

Note : Students have to attempt five questions in total, first being compulsory and selecting one from each unit. All questions carry equal marks.

1. (a) How many number of subset of a set having n elements.
- (b) Define equivalence relation ?
- (c) Evaluate $\lim_{x \rightarrow 0} \frac{\sin x}{x}$
- (d) Discuss the removable discontinuity.
- (e) Find $\frac{dy}{dx}$ for $y = \sin^{-1}(x)$.
- (f) If $\tan A = \frac{4}{3}$ then evaluate $\cos A$ and $\sin A$
- (g) Evaluate the value of $\int_0^1 \frac{dx}{1+x^2}$.

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5. (a) Test continuity of the function

$$f(x) = \begin{cases} (x-a) \sin \frac{1}{x-a} & : x \neq a \\ 0 & : x = a \end{cases}$$

- (b) Prove that

$$3 \cos^2 \frac{\pi}{4} + \sec \frac{2\pi}{3} + 5 \tan^2 \frac{\pi}{3} = \frac{29}{2}$$

Unit-III

6. Differentiate the following function with respect to x .

$$(a) y = \tan^{-1} \left(\frac{\sqrt{1+x^2}-1}{x} \right)$$

$$(b) y = \left(\frac{\sin x + e^x}{1 + \log x} \right)$$

7. Differentiate the function with respect to x .

$$(i) y = \frac{\sqrt{1+\cos x}}{\sqrt{1-\cos x}}$$

$$(ii) y = x^{\log x}$$

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Unit-I

2. (a) If $A = \{2, 4, 6, 8\}$ and $B = \{6, 8, 10, 12\}$ then find
 - (i) $A \cup B$
 - (ii) $A - B$
 - (iii) $A \cap B$
- (b) In a group of 65-people, 40 like cricket, 10 like both cricket and tennis. find :
 - (i) How many like tennis ?
 - (ii) How many like tennis only and not cricket.
3. (a) If $f: \mathbb{R} \rightarrow \mathbb{R}$ is defined as $f(x) = \frac{5x+3}{7} ; x \in \mathbb{R}$.
Prove that f is bijective function and hence find the inverse of f .
- (b) If the map $f: \mathbb{R} \rightarrow \mathbb{R}$ is given by $f(x) = \log(1+x)$ and the map $g: \mathbb{R} \rightarrow \mathbb{R}$ is given by $g(x) = e^x$ find $(g \circ f)(x)$ and $(f \circ g)(x)$.

Unit-II

4. (a) If $\tan A = \frac{1}{2}$ and $\tan B = \frac{1}{3}$, find $\tan(2A+B)$.
- (b) Show that $\lim_{x \rightarrow 0} \frac{e^{1/x}-1}{e^{1/x}+1}$ does not exist.

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Unit-IV

8. (a) Let $f(x) = x^2 - 5x + 6$, find $f(A)$, if

$$A = \begin{bmatrix} 2 & 0 & 1 \\ 2 & 1 & 3 \\ 1 & -1 & 0 \end{bmatrix}$$

- (b) Prove that $\begin{vmatrix} x+a & b & c \\ a & x+b & c \\ a & b & x+c \end{vmatrix} = x^3(a+b+c)$

9. (a) Solve the given system of linear equations by matrix method.

$$x - y + z = 1, 2x + y + z = 2, x - 2y + z = 4$$

$$(b) \text{ If } A = \begin{bmatrix} 1 & 3 & 5 \\ -1 & 3 & 7 \\ 0 & -5 & 7 \end{bmatrix} \text{ and } B = \begin{bmatrix} 2 & 4 & 6 \\ 0 & -2 & 4 \\ -6 & 8 & 8 \end{bmatrix}$$

Prove that $(AB)^T = B^T A^T$.