022 TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	ALL (Except B. Arch)	Pass Marks	32
Year / Part	I / I	Time	3 hrs.

Subject: - Engineering Mathematics I *(SH401)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. State Leibnitz theorem. If $\log y = \tan^{-1} x$, then show that
   $(1+x^2)y_{n+2} + (2nx + 2x - 1)y_{n+1} + (n^2 + n)y_n = 0$ [1+4]
2. State Rolle's theorem. Is the theorem true when the function is not continuous at the end points? Justify your answer. Verify Rolle's theorem for $f(x) = x^2 5x + 6$ on [2,3]. [1+2+2]
3. State L-Hospital's rule. Evaluate $\lim_{x \to 1} (2-x)^{\tan\left(\frac{\pi x}{2}\right)}$ [1+4]
4. Find the asymptotes of the curve $(x+y)^2(x+2y+2) = x + 9y - 2$ [5]
5. Find the pedal equation of the ellipse $\frac{x^2}{b^2} + \frac{y^2}{a^2} = 1$. [5]
6. Evaluate the integral $\int_{-1}^{1} \frac{1}{x^2} dx$ [5]
7. Apply the rule of differentiation under integral sign to evaluate $\int_0^\infty \frac{e^{-ax} \sin x}{x} dx$ and hence deduce that $\int_0^\infty \frac{\sin x}{x} dx = \frac{\pi}{2}$ [5]
8. Define Beta function. Apply Beta and Gamma function to evaluate $\int_0^{2a} x^5 \sqrt{2ax - x^2}\, dx$ [5]
9. Find the area common to the circle r = a and the cordioid r = a(1+cosθ) [5]
10. Through what angle should the axes be rotated to reduce the equation $3x^2 + 2xy + 3y^2 - \sqrt{2x} = 0$ into one with the xy term missing? Also obtain the transformed equation. [2+3]
11. Derive the equation of an ellipse in standard form. [5]
12. Find the product of semi-axis of the conic $x^2 - 4xy + 5y^2 = 2$ [5]

OR

Describe and sketch the graph of conic $r = \frac{12}{3 + 2\cos\theta}$

13. Solve the differentiate equation of $(x^2 - y^2)dx + 2xydy = 0$ [5]
14. Solve: $y = yp^2 + 2px$ where $p = \frac{dy}{dx}$ [5]
15. Solve $(D^2 - 6D + 9)y = x^2 e^{2x}$ [5]