


Indian Statistical Institute
MSLIS, End-semester Examination
Paper-12-ELEMENTS OF MATHEMATICS-II

Time: 3 hr

Total Marks: 70

Answer Any Seven Questions

Q1	What is meant by limit of a function. Estimate the value of the following limit. $\lim_{x \rightarrow 2} g(x) \quad \text{where, } g(x) = \begin{cases} \frac{x^2 + 4x - 12}{x^2 - 2x} & \text{if } x \neq 2 \\ 6 & \text{if } x = 2 \end{cases}$	10
Q2	Estimate the value of the following limits. $\lim_{t \rightarrow 0^+} H(t) \quad \text{and} \quad \lim_{t \rightarrow 0^-} H(t) \quad \text{where, } H(t) = \begin{cases} 0 & \text{if } t < 0 \\ 1 & \text{if } t \geq 0 \end{cases}$	10
Q3	State Rolle's theorem. Let $f(x) = \frac{1}{x^2}$. Determine if Rolle's Theorem guarantees the existence of some c in $(-1, 1)$ with $f'(c) = 0$. If not, explain why not.	10
Q4	Explore the Mean Value theorem. Determine the value of c which satisfies the conclusion of the Mean Value theorem for the following function $f(x) = x^3 + 2x^2 - x$ on $[-1, 2]$	10
Q5	Find the basic derivatives of: a. x^n b. $\log x$ c. e^x d. $\sec x$ e. $\operatorname{cosec} x$	10
Q6	Find the derivative of the following function: a. $6x^3 - 9x + 4$ b. $2x^3 + \frac{3}{x}$	10
Q7	Use product rule to derivatives of : a. $x^2 \cos x$ b. $e^x \sin x$	10
Q8	Apply quotient rule to find the derivatives of: a. $\frac{1}{ax^2 + bx + c}$ b. $\frac{2x}{3x^2 + 1}$	10
Q9	Find the integrals of basic functions a. $\int x \, dx$ b. $\int \sin x \, dx$	10

	c. $\int \operatorname{cosec}^2 x \, dx$ d. $\int \frac{1}{x} \, dx$ e. $\int a^x \, dx$	
Q10	Use Integration by substitution to compute the integral of - $\int \sin mx \, dx$	10
Q11	Find the integral of the function by using the method of "Integration by partial fractions" $\int \frac{1}{(x+1)(x+2)} \, dx$	10
Q12	Find the integral of $\int (\sin x + \cos x) \, dx$	10