



K25U 1338

Reg. No. : .....

Name : .....

**II Semester B.Sc. Degree (C.B.C.S.S. – O.B.E. – Supplementary/  
Improvement) Examination, April 2025  
(2019 to 2023 Admissions)  
COMPLEMENTARY ELECTIVE COURSE IN STATISTICS/COMPUTER  
SCIENCE WITH AI AND ML  
2C02STA : Probability Theory and Random Variables**

Time : 3 Hours

Max. Marks : 40

**Instruction : Use of calculators and statistical tables are permitted.****PART – A****Short Answer.** Answer all 6 questions.**(6×1=6)**

1. Define random experiment.
2. State addition theorem on 2 events.
3. For any two arbitrary events A and B with  $P(A/B) = 0.4$ , find  $P(A^c/B)$ .
4. Find  $P(A \cap B)$  if the two events A and B are mutually exclusive.
5. Define mutual independence.
6. Define continuous random variable.

**PART – B****Short Essay.** Answer any 6 questions.**(6×2=12)**

7. Define sample space and write the sample space for the random experiment of throwing two fair six sided dice.
8. Let A and B be two events associated with an experiment and suppose  $P(A) = 0.5$  while  $P(A \text{ or } B) = 0.8$ . Let  $P(B) = p$ . For what value of p are A and B mutually exclusive ?

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9. In a class of 30 students, 20 students play basketball, 15 students play football and 10 students play both basketball and football. If a student is chosen at random from the class, what is the probability that the student plays football given that the student plays basketball ?
10. Prove that  $A^c$  and  $B^c$  are independent if A and B are independent.
11. Define distribution function of a random variable.
12. Given the probability density function of X as  $f(x) = 2e^{-x}$ ,  $x > 0$ . Find the density of  $Y = 2X - 5$ .
13. Find c such that the following is a probability density function of a random variable X

$$f(x) = \begin{cases} cx^2 + \frac{4}{9}x, & 1 < x < 2 \\ 0, & \text{otherwise} \end{cases}$$

14. What are the properties of joint probability mass function of (X, Y) ?

**PART – C****Essay.** Answer any 4 questions.**(4×3=12)**

15. Given two events A and B where  $P(A) = 0.3$  and  $P(B) = 0.5$ . Use Boole's inequality to find the upper bound for  $P(A \cup B)$  and  $P(A \cap B)$ .
16. Explain the frequency definition of probability and give an example.
17. A box contains 6 red and 4 blue balls. 2 balls are drawn at random. Calculate the probabilities of choosing :
  - i) 2 red balls
  - ii) 2 blue balls
  - iii) 1 red ball and 1 blue ball.
18. State and prove multiplication theorem on probability for any two events A and B.



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19. A continuous random variable X has the probability density function  $f(x) = a + bx$ ,  $0 \leq x \leq 1$ . If the mean of the distribution is  $\frac{1}{2}$ , find a and b.
20. The joint probability distribution of two random variables X and Y is given by,
 
$$P(X = 0, Y = 1) = \frac{1}{3}, P(X = 1, Y = -1) = \frac{1}{3}, P(X = 1, Y = 1) = \frac{1}{3}.$$
  - i) Find marginal distributions of X and Y.
  - ii) Find the conditional probability distribution of X given  $Y = 1$ .

**PART – D****Long Essay.** Answer any 2 questions.**(2×5=10)**

21.
  - i) Describe axiomatic definition of probability explaining the terms sigma field and probability space.
  - ii) Prove that  $P(\phi) = 0$ .
22.
  - i) State and prove theorem on total probability.
  - ii) A purse contains 2 silver coins and 4 copper coins and a second purse contains 4 silver coins and 3 copper coins. If a coin is selected at random from one of the purse. What is the probability that it is a silver coin ?
23. The diameter, say X, of an electric cable, is assumed to be a continuous random variable with probability density function  $f(x) = 6x(1 - x)$ ,  $0 \leq x \leq 1$ 
  - i) Obtain the distribution function of X.
  - ii) Compute  $P\left(X \leq \frac{1}{2} / \frac{1}{3} \leq X \leq \frac{2}{3}\right)$ .
  - iii) Determine the number k such that  $P(X < k) = P(X > k)$ .
24. Given the joint probability density function of two random variables X and Y as ;
 
$$f(x) = \begin{cases} c(2x + y), & 2 < x < 6, \quad 0 < y < 5 \\ 0, & \text{otherwise} \end{cases}$$
 Find :
  - i) c
  - ii)  $P(3 < X < 4, Y > 2)$
  - iii)  $f_{X/Y}(x/y)$ .