Model Question Paper-I with effect from 2025

USN | | | | | | | | | | | **1BMATC101**

First Semester B.E./B.Tech. Degree Examination
Differential Calculus and 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**	**CO**
Q 1.	**a**	With usual notations, prove that $\tan(\emptyset) = r\frac{d\theta}{dr}$.	**6**	**L2**	1
	b	Find the angle between pair of curves, $r\,sec^2\left(\frac{\theta}{2}\right) = 2a$, $r\,cosec^2(\frac{\theta}{2}) = 2b$.	**7**	**L2**	1
	c	Find the pedal equation of the curve $r^n = a^n cosn\theta$.	**7**	**L2**	1
		OR			
Q 2.	**a**	Find the radius of curvature of the curve $x^3 + y^3 = 3axy$, at the point $(\frac{3a}{2}, \frac{3a}{2})$.	**6**	**L2**	1
	b	Find the radius of curvature of the parametric curve $x = a(t - sint),\ y = a(1 - cost)$.	**7**	**L2**	1
	c	Show that ρ varies inversely as r^{n-1} for the curve $r^n = a^n \sin(n\theta)$,	**7**	**L2**	1
		Module-2			
Q 3.	**a**	Obtain the series of the function $y = \log(1 + cosx)$ upto the term contains x^4	**6**	**L2**	1
	b	Evaluate (i). $\lim_{x\to a}\left(\frac{x^x - a^x}{x^a - a^a}\right)$ and (ii). $\lim_{x\to 0}\frac{\sinh(x) - x}{\sin(x) - x\cos(x)}$.	**7**	**L2**	1
	c	If $u = x^3 - 3xy^2 + x + e^x\,cosy + 1$ *show that* $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2}=0$	**7**	**L2**	1
		OR			
Q 4.	**a**	*If* $z = f(x,y)$ where $x = e^u sinv$ *and* $y = e^u cosv$ then prove that $\left(\frac{\partial z}{\partial u}\right)^2 + \left(\frac{\partial z}{\partial v}\right)^2 = e^{2u}\left\{\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2\right\}$	**6**	**L2**	1
	b	If $u = \frac{yz}{x},\ v = \frac{xz}{y},\ w = \frac{xy}{z}$ show that $\frac{\partial(u,v,w)}{\partial(x,y,z)} = 4$	**7**	**L2**	1
	c	Find the extreme value of the function $f(x,y) = x^3 + y^3 - 3x - 12y + 20$	**7**	**L2**	1
		Module-3			
Q 5.	**a**	Solve the differential equation $cosx\,dy = y(sinx - y)dx$	**6**	**L2**	1

	b	Solve the differential equation $(x-y)dx - dy = 0\ ,\ y(0) = 2$	7	L2	1
	c	Solve the differential equation $(3x^2y^4 + 2xy)dx + (2x^3y^3 - x^2)dy = 0$	7	L2	1
		OR			
Q 6.	a	Find the orthogonal trajectories of $\frac{x^2}{a^2} + \frac{y^2}{b^2+\lambda} = 1\ where\ \lambda$ is the parameter.	6	L2	1
	b	A bacterial population B is known to have a rate growth proportional to B itself. If between noon and 2PM the population triples, at what time no controls being exerted, should B become 100times what it was at noon.	7	L3	1
	c	Radium decomposes at a rate proportional the quantity of radium present. Suppose that it is found that in 25 years approximately 1.1% of a certain quantity of radium has decomposed. Determine approximately how long will it take for half of the original amount of radium to decompose. -	7	L3	1
		Module-4			
Q 7.	a	Solve $y^{111} - 3y^{11} - y^1 + 3y = 0$	6	L2	1
	b	Solve $(D^2 - D + 1)y = sinhx$	7	L2	1
	c	Solve $(D^2 + 5D - 6)y = sin4x\ sinx$	7	L2	1
		OR			
Q 8.	a	Solve $(D^2 + 1)y = cosx$ by the Method of variation of parameters.	6	L2	1
	b	Solve $x^2\frac{d^2y}{dx^2} - 3x\frac{dy}{dx}\ 5y = x^2cosx(logx)$	7	L2	1
	c	Construct the governing equation of the free, damped motion of a mass?	7	L2	1
		Module-5			
Q 9.	a	Find the rank of the matrix $A = \begin{bmatrix} 2 & 3 & -1 & -1 \\ 1 & -1 & -2 & -4 \\ 3 & 1 & 3 & -2 \\ 6 & 3 & 0 & 7 \end{bmatrix}$	6	L2	2
	b	Test for the consistency of the following system and then solve x-2y+3z=2, 3x-y+4z=4, 2x+y-2z=5.	7	L2	2
	c	Solve the following system of equation by Guass elimination method $2x_1 + 2x_2 + x_3 + 2x_4 = 7,\quad -x_1 + 2x_2 + x_4 = -2,$ $-3x_1 + x_2 + 2\,x_3 + x_4 = -3,\ \ -x_1 + 2x_4 = 0.$	7	L3	2
		OR			
Q 10.	a	Solve the following system of equations by Gauss seidel method $10x + y + z = 12,\quad x + 10y + z = 12\ ,\ \ x + y + 10z = 12$	6	L3	2
	b	Apply power method to find the eigenvalues and eigenvectors of the matrix $\begin{bmatrix} -2 & 2 & 3 \\ 2 & 1 & 6 \\ 3 & 6 & -2 \end{bmatrix}$.	7	L3	2
	c	Diagonalize the matrix A= $\begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}$.	7	L2	2