

MAT-I-001
B.Sc. I Semester (NEP) Degree Examination
MATHEMATICS
Algebra - I and Calculus - I
Paper: MATDSCT - 1.1

Time : 2 Hours

Maximum Marks : 60

Instructions to Candidates:

Answer All the Sections.

SECTION - A

Answer any FIVE of the following questions.

(5×2=10)

1. a) Reduce the Matrix $\begin{pmatrix} 1 & 5 & 4 \\ 2 & 8 & 6 \\ 3 & 22 & 7 \end{pmatrix}$ to the echelon form.
- b) Find the eigen values of $\begin{pmatrix} 3 & 4 \\ 3 & 2 \end{pmatrix}$.
- c) Find the angle between radius vector and tangent for the curve $r \sec^2\left(\frac{\theta}{2}\right) = 2$.
- d) Show that $f(x) = \begin{cases} x \cdot \sin\left(\frac{1}{x}\right) & \text{at } x \neq 0 \\ 0 & \text{at } x = 0 \end{cases}$ is continuous at $x = 0$.
- e) Evaluate $\lim_{x \rightarrow 0} (\cot x - \operatorname{cosec} x)$
- f) Find the n^{th} derivative of $\cos 3x \cdot \cos 2x \cdot \cos x$.
- g) Find the double points on the curve
$$x^3 + x^2 + y^2 - x - 4y + 3 = 0.$$

SECTION - B

Answer any FOUR of the following questions.

(4×5=20)

2. Verify system

$$x + y + z = -4$$

$$x - 2y + 3z = 5$$

$$4x + 3y + 4z = 7 \quad \text{for constant and hence solve}$$

3. Show that the following curves are Orthogonal

$$r^2 \cdot \cos 2\theta = a^2 \quad \text{and} \quad r^2 \cdot \sin 2\theta = b^2$$

4. Verify Rolle's Theorem for the function

$$f(x) = \log \left(\frac{x^2 + mn}{mx + nx} \right) \text{ over } [m, n] \text{ where } 0 < m < n$$

5. Prove that every differentiable function is continuous but not conversely.

6. If $Y = \sin^{-1} \left(\frac{2x}{1+x^2} \right)$ then show that $(1+x^2)Y_{n+2} + 2(n+1)xY_{n+1} + n(n+1)Y_n = 0$.

7. Find the derivative of arc for the curve <https://www.karnatakastudy.com>
 $r = a(1 - \cos \theta)$

SECTION - C

Answer any THREE of the following questions.

(3×10=30)

8. Show that $A = \begin{pmatrix} 1 & 2 & 1 \\ -1 & 0 & 3 \\ 3 & -1 & 1 \end{pmatrix}$ satisfies the Cayley Hamilton theorem and hence find inverse.

9. Find the Centre of curvature and evolute of the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

10. a) Show that $\log(1-x) = -(x + \frac{x^2}{2} + \frac{x^3}{3} + \frac{x^4}{4} + \dots)$ using Maclaurin's expansion.
- b) Evaluate $\lim_{\theta \rightarrow \pi/2} (\sin \theta)^{\tan \theta}$
11. a) Prove that $D^n [e^{ax} \cdot \sin(bx + c)] = (a^2 + b^2)^{n/2} \cdot e^{ax} \sin[n \tan^{-1}(b/a) + (bx + c)]$
- b) Find the n^{th} derivative of $\frac{3x}{2x^2 - x - 1}$
12. Trace the curve $Y^2 = x^2 \left(\frac{3a - x}{a + x} \right)$
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