R13

SET - 1

II B. Tech II Semester Regular Examinations, April/May – 2016
PROBABILITY AND STATISTICS
(Com. to CSE, IT, CHEM, PE, PCE)

Time: 3 hours   Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
2. Answer **ALL** the question in **Part-A**
3. Answer any **THREE** Questions from **Part-B**
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PART –A

1. a) Let the phase error in a tracking device have probability density   (3M)
$F(x) = \begin{cases} \cos x & 0 < x < \frac{\pi}{2} \\ 0 & elsewhere \end{cases}$ find the probability that the error is between $0 \ and \ \frac{\pi}{4}$

   b) A random variable X has the discrete uniform distribution   (3M)
$f(x, K) = \{\frac{1}{K}, \quad x = 1,2,3 \dots \dots K$ find the moment generating function of X

   c) A comparison of coffee prices at 4 randomly selected stores in San Diego showed   (4M)
increases from the previous month of 12,15,17 and 20 cents for a one kilo bag.
Find the variance of this sample of price increases.

   d) Suppose that an allergist wishes to test the hypothesis that atleast 30% of the   (4M)
public is allergic to some cheese products. Explain how the allergist could commit
i) A type 1 error ii) A type 2 error

   e) If n=50,$\Sigma X = 75, \Sigma Y = 80, \Sigma X^2 = 130, \Sigma Y^2 = 140, \Sigma XY = 120$, find the value   (4M)
of the correlation coefficient r.

   f) Under what situations is a c-chart useful?   (4M)

PART -B

2. a) Of a large group of men, 5% are under 60 inches in height and 40% are between   (8M)
60 and 65 inches. Assuming normal distribution, find the mean and standard
deviation.

   b) Assume that 4 % of the population over 65 years has Alzheimer's disease.   (8M)
Suppose a random sample of 9600 over 65 is taken. Find the probability p that
lower than 400 of them have the disease.

3. a) Find the moment generating function of the exponential distribution   (8M)
$f(x) = \frac{1}{c} e^{-\frac{x}{c}}$ $0 \le x \le \infty, \ c > 0$.Hence find its mean and standard
deviation.

   b) A lot containing 7 components is sampled by a quality inspector; the lot contains   (8M)
4 good components and 3 defective components. A sample of 3 is taken by the
inspector. Find the expected value of the number of good components in this
sample.

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4. a) If X is a binomial random variable, show that   (8M)
$\hat{P} = \frac{X}{n}$ is an unbiased estimator of p

   b) A random sample of size n_1=25 , taken from a normal population with a standard   (8M)
deviation $\sigma_1 = 5$, has a mean of $\overline{x_1}$ =80. A second random sample of size n_2=36 ,
taken from a different normal population with a standard deviation $\sigma_2 = 3$, has a
mean of $\overline{x_2} = 75$. Find a 95% confidence interval for the difference of the actual
population means $\mu_1 - \mu_2$.

5. a) A manufacturer claims that the mean breaking strength of a cable is 8 kgs, with a   (8M)
standard deviation of 0.5 kg.Test the hypothesis that the mean $\mu = 8$ kgs against
$\mu \neq 8$ if a random sample of 50 cables is tested and found to have a mean
breaking strength of 7.8 kgs. Use a 0.01 level of significance.

   b) A manufacturer of a medicine claimed that it was 90% effective in relieving an   (8M)
allergy in 8 hours. In a sample of 200 people who had the allergy, the medicine
provided relief for 160 people. Determine whether the manufacturer's claim is
legitimate at a 0.01 level of significance.

6. a) Fit a second degree parabola to the following data using the method of least   (8M)
squares.

x	0	1	2	3	4
y	1	1.8	1.3	2.5	6.3

   b) Obtain the line of regression of Y on X and estimate Y when X =55 from the   (8M)
following data

X	40	50	38	60	65	50	35
Y	38	60	55	70	60	48	30

7. a) 35 successive samples of 100 castings each , taken from a production line,   (8M)
contained respectively, 3, 3, 5, 3, 5, 0, 3, 2, 3,5,6,5, 9,1,2,4, 5,2,0,10,3, 6,3,2,5, 6,
3,3,2,5,1,0,7,4 and 3 defectives. If the fraction defective is to be maintained at
0.02, construct a p-chart for this data.

   b) The specification limits on a valve diameter (mm)are LSL (lower specification   (8M)
limit)=10.98,and USL (upper specification limit)=11.01.Measurements on 80
valves gave $\bar{x} = 10.991 \ and \ s = 0.0035$ .Estimate the process capability index
C_p.

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PART –A

1. a) The mean of a Binomial distribution is 3 and variance is 9/4 find the probabilities (3M)
   $P(X \geq 7), P(1 \leq X < 6)$
   b) If a Poisson variate X is such that P(x=1)=2P(x=2) find the mean and variance of (4M)
   X
   c) An electrical firm manufactures light bulbs whose length of life is approximately (3M)
   normally distributed, with mean 800 hours and standard deviation 40 hours. Find
   the probability that a random sample of 16 bulbs will have an average life of less
   than 775 hours.
   d) A sociologist is concerned about the effectiveness of a training course designed to (4M)
   get more drivers to use seat belts in cars.
   i) What hypothesis is he testing if he commits a type one error
   ii) What hypothesis is he testing if he commits a type two error
   e) Calculate the correlation coefficient between X and Y series from the following (4M)
   data:

	X series	Y series
No. of items	15	15
Arithmetic Mean	25	18
Sum of squares of deviations from the mean	136	138

   Sum of the product of deviations of X and Y from their respective means =122
   f) What are change variation and assignable variation? (4M)

PART -B

2. a) In a lottery there are 200 prizes of Rs.5, 20 prizes of Rs.25, and 5 prizes of (8M)
   Rs.100.Assumingthat 10,000 tickets are to be issued and sold, what is a fair price
   to pay for a ticket?
   b) In a certain city the daily consumption of water (in millions of litres) which (8M)
   follows a Gamma distribution with $\lambda = 2 \ and \ a = \frac{1}{3}$ of the daily capacity of that
   city is 9 million litres of water, what is the probability that on any given day the
   water supply is inadequate?

3. a) The probability distribution of a discrete random variable X is (8M)
   $f(x) = \binom{3}{x}\left(\frac{1}{4}\right)^{x}\left(\frac{3}{4}\right)^{3-x}, x = 1,2,3.$ Find the mean of X.
   b) Derive the moment generating function of the Poisson distribution. (8M)

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4. a) Travelling between two campuses of a university in a city via buses takes, on   (8M)
average 28 minutes with a standard deviation of 5 minutes. In a given week a bus
transported passengers 40 times. What is the probability that the average transport
time is more than 30 minutes?(Assume that the mean is measured to the nearest
minute.)

   b) A machine produces metal pieces that are cylindrical in shape. A sample of pieces   (8M)
is taken and the diameters are found to be 1.01, 0.97,1.03,1.04, 0.99, 0.98, 0.99,
1.01 and 1.03 cm. Find a 99% confidence interval for the mean diameter of pieces
from the machine, assuming an approximately normal distribution.

5. a) A random sample of 100 recorded deaths in a country showed an average life span   (8M)
of 71.8 years. Assuming a population standard deviation of 8.9 years, does this
seem to indicate that the mean life span today is greater than 70 years? Use a 0.05
level of significance.

   b) Of the two salesmen, X claims that he has made more sales than Y. For the   (8M)
accounts examined, which were comparable for the two salesmen, the following
results were obtained.

	X	Y
Number of sales	10	17
Average size of sales	Rs.6200	Rs.5600
Standard Deviation of Sales	Rs.690	Rs.600

Do these two "average size of sales" differ significantly (5% level of significance)

6. a) Fit an exponential curve of the form $y = ab^x$ to the following data   (8M)

x	1	2	3	4	5	6	7	8
y	1	1.2	1.8	2.5	3.6	4.7	6.6	9.1

   b) Calculate the regression coefficients of Y on X and X on Y from the following   (8M)
data:$\Sigma X = 50, \Sigma Y = 60, \Sigma XY = 350, \bar{x} = 5, \bar{y} = 6, \sigma_x^2 = 4, \sigma_y^2 = 9$

7. a) A machine is set to deliver packets of a given weight. 10 samples of size 5 each   (8M)
were recorded. Below is given the relevant 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

   b) A drilling machine bores holes with a mean diameter of 0.5230cm. With a   (8M)
standard deviation of 0.0032 cm. Calculate the 2-sigma and 3-sigma upper and
lower control limits for the mean s of samples 4 and draw the control chart.

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PART –A

1. a) Out of 800 families with 5 children each, how many would expect to have   (3M)
        i) 3 boys
        ii) At least one boy
    b) Let   X   be   a   random   variable   with   density   function   (4M)
        $f(x) = \begin{cases} \frac{x^2}{3} & -1 < x < 2 \\ 0 & elsewhere \end{cases}$ Find the expected value of $g(X) = 4X + 3$
    c) A certain type of thread is manufactured with a mean tensile strength of 78.3   (3M)
        kilograms and standard deviation of 5.6 kilograms. How is the variance of the
        sample mean changed when the sample size is increased from 64 to 196?
    d) The mean score for students on an aptitude test at a certain college is 540, with a   (4M)
        standard deviation of 50. What is the probability that two groups selected at
        random, consisting of 32 and 50 students respectively will differ in their mean
        scores by more than 20 points
    e) Prove that the correlation coefficient is independent of change of scale   (4M)
    f) Discuss the conditions for a process to be not in the state of control   (4M)

PART –B

2. a) In testing a certain truck tyre over a rugged terrain, it is found that 25% of the   (8M)
        trucks fail to complete the test run without a blowout and of the next 15 trucks
        tested, find the probability that
        i) from 3 to 6 have blowouts
        ii) Fewer than 4 have blowouts.
        iii) More than 5 have blowouts.
    b) A random sample of size 100 is taken from an infinite population with mean   (8M)
        $\mu = 76$ and variance $\sigma^2 = 256$. what is the probability that the random variable
        x will lie between 75 and 78?

3.   Find the first four moments of the Binomial Distribution.   (16M)

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4. a) The following table gives the number of aircraft accidents that occur during various days of the week. Find whether the accidents are uniformly distributed over the week. (Level of significance 5%) (8M)

Days of the week	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Number of accidents	14	16	8	12	11	9	14

b) The average zinc concentration recovered from a sample of measurements taken in 36 different locations in a river is found to be 2.6 gms. per ml. Find the 95% and 99% confidence intervals for the mean zinc concentration in the river. Assume that the population standard deviation is 0.3 gm per ml. (8M)

5. a) It is claimed that a vacuum cleaner uses an average of 46 kilowatt hours per year. If a random sample of 12 homes indicates that the vacuum cleaners use an average of 42 kilowatt hours per year with a standard deviation of 11.9 kilowatt hours, does this suggest at 0.05 level of significance that vacuum cleaners use   on average less than 46 kilowatt hours annually (assume that the population of kilowatt hours is normal) (8M)

b) Can the following samples be regarded as coming from the same normal populations? (8M)

Sample	Size	Sample Mean	Sum of squares of deviations from the mean
1	10	12	120
2	12	15	314

6. a) Fit a straight line to the following data (8M)

x	1	2	3	4	5	6	7	8	9
y	9	8	10	12	11	13	14	16	15

b) The correlation coefficient between two variables X and Y is r = 0.6. (8M)
If $\sigma_x = 1.50, \sigma_y = 2.00, \bar{x} = 10 \ and \ \bar{y} = 20, find \ the \ regression \ lines \ of$
i) $Y \ on \ X$ ii) $X \ on \ Y$

7. a) A plastics manufacturer makes blanks for use in the manufacture of eye-glass temples. Specifications require that the thickness of these blanks have (8M)
$\bar{x} = 0.150 \ inch \ and \ \sigma = 0.002 \ inch$. Calculate a 2-sigma and 3-sigma upper and lower control limits of samples 5 in number and prepare a control chart

b) Based on 15 subgroups each of size 200 taken at intervals of 45 minutes from a manufacturing process, the average fraction defective was found to be 0.068.Calculate the value of the central line and upper and lower control limits. (8M)

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PART –A

1. a) The mean intelligence quotient (I.Q.) of a large number of children of age 14 was 100 and the standard deviation 16. Assuming that the deviation is normal find the percentage of children with I.Q. under 80. (3M)

    b) Let X be a random variable with density function (4M)
$$f(x) = \begin{cases} \frac{x^2}{3} & -1 < x < 2 \\ 0 & elsewhere \end{cases}$$ Find the varaince of $g(X) = 4X + 3$

    c) Find the variance of the data 3,4,5,6,6 and 7 representing the number of fish caught by a random sample of 6 fishermen on a particular day. (3M)

    d) A sample of size 400 was drawn and the sample mean was found to be 99. Test whether this sample could have come from a normal population with mean 100 and variance 64 at 5% level of significance. (4M)

    e) Find the value of the coefficient of correlation of two independent variables. (4M)

    f) What is the control charts used for measurements? (4M)

PART -B

2. a) Suppose that the lifetime of a certain kind of an emergency backup battery (in hours) is a random variable X with the Weibull distribution, with $\alpha = 0.1 \ and \ \beta = 0.5$. find i) The mean lifetime of these batteries. ii) The probability that such a battery will last more than 300 hours. (8M)

    b) If a car agency sells 50% of its inventory of a certain foreign car equipped with side airbags, find a formula for the probability distribution of the number of cars with side airbags among the next 4 cars sold by the agency. (8M)

3. a) Find the moment generating function of the Binomial distribution about the origin. (8M)

    b) A continuous random variable X has the density function (8M)
$$f(x) = \begin{cases} e^{-x}, & x > 0 \\ 0, & elsewhere \end{cases}$$ Find the expected value of $g(X) = e^{\frac{2X}{3}}$

4. a) A certain machine makes electrical resistors having a mean resistance of 40 ohms and a standard deviation of 2 ohms. What is the probability that a random sample of 36 of these resistors will have a combined resistance of more than 1458 ohms? (8M)

    b) In a random sample of n=500 families owning television sets in a city A, it is found that 340 families subscribe to the HBO channel. Find a 95% confidence interval for the actual proportion of families with television sets in this city that subscribe to HBO. (8M)

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5. a) Consider the following measurements of the heat producing capacity of coal   (8M)
produced by two mines

Mine 1	8260	8130	8350	8070	8340	
Mine 2	7950	7890	7900	8140	7920	7840

 Can it be concluded that the two population variances are equal?

b) 200 digits are chosen at random from a set of tables. The frequencies of the digits   (8M)
are as follows:

Digit	0	1	2	3	4	5	6	7	8	9
Frequency	18	19	23	21	16	25	22	20	21	15

Use the χ^2 test to assess the correctness of the hypothesis that the digits were
distributed in equal numbers in the tables from which they were chosen.

6. a) Fit a second degree parabola $y = a + bx + cx^2$ to the following data   (8M)

x	1	2	3	4	5	6	7	8	9
y	2	6	7	8	10	11	11	10	9

b) Obtain the rank correlation from the following data   (8M)

X	68	64	75	50	64	80	75	40	55	64
Y	62	58	68	45	81	60	68	48	50	70

7. a) Construct an $\bar{x}$ chart for the following data.   (8M)

Sample number	Observations		
1	32	36	42
2	28	32	40
3	39	52	28
4	50	42	31
5	42	45	34
6	50	29	21
7	44	52	35
8	22	35	44

Determine whether the process is in control

b) If the average fraction defective of la large sample of products is 0.1537, calculate   (8M)
the control limits

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