of 32 cubic ft. Find the dimensions of the box requiring least material for its construction.	7	L3	1
OR					
Q 6.	a	Solve $\frac{dy}{dx} + \frac{y \cos x + \sin y + y}{\sin x + x \cos y + x} = 0$	6	L2	1
	b	Show that the family of parabolas $y^2 = 4a(x + a)$ is self-orthogonal.	7	L2	1
	c	Solve the equation $(px - y)(py + x) = 2p$ by reducing into Clairault's form, by taking the substitutions $u = x^2$ and $v = y^2$.	7	L2	1
Module-4					
Q 7.	a	Solve $\frac{d^3y}{dx^3} + 2\frac{d^2y}{dx^2} + \frac{dy}{dx} = e^{-x} + \sin 2x$	6	L2	1
	b	Solve by variation of parameter method $\frac{d^2y}{dx^2} + y = \frac{1}{1 + \sin x}$	7	L2	1
	c	Solve $x^2 y'' + xy' + y = 2\cos^2(\log x)$	7	L2	1
OR					
Q 8.	a	Solve $\frac{d^2y}{dx^2} - 4y = 3^x + \cosh(2x - 1)$	6	L2	1
	b	Solve $(3 + 2x)^2 \frac{d^2y}{dx^2} + 5(3 + 2x) \frac{dy}{dx} + y = 4x$	7	L2	1
	c	Solve by variation of parameter method $\frac{d^2y}{dx^2} + \frac{dy}{dx} - 2y = \frac{1}{1 - e^x}$	7	L2	1
Module-5					
Q 9.	a	Find the rank of the following matrices by reducing into row echelon form. $\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}$	6	L2	2
	b	Solve by Gauss – Seidel iteration method: $20x + y - 2z = 17, 3x + 20y - z = -18, 2x - 3y + 20z = 25$	7	L2	2
	c	Determine the dominant Eigen value and the corresponding Eigen vector of the following matrix by using Rayleigh's power method. $\begin{bmatrix} 4 & 1 & -1 \\ 2 & 3 & -1 \\ -2 & 1 & 5 \end{bmatrix}$	7	L2	2
OR					
Q 10.	a	Investigate the values of λ and μ so that the equation $2x + 3y + 5z = 9; 7x + 3y - 2z = 8; 2x + 3y + \lambda z = \mu$ have (i) no solution (ii) a unique solution and (iii) an infinite number of solution.	6	L2	2
	b	Solve by Gauss elimination method: $2x + y + z = 10; 3x + 2y + 3z = 18; x + 4y + 9z = 16.$	7	L2	2
	c	Find the Eigen values and Eigen vectors of the following matrix $\begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$	7	L2	2