

**IMSc (DS) (NEP) Sem.-1 Examination
MDC-114T**

Mathematical Science Concepts-I

Time : 2-00 Hours]

February-2025

[Max. Marks : 50

Instructions: All questions are compulsory. Use of non-programmable scientific calculator is allowed.

Q.1 (a) If $A = \{1, 2\}$, $B = \{2, 3\}$, $C = \{3, 4\}$, then evaluate (i) $(A \cup B)$, (ii) $(B \cap C)$, (iii) $(C \times A)$, (iv) $(A \Delta C)$. (05)

(b) Find the sum of n terms of series $1^3 + 2^3 + 3^3 + \dots + n^3$. (05)

OR

(a) If $f(x) = \frac{1+x}{1-x}$, show that $f\{f(\tan \theta)\} = -\cot \theta$. (05)

(b) Prove that intersection of sets is commutative. (05)

Q.2 (a) Find $\lim_{x \rightarrow 0} \frac{\sin 2x}{\sin 5x}$. (05)

(b) Given the function $f(x) = \begin{cases} 5x - 3k, & x \leq 1 \\ 3x^2 + kx, & x > 1 \end{cases}$. Find the value of k for which function is continuous at $x = 1$. (05)

OR

(a) Find $\lim_{x \rightarrow 1} \frac{x^n - 1}{x - 1}$. (05)

(b) Find $\lim_{x \rightarrow 0^+} \frac{\log x}{\operatorname{cosec} x}$, using L'Hospitals rule. (05)

Q.3 (a) Monthly expenditures for a sample of 12 Gujarat University employees are provided in rupees (Rs.) as: 34500, 35500, 36500, 34800, 33550, 33100, 34900, 37300, 35400, 39250, 35200 and 34800. Compute Mean, Median and Mode for this sample of data. (05)

(b) Complete the following table and draw a pie chart of outdoor sports. (05)

Sports	Frequency	Relative Frequency	Percent Frequency
Cricket	15		
Football	20		
Volleyball	5		
Basketball	6		
Baseball	4		

OR

(a) The options of transportation have three alternatives: AMTS, BRTS, and METRO. A sample of 120 responses provides 60 AMTS, 24 BRTS, and 36 METRO. Show the frequency and relative frequency distributions. (05)

(b) Discuss types of data and their sources. (05)

- Q.4** (a) Consider an experiment of tossing three coins; find the sample space of the experiment and probability of an event that the upward face of all three coins is same. (05)
- (b) An experiment has six equally likely outcomes: A, B, C, D, E and F . (05)
- What is the probability that E occurs?
 - What is the probability that any two of the outcomes occur (e.g., A or E)?
 - What is the probability that any four of the outcomes occur (e.g., A or C or D or F)?

OR

- (a) Discuss briefly about Probability functions: pmf, pdf and cdf. (05)
- (b) *The Indian Express* publishes an annual list of the 500 startup companies in the India. (05)
The following data show the five states with the highest number of startup companies (*The Indian Express*, 2023)
Suppose a startup company is chosen randomly. What are the probabilities of the following events?
- Let D be the event the company is headquartered in Delhi. Find $P(D)$.
 - Let G be the event the company is headquartered in Gujarat. Find $P(G)$.
 - Let B be the event the company is headquartered in one of these states. Find $P(B)$.

State	Number of Companies
Delhi	54
Maharashtra	52
Gujarat	48
West Bengal	33
Uttar Pradesh	30

- Q.5** Attempt any **TEN** out of **TWELVE**: (Each carries 01 mark) (10)
- Define Finite Set and Infinite set.
 - Let $A = \{2, 4, 6, 8\}$, find the range of function $f: A \rightarrow \mathcal{R}, f(x) = x^2$.
 - Write the first five terms of sequences $a_n = 4n - 12$.
 - Give definition of continuity at a point.
 - $\lim_{x \rightarrow 0} (1 + x)^{\frac{1}{x}} = \underline{\hspace{2cm}}$.
 - When a function $f(x)$ is said to have removable discontinuity at point $x = c$?
 - Briefly discuss Representation of Data.
 - Write down the formula of Standard Deviation.
 - For some class size data, given sample mean is 30 and sample standard deviation is 6. Calculate coefficient of variation.
 - Define Random Experiment.
 - Provide multiplication law of probability.
 - Explain union of two events using Venn diagram.
