# Model Question Paper-I with effect from 2025

USN | | | | | | | | | | |　　**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 $tan\emptyset = r\frac{d\theta}{dr}$. | **6** | **L2** | 1 |
| | **b** | Show that the angle of intersection of the curves $r = a\log\theta$ and $r = {}^{a}/_{\log\theta}$ is $tan^{-1}\left[{}^{2e}/_{(1-e^2)}\right]$. | **7** | **L2** | 1 |
| | **c** | Show that the radius of curvature at $x = \frac{\pi}{2}$ of the curve $y = 4sinx - sin2x$ 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, $r^2sec2\theta = a^2$ | **7** | **L2** | 1 |
| | | **Module-2** | | | |
| **Q 3.** | **a** | Expand $log\ (secx)$ 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 $f(x, y) = x^3y^2(1 - x - y)$. | **7** | **L2** | 1 |
| | | **OR** | | | |
| **Q 4.** | **a** | Evaluate $\lim_{x\to a}\left(2 - \frac{x}{a}\right)^{tan(\pi x/2a)}$ | **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 $Esin\omega t$, satisfies the equation $L\frac{di}{dt} + Ri = Esin\omega t$. 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 $\left(xy^2 - e^{{}^{1}/_{x^3}}\right)dx - x^2ydy = 0$ | **6** | **L2** | 1 |
| | **b** | Solve for p. $\frac{dy}{dx} - \frac{dx}{dy} = \frac{x}{y} - \frac{y}{x}$. | **7** | **L2** | 1 |

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|---|---|---|---|---|---|
| | 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 $\frac{dy}{dx}+\frac{yCosx+Siny+y}{Sinx+xCosy+x}=0$ | 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 $\frac{d^3y}{dx^3}+2\frac{d^2y}{dx^2}+\frac{dy}{dx}=e^{-x}+sin2x$ | 6 | L2 | 1 |
| | b | Solve by variation of parameter method $\frac{d^2y}{dx^2}+y=\frac{1}{1+sinx}$ | 7 | L2 | 1 |
| | c | Solve $x^2y''+xy'+y=2cos^2(logx)$ | 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 $\lambda$ and $\mu$ 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 |