



First Semester B.E./B.Tech. Degree Examination, June/July 2026
Calculus and Differential Equations

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. With usual notations, prove that $\tan \phi = r \frac{d\theta}{dr}$. (06 Marks)
- b. Find the angle between the curves $r = \sin \theta + \cos \theta$ and $r = 2 \sin \theta$. (07 Marks)
- c. Find the radius of curvature of the curve $x = a(\cos t + t \sin t)$; $y = a(\sin t - t \cos t)$. (07 Marks)

OR

- 2 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 Marks)
- b. Find the Pedal equation of the curve $\frac{2a}{r} = 1 - \cos \theta$. (07 Marks)
- c. With usual notations, prove that $\rho = \frac{(1 + y_1^2)^{\frac{3}{2}}}{y_2}$. (07 Marks)

Module-2

- 3 a. Find the Maclaurin's series for $\tan x$ upto the term containing x^4 . (06 Marks)
- b. If $z = e^{ax+by} f(ax - by)$, show that $b \frac{\partial z}{\partial x} + a \frac{\partial z}{\partial y} = 2abz$. (07 Marks)
- c. Examine the function $f(x, y) = x^3 y^2 (1 - x - y)$ for extreme values. (07 Marks)

OR

- 4 a. Evaluate $\lim_{x \rightarrow 0} (\cos x)^{\frac{1}{x^2}}$. (06 Marks)
- b. If $u = \frac{yz}{x}$, $v = \frac{zx}{y}$, $w = \frac{xy}{z}$, show that Jacobian $\frac{\partial(u, v, w)}{\partial(x, y, z)} = 4$. (07 Marks)
- c. If $u = f(2x - 3y, 3y - 4z, 4z - 2x)$, then find the value of $6 \frac{\partial u}{\partial x} + 4 \frac{\partial u}{\partial y} + 3 \frac{\partial u}{\partial z}$. (07 Marks)

Module-3

- 5 a. Solve : $x \frac{dy}{dx} + y = x^3 y^6$ (06 Marks)
- b. A copper ball originally at 80°C cools down to 60°C in 20 minutes, if the temperature of the air being 40°C , what will be the temperature of the ball after 40 minutes from the original? (07 Marks)
- c. Solve $xyp^2 - (x^2 + y^2)p + xy = 0$ where $p = \frac{dy}{dx}$. (07 Marks)

OR

- 6 a. Solve $(x^2 + y^3 + 6x)dx + 3xy^2 dy = 0$ (06 Marks)
- b. Prove that system of parabolas $y^2 = 4a(x + a)$ are self orthogonal. (07 Marks)
- c. Find the general solution of the equation $(px - y)(py + x) = a^2 p$ by reducing into Clairaut's form, taking the substitution $u = x^2$, $v = y^2$. (07 Marks)

Module-4

- 7 a. Solve : $\frac{d^4 y}{dx^4} - 16y = 0$ (06 Marks)
- b. Solve : $[D^2 + 5D + 6]y = e^x + e^{-x}$ (07 Marks)
- c. Using the method of variation of parameters, solve : $(D^2 + 4)y = \tan 2x$. (07 Marks)

OR

- 8 a. Solve : $(D - 1)^2 y = x^2$ (06 Marks)
- b. Solve : $y'' + 4y' + 4y = 3 \sin x$ (07 Marks)
- c. Solve : $x^2 y'' - xy' + y = \log x$ (07 Marks)

Module-5

- 9 a. Find the rank of a matrix
- $$\begin{bmatrix} 1 & -2 & -1 & 3 \\ 2 & 5 & -4 & 7 \\ -1 & -2 & -1 & 2 \\ 3 & 3 & -5 & 10 \end{bmatrix}$$
- (06 Marks)
- b. Solve the following system of equations by Gauss-Jordan method:
 $2x + 5y + 7z = 52$, $2x + y - z = 0$, $x + y + z = 9$. (07 Marks)

- c. Find the dominant eigen value and the corresponding eigen vector of the matrix

$$A = \begin{bmatrix} 2 & 0 & 1 \\ 0 & 2 & 0 \\ 1 & 0 & 2 \end{bmatrix} \quad \text{with } X^{(0)} = (1, 0, 0)^T. \quad \text{Carry out five iterations.} \quad (07 \text{ Marks})$$

OR

- 10 a. Determine the values of λ and μ for which the system of equations:

$$x + 2y + 3z = 6, \quad x + 3y + 5z = 9, \quad 2x + 5y + \lambda z = \mu, \quad \text{have}$$

- i) No solution ii) Unique solution iii) Many solution (06 Marks)

- b. Solve the following system of equations :

$$x - 2y + 3z = 2, \quad 3x - y + 4z = 4, \quad 2x + y - 2z = 5$$

by Gauss Elimination Method. (07 Marks)

- c. Solve the system of equations :

$$5x + 2y + z = 12, \quad x + 4y + 2z = 15, \quad x + 2y + 5z = 20$$

by Gauss – Seidel Method. Perform 3 iterations. (07 Marks)

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