(Time: 3 Hours) (Total Marks: 100)

N.B. 1. All questions are compulsory.

2. Attempt any two sub-questions from three sub-questions from Q.2, Q.3, Q.4, Q.5

3. Figures to the right indicate full marks.

4. Use of non-programmable calculator is allowed.

Q.1 a. **Attempt ANY FIVE sub-questions:** (20)

i. A and A^c form partition of S. State true or false. Give reason.

ii. $P(A/B) \geq P(B)$. State true or false. Give reason.

iii. If a random variable x has a Uniform distribution with, range 1 to n, then its variance is -----

iv. The number of parameters involved in binomial p.d.f is/are…. State the parameter/s.

v. For a Poisson distribution Mean = 5 and Variance = 8. State true or false. Give reason.

vi What is the median of a distribution in terms of Cumulative distribution function?

vii In hypergeometric distribution units are selected with replacement.. State true or false. Give reason.

b. **Answer the following in one/ two sentences: (Any Five)** (10)

i. If X is a discrete random variable then define Quartiles.

ii. Define a Bernoulli experiment.

iii. State mean of a hypergeometric distribution..

iv. If $P(A) = 1/12$, $P(B) = 1/3$ and $P(A \cap B) = 1/52$, find $P(A/B)$ and $P(B/A)$.

v. Give any 2 examples of a random variable which follows uniform distribution.

vi When are two events mutually exclusive as well as independent?

vii $Cov(X, Y) = 0$ implies that X and Y are two independent random variables. State true or false and give reason.

Q.2 **Attempt any TWO sub-questions:** (20)

a. i. Suppose A and B are independent events, defined on a sample space S, then prove that (05)

- A and B^c are independent

- A^c and B are independent

ii. The odds that A speaks truth are 6:2 and odds that B speaks truth are 7:4. In what percentage of cases are A and B likely to contradict each other on an identical point? (05)

b. i. State and Prove Multiplication theorem of probability for two events A and B. (05)

ii. A bag contains 12 white and 18 black balls. Two balls are drawn in succession without replacement. What is the probability that first is white and the second is black? (05)

	c	Widgets are manufactured in three factories A,B and C. The proportion of defective widgets from each factory are as follows. Factory A : 0.01 Factory B : 0.04 Factory C : 0.02 Factories A, B produce 30% of the widgets apiece, and the remaining 40% come from factory C. Imagine that an upset customer returns a defective widget to your company. As the manager finds out the probabilities that defective widget had come from 3 factories, which factory is liable for penalty?	(10)

Q.3		**Attempt any TWO sub-questions:**	**(20)**
a.	i.	Given Joint probability mass function of two discrete random variables, how does one examine whether they are independently distributed?	(03)
	ii.	A box contains 3 red marbles and 5 green marbles. Two marbles are taken at random without replacement. Let X be the number of green marbles obtained. Obtain the probability distribution of X and state the cumulative distribution function of X.	(07)
b.	i.	State and prove addition theorem of expectation for two random variables.	(04)
	ii.	Find the value of k if a random variable X has the following probability distribution:	(06)

X	-2	-1	0	1	2	3
P(x)	0.1	K	0.2	2k	0.3	k

Hence obtain
- P(X<1)
- P(X≥0)
- P(-1<X≤2)
- P(-1≤X≤1)

c.		A discrete random variable X has the following probability distribution	(10)

X	1	2	3	4
P(x)	0.4	0.3	0.2	0.1

Obtain the first 3 raw moments. Hence find first three central moments.
Also find mean, variance and coefficient of skewness.

Q.4		**Attempt any TWO sub-questions:**	**(20)**
a.	i.	Define a random variable X having discrete Uniform distribution. Derive its mean and variance.	07
	ii.	The mean and the variance of a binomial variate with parameters n and p are 2.4 and 1.44 respectively. Find P(X=0)	(03)
b.		If x is a Poisson variate with parameter "m", write probability distribution of X. Derive mean and variance of X.	(10)

   c.   i.   Derive recurrence relation for probabilities of binomial distribution with   (05)
            parameters n and p.

        ii.   A jar contains 25 pieces of candy of which 11 are yoghurt covered nuts   (05)
            and the rest are yoghurt covered raisins. Let X be the number of candies
            with nuts in a random sample of 7 pieces of candy selected without
            replacement. Compute $P(X>5)$

Q.5   **Attempt any TWO sub-questions:**   **(20)**

   a.   i.   Define Cumulative distribution function of a discrete random variable.   (05)
            Also state its properties.

        ii.   Five boys and 2 girls are to be seated in a row. Find the probability that   (05)
             •   Girls are together
             •   Girls are not together

   b.   The joint p.m.f of random variables X and Y is as given below: (10)

X\Y	1	2
1	0.1	0.2
2	0.2	0.1
3	0.3	0.1

Find correlation coefficient between X and Y

   c.   i   Give three applications of Poisson distribution   (03)

        ii   It is stated that 2% of optical lenses supplied by a manufacturer are   (07)
           defective. What is the probability that in a random sample of 200 lenses
             •   3 or more are defective
             •   At least two are defective
             •   At most two are defective
        (Given $e^{-4}= 0.001832$, $e^{-0.4}= 0.6703$)