Code No: R21052 **R10** SET - 1

II B. Tech I Semester Supplementary Examinations, September - 2014
PROBABILITY AND STATISTICS
(Com. to CSE, IT)

Time: 3 hours Max. Marks: 75

Answer any FIVE Questions
All Questions carry Equal Marks
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1. a) State the axioms of probability. State and prove the addition theorem of probability.
   b) Companies B_1, B_2 and B_3 produce 30%, 45% and 25% of the cars respectively. It is known that 2%, 3% and 2% of these cars produced from B_1, B_2 and B_3 are defective. i) What is the probability that a car purchased is defective? ii) If a car purchased is found to be defective, what is the probability that this car is produced by the company B_1?

2. a) Suppose that the life in hours X of a certain kind of TV tubes has the probability density function

$$f(x)=\begin{cases}\dfrac{100}{x^2}, & when\ x\geq 100,\\ 0, & when\ x<100,\end{cases}$$

   Find the distribution function of X. What is the probability that none of three such tubes will have to be replaced during the first 150 hours of operation?

   b) Given $f(x)=\begin{cases}kx(1-x), & for\ \ 0<x<1,\\ 0, & elsewhere\end{cases}$

   Find the constant k. Also find the mean and variance of X.

3. a) Obtain the moment generating function of the binomial distribution. Derive from it the result that the sum of two binomial variates is a binomial variate if the variates are independent and have the same probability of success.
   b) The marks obtained in an examination are found to be normally distributed. If 15% of the students get more than 60 marks and 40% of the students get less than 30 marks, find the mean and standard deviation of the marks.

4. a) A random sample of size 100 is taken from an infinite population having the mean μ =76 and variance σ^2 = 256. What is the probability that $\bar{x}$ will be between 75 and 80?
   b) A population consists of six numbers 2, 4, 6, 8, 10 and 12. Consider all possible samples of size 2 which can be drawn from this population. Find: i) the population mean ii) the population standard deviation iii) the mean if the sampling distribution of means iv) the standard deviation
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5. a) Explain the terms: i) sampling distribution ii) standard error iii) type-I and type-II errors.
   b) In a random sample of 160 workers exposed to a certain amount of radiation, 30 workers are severely affected. Construct a 99% confidence interval for the corresponding true percentage.

6. a) Two independent samples of sizes 8 and 7 items respectively had the following values.

Sample I	11	11	13	11	15	9	12	14
Sample II	9	11	10	13	9	8	10	--

   Is the difference between the means of the sample significant? Test at 5% LOS.
   b) The number of automobile accidents per week at a certain junction is as follows: 12, 8, 20, 2, 14, 10, 15, 6, 9, 4. Are these frequencies in agreement with the belief that accidents conditions are same during this 10 week period?

7. a) The lines of regression in a bivariate distribution are X + 9Y = 7 and Y + 4X = 49/3. Find:
   i) Mean of X and Y. ii) Coefficient of correlation.
   b) Construct a suitable control chart for the following data and draw your conclusions.

Each sample of 30 articles	1	2	3	4	5	6	7	8
No. of defectives	2	4	7	8	10	6	9	6

8. a) Derive the steady state equations of an M/M/1 queuing model.
   b) Customers arrive at the ration stop in Poisson fashion with an average of a customer every 10 minutes. If the service time is 5 minutes, then find: i) the average number of customers in the system. ii) Average waiting time iii) average length of waiting line.

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1. a) Explain the terms: i) distribution function ii) probability density function iii) conditional probability.
   b) Three urns are given each containing identical red and white balls as indicated: Urn I: 4 red and 3 white; Urn II : 2 red and 5 white; Urn III : 1 red and 6 white. An urn is chosen at random and two balls are drawn at random without replacement from this urn. If both balls are red, what is the probability that urn I was chosen.

2. a) Given the probability function of X.

X	0	1	2	3
p(X)	0.1	0.3	0.5	0.1

   Find: i) the probability function of Y. ii) The mean and variance of Y, if Y=2X.
   b) A random variable has the density function

$$f(x) = \begin{cases} K\dfrac{1}{1+x^2}, & if\ -\infty < x < \infty \\ 0, & elsewhere \end{cases}$$

   Determine K and the mean of the distribution.

3. a) Find the moment generating function of Poisson distribution. Hence find its mean and variance and show that they are equal.
   b) In a test on 2000 electric bulbs, it was found that the life of a particular make was normally distributed with an average life of 2040 hours and standard deviation of 40 hours. Estimate the number of bulbs likely to burn for i) more than 2140 hours and ii) between 1920 and 2080 hours.

4. a) If the population is 3, 6, 9, 15, 27, then i) list all possible samples of size 3 that can be taken without replacement from the finite population ii) calculate the mean of each of the sampling distribution of means. iii) Find the standard deviation of sampling distribution of means.
   b) A random sample of size 16 taken from a normal population showed a mean of 41.5 inches and the sum of the squares of the deviations from the mean is 135 sq. inches. Find the maximum error with 95% confidence.
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5. a) Explain the terms: i) parameter ii) Critical region iii) one tail and two tail tests.
   b) An ambulance service claims that it takes on the average 8.9 minutes to reach its destination in emergency calls. To check this claim, the agency which licenses ambulance services has them timed out on 50 emergency calls, getting a mean of 9.3 minutes with a standard deviation of 1.6 minutes. What can they conclude at the level of significance 0.05?

6. Two researchers adopted different sampling techniques while investigating the same group of students to find the number of students falling under different intelligence levels. From the results given as follows, would you say that the sampling techniques adopted by the 2 researchers are independent of the number of students in each level?

Researcher	Number of students in each level				Total
	Below average	Average	Above average	Genius	
X	86	60	44	10	200
Y	40	33	25	2	100
Total	126	93	69	12	300

7. a) Obtain the lines of regression from the following data and estimate the value of y when $x = 12$.

x	2	4	5	7	8	13	16
y	2.4	5.6	5.8	8.9	9.0	17.0	21.2

   b) Write a short note on R – chart and attributes chart.

8. a) Explain M/M/1 queuing model.
   b) A person repairing transistors finds that the time spent on a set has an exponential distribution with mean 20 minutes. If the transistors are repaired in the order in which they arrive and their arrival is approximately Poisson with an average rate of 15 per 8-hour day.
      i) What is the repairman's expected idle time each day?
      ii) How many transistor sets are ahead of the average set just brought in?

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1. a) Explain conditional probability and stochastic independence of two events.
   b) State Baye's theorem. The probabilities of A, B, C to become Directors of a factory are $\frac{5}{10}, \frac{3}{10}, \frac{2}{10}$ respectively. The probabilities that the Bonus schemes will be introduced if they become Directors are 0.02, 0.03, and 0.04. Determine the probability that A, B, C to become Directors if the Bonus Scheme is introduced.

2. a) A random variable X has the following probability function:

X	-2	-1	0	1	2	3
p(X)	0.1	k	0.2	$2k$	0.3	k

   i) Find the value of k. ii) Calculate the mean and variance.
   b) The diameter of an electric cable X is a continuous random variable with probability function $f(x) = \begin{cases} 1-(1+x)e^{-x}, & for\ x \geq 0; \\ 0, & otherwise \end{cases}$
   Check that the above is a pdf and find the expectation of X.

3. a) Obtain the moment generating function of the binomial distribution. Derive from it the result that the sum of two binomial variates is a binomial variate if the variates are independent and have the same probability of success.
   b) In a distribution exactly normal, 7% of the items are under 35 and 80% are under 63. What are the mean and the standard deviation of the distribution?

4. a) A random sample of size 64 is taken from a population with standard deviation 5.1. Given that the sample mean is 21.6, construct a 99% confidence interval for the population mean μ
   b) If the mean breaking strength of copper wire is 575 lbs. with a standard deviation of 8.3 lbs. How large a sample must be used in order that there will be one chance in 100 that the mean breaking strength of the sample is less than 572 lbs.

5. a) Write about: i) point estimation and interval estimation.
   ii) Type-I and Type-II errors iii) Standard error
   b) A die is thrown 256 times. An even digit turns up 156 times. Can we say that the die is unbiased.
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6. a) Out of 9 persons suffering from a disease, 5 people were treated with a new drug, while the remaining were not treated. The following is survival times:

Treated	2.1	5.3	1.4	4.6	0.9
Not treated	1.9	0.5	2.8	3.1	1.8

Test whether the new drug treatment is effective in curing the diseases at 0.05 level of significance.

b) The following table gives the crop yield (in thousands of tons) in four districts of a state. Using ANOVA, test whether the mean yield of the crop is equal in the four districts at 5% level of significance.

A	B	C	D
12	13	23	15
23	23	13	18
16	12	15	23
20	12	9	12

7. a) The following results were obtained in the analysis of data on the yield of dry bark in ounces (Y) and age in years (X) of 200 cinchona plants:

	X	Y
Average	9.2	16.5
Standard Deviation	2.1	4.2

Correlation Coefficient is +0.84. Construct the two lines of regression and estimate the yield of dry bark of a plant of age 8 years.

b) Explain the construction and function of $\overline{X}$ chart.

8. A departmental store has a single cashier. During the rush hours, customers arrive at the rate of 20 customers per hour. The average number of customers that can be processed by the cashier is 24 per hour. Assuming the conditions for the use of single-channel queuing model, determine: i) Probability that the cashier is idle? ii) Average number of customers in the queuing system? iii) Average time a customer spends in the queue waiting for service?

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SET - 4

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1. a) State and prove the addition theorem of probability.
   b) State Baye's theorem. Three urns are given each containing identical red and white balls as indicated: Urn I : 4 red and 3 white; Urn II : 3 red and 6 white; Urn III : 1 red and 8 white. An urn is chosen at random and two balls are drawn at random without replacement from this urn. If both balls are red, what was the probability that urn I was chosen.

2. a) From a lot of 10 items containing 3 defectives, a sample of 4 items is drawn at random without replacement. Let the random variable X denote the number of defectives in the sample. Find: i) the probability distribution of X. ii) $P(X \le 1)$.
   b) The diameter of an electric cable X is a continuous random variable with probability function $f(x) = \begin{cases} 1-(1+x)e^{-x}, & for\ x \ge 0; \\ 0, & otherwise \end{cases}$
   Check that the above is a pdf and find the expectation of X.

3. a) Find the moment generating function of Poisson random variate. Prove that the sum of two independent Poisson random variates is also a Poisson variate.
   b) Let the random variable X is normally distributed with mean 8 and standard deviation 4. Find: i) $P(5 \le x \le 10)$ and ii) $P(X \ge 15)$

4. a) Find the confidence limits for the mean of a normally distributed population from which the following sample was taken: 5, 7, 14, 13, 23, 12, 18, 9, 15, 20.
   b) The mean of a certain normal population is equal to the standard error of the mean of the samples of 64 from that distribution. Find the probability that the mean of the sample size 36 will be negative.

5. a) Explain: i) Type-I and Type-II errors. ii) One tailed and Two tailed tests. iii) Level of significance.
   b) A manufacturer claimed that at least 95% of the equipment which he supplied to a factory conformed to specifications. An examination of a sample 200 pieces of equipment revealed that 185 were faulty. Test his claim at a significance level of 0.05.
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Code No: R21052 **R10** SET - 4

6. a) Explain X^2 - test for independence of attributes.
   b) A company wishes to test whether its three salesmen A, B and C tend to make sales of same size or whether they differ in selling ability as measured by the average size of their sales. During the last week, out of 14 sales, A made 5, B made 4 and C made 5 calls. The following are the weekly sales record (in Rs. thousand) of the three salesmen.

A	4	6	5	9	10
B	6	3	3	4	-
C	7	9	5	6	5

   Perform ANOVA to test whether the three salesmen's average sales differ in size.

7. a) Explain different types of control charts with illustrations.
   b) Fit a regression line of Y on X and predict Y if X = 10.

X:	- 1	5	3	2	1	1	7	3
Y:	- 6	1	0	0	1	2	1	5

8. a) Explain the characteristic features of an M/M/1 queue.
   b) A person repairing transistors finds that the time spent on a set has an exponential distribution with mean 20 minutes. If the transistors are repaired in the order in which they arrive and their arrival is approximately Poisson with an average rate of 15 per 8-hour day. What is the repairman's expected idle time each day? How many transistor sets are ahead of the average set just brought in?