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

II B. Tech I Semester Supplementary Examinations, Jan - 2015
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) i) List the axioms of probability.
   ii) State and prove addition theorem on probability.
   b) If A and B are two events and the probability P (B) $\neq$ 1, prove that
   $P(A/B^1) = \frac{[P(A) - P(A \cap B)]}{[1 - P(B)]}$ and hence deduce that P (A∩B) ≥ P (A) +P(B) - 1.

2. a) What are continuous and discrete random variables? Give examples to each.
   b) Let two dice be thrown at random. Let X be the discrete random variable that assigns to each point (a,b) the maximum of its numbers i.e X(a,b)= max (a,b) then find distribution.

3. a) Determine the mean and variance of normal distribution.
   b) A continuous random variable X has the probability density function
   $$f(x) = \begin{cases} kx^2 e^x & x > 0 \\ 0, & otherwise \end{cases}$$
   where 'k' is a constant. Find the moment about origin and hence find mean and variance of X.

4. a) Assume that the heights of 3000 male students at a college are normally distributed with mean 68 in. and Standard Deviation 3 in. If 80 samples consisting of 25 students each are obtained. What would be the expected mean and SD of the resulting Standard Deviation mean if the sampling is done: i) with replacement and ii) without replacement.
   b) A random sample of size 100 is taken from a population with σ = 5. Given that the sample mean is $\bar{x}$ = 21.6, construct a 95% confidence interval for the population mean μ.

5. a) List the steps involved in the procedure of testing a hypothesis.
   b) In a referendum submitted to the students body at a university, 850 men and 566 women voted. 530 of the men and 304 of the women noted yes. Does this indicate a significant difference of opinion on the matter at 1% level, between men and women students?
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6. a) Two batteries are tested for their length in life and the following data are obtained:

	No. of sample	Mean life in hours	Variance
Type A	9	600	121
Type B	8	640	144

Is there a significant difference in two means? Value of A for 15 degrees of freedom at 5% level is 2.131.

b) Explain AIVOVA for one-way classified data.

7. a) Classify control charts.

b) A machine is set to deliver packets of a given weight. Ten samples of size 5 each were recorder. Below are given data.

Sample No.	1	2	3	4	5	6	7	8	9	10
Range	7	7	4	9	8	7	12	4	11	5

Draw the R-chart and comment on its state of control.

8. a) Describe the basic elements of queuing system.

b) Establish the probability distribution formula for pure death process.

Code No: R21052

R10

SET - 2

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1. a) State and prove Bayes' theorem.
   b) From a regular deck of 52 cards one card is selected at random. Defining event A as "select a king" B as select a "jack or queen" and C as "select a heart". Verify if A, B and C events are independent.

2. a) If x is a continuous random variable with probability density function given by

$$f(x) = \begin{cases} kx, & when\ 0 < x < 2 \\ 2k, & when\ 2 < x < 4 \\ k(6-x), & when\ 4 < x < 6 \\ 0, & otherwise \end{cases}$$

   Find the value of k and also find the cumulative distribution function F(x). Also verify $F^1(x) = f(x)$.
   b) List the properties of probability distribution function.

3. a) In a factory manufacturing razer blades, there is a small chance of $\frac{1}{50}$ for any blade to be defective. The blades are placed in packets of 10 blades. Using Poisson distribution, calculate the approximate number of packets containing not more than 2 defective blades in a consignment of 10,000 packets.
   b) Determine mode and median of normal distribution.

4. A population consists of four numbers 3, 4, 5 and 6. Consider all possible distinct samples of size 2 with replacement. Find i) population mean ii) Population SD iii) Standard Deviation of Means (SDM) iv) mean of SDM (v) SD of SDM. Verify (iii) and (v) directly from (i) and (ii) by using appropriate formula.

5. a) Explain null hypothesis and alternative hypothesis.
   b) Test the significance of the difference between the means of the sample from the following Data.

	Size of sample	Mean	S.D
Sample A	100	61	4
Sample B	200	63	6
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Code No: R21052 **R10** SET - 2

6. a) List the properties of χ^2 - distribution.
   b) The yield of 10 machines before and after services is as follows:

Machine	1	2	3	4	5	6	7	8	9	10
Before service	15	17	12	18	16	13	15	17	19	18
After service	20	19	18	22	20	19	21	22	24	24

   Apply t-test to determine whether servicing of machines had any effect on their yield.

   Given for $\gamma = 9, t_{0.05} = 2.26$

7. a) List down the advantages of statistical control over 100% inspection process.
   b) Calculate the sample correlation coefficient ρ using the data:

x	11.1	10.3	12.0	15.1	13.7	18.5	17.3	14.2	14.8	15.3
y	10.9	14.2	13.8	21.5	13.2	21.1	16.4	19.3	17.4	19.0

8. Explain (M/M/1): (FCFS) Queuing model. Derive and solve the difference equation in steady state of the model.

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1. a) If A and B are two events and the probability $P(B) \neq 1$, prove that
$$P(A/B^1) = \frac{[P(A) - P(A \cap B)]}{[1 - P(B)]}$$
b) In a certain group of computer personnel, 65% have insufficient knowledge of hardware, 45% have inadequate idea of software and 70% are in either one or both of the two categories. What is the percentage of people who know software among those who have a sufficient knowledge of hardware?

2. a) If the probability density of a random variable is given by $f(x) = \begin{cases} k(1-x^2) & for\ 0 < x < 1 \\ 0 & elsewhere \end{cases}$.
Find the value of k and the probabilities that a random variable will take on a value:
i) Between 0.1 and 0.2. ii) Greater than 0.5.
b) Suppose that the life in hours of a certain bulb is a continuous random variable with density function. $f(x)\begin{cases} = \frac{100}{x^2}, x \geq 100 \\ = 0 \quad \text{otherwise} \end{cases}$
What is the probability that the bulb will last less than 200 hours if it is known that it was still functioning after 150 hours?

3. a) Determine the mean and variance of a normal distribution.
b) List the properties of moment generating function.

4. If a population consists of observations 3, 6,9,15,27 then:
i) List all the possible samples of size 3 that can be taken without replacement from the finite population.
ii) Calculate the mean of the sampling distribution of means, and show that it is an unbiased estimate of the population mean.
iii) Calculate the standard deviation of the sampling distribution of means.
iv) Show that sample standard deviation is a biased estimator of population standard deviation.
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Code No: R21052 **R10** SET - 3

5. a) Differentiate two-tailed tests of hypothesis from one-tailed tests.
   b) In a sample of 1000 citizens of India, 540 are wheat eaters and the rest are rice eaters. Can we assume that both rice and wheat are equally popular in India at 1% level of significance?

6. a) What are the important properties of t-distribution?
   b) In an experiment on immunization of cattle from tuberculosis is the following results were obtained:

	Affected	Not affected
Inoculated	12	26
Not Inoculated	16	6

   Calculate χ^2 and discuss the effect of vaccine in controlling susceptibility to tuberculosis. (Given that for $\gamma = 1$, $X^2{}_{0.05} = 3.84$)

7. a) What is the significance of control charts for attributes? What are its two types?
   b) If the average fraction defective of a large sample of products is 0.1537, calculate the control limits.

8. For the (M/M/1) queuing system, find:
   a) expected value of queue length n
   b) Probability distribution of waiting time ω.

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1. a) Two students A and B work independently on a problem. The probability that the first one will solve it is $\frac{3}{4}$ and the probability that second one will solve it is $\frac{2}{3}$. What is the probability that the problem will be solved?
   b) Box 1 contains 1 white and 999 red balls. Box 2 contains 1 red and 999 white balls. A ball is picked from a randomly selected box. If the ball is red, what is the probability that it came from box 1.

2. a) Let a pair of dice be thrown. If X is the sum of the numbers that appears on the two dice. Find the mean of X.
   b) Let X be a continuous random variable assuming any value x in $[0, \pi/2]$
   i) Verify if $f(x) = \cos x$ in $[0, \pi/2]$ is suitable for a pdf.
   ii) Find the probability that $x \in [0, \pi/4]$.

3. a) List the properties of normal distribution.
   b) Obtain the moment generating function of the random variable x having probability density function $f(x) = \begin{cases} x, & 0 \le x < 1 \\ 2-x, & 1 \le x < 2 \\ 0, & elsewhere \end{cases}$

4. a) A normal distribution has mean 0.5 and standard deviation 2.5. find:
   i) the probability that the mean of a random sample of size 16 from the population is positive.
   ii) The probability that the mean of a sample of size 90 from the population will be negative.
   b) Show that S^2 is an unbiased estimator of the parameter σ^2.

5. a) Explain type I and type II errors in testing of hypothesis.
   b) Examine whether the differences between: i) means and ii) standard deviations are significant.

Sample	Size	Mean	S.D
I	100	582	24
II	100	546	28
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Code No: R21052 **R10** SET - 4

6. a) Write a note on student's t-distribution.
   b) Two samples are drawn from two normal populations. From the following data, test whether the two samples have the same variance at 5% level.

Sample 1	60	65	71	74	76	82	85	87		
Sample 2	61	66	67	85	78	63	85	86	88	91

7. a) How P-chart is constructed?
   b) The table below gives the measurements obtained in 20 samples. Construct $\bar{x}$ and R charts.

$\bar{x}$	6	8	6	4	-2	0	-6	-6	4	0	2	4	2	0	1.0	0	4	8	6	4
R	3	1	1	3	2	4	3	3	3	4	5	3	5	2	3	4	3	2	3	6

8. Explain (M/M/1) queue model. Derive steady state difference equations and their solutions.