Seat No.: _____ *Enrolment No._____*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2014

Subject code: 2714601 **Date: 07-01-2015**

Subject Name: Statistics for Engineers

Time: 02:30 pm - 05:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use of Statistical Tables is allowed.**

Q.1

1. Given that $f(x) = \frac{k}{3^x}$ is a probability distribution for a random variable that can take on the values $x = 0, 1, 2, 3$ and 4, find k. **02**

2. Use Table 1 to find B(9; 12, 0.60). **01**

3. What are the mean and the variance of the binomial distribution with n = 4 and p = 0.70? **02**

4. Use Table 2 to find $\sum_{k=3}^{12} f(k; 7.5)$. **02**

5. Given the probability density $f(x) = \frac{k}{1+x^2}$ for -Ð < x < Ð, find *k*. **02**

6. For what values of μ and σ, a normal distribution is consider as a standard normal distribution? **01**

7. Find the value of $z_{0.01}$. **02**

8. If a random variable has a normal distribution, what is the probability that it will take on a value within 3 standard deviation of the mean? **02**

Q.2 **(a)** The following are measurements of the air velocity in cm/s and evaporation coefficient in mm^2/s of burning fuel droplets in an impulse engine **07**

Air Velocity	20	60	100	140	180	220	260	300	340	380
Evaporation Coefficient	0.18	0.37	0.35	0.78	0.56	0.75	1.18	1.36	1.17	1.65

Fit a straight line to these data by the method of least squares and use it to estimate the evaporation coefficient of a droplet when the air velocity is 190 cm/s. Also calculate the residual sum of squares.

(b) Find the rank correlation coefficient of the following data: **07**

X	15	14	25	14	14	20	22
Y	25	12	18	25	40	10	7

OR

(b) The following are the numbers of minutes it took 10 mechanics to assemble a piece of machinery in the morning, X, and in the late afternoon, Y: **07**

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

Calculate correlation coefficient r.

Q.3 **(a)** If the probability is 0.60 that steam will condense in a thin-walled aluminum tube at certain atm pressure follow binomial distribution, then find the probabilities that under stated conditions steam will condense in **03**

(i) 4 of 12 such tubes

(ii) at the most 6 of 12 tubes

(iii) anywhere from 5 to 8 tubes of 12 tubes

(b) Prove the statement. ñWhen n is large and p is small, binomial probabilities are often approximated by means of Poisson distribution with ɔ = np **07**

(c) A consulting engineer receives, on average, 0.7 requests per week. If the number of requests follows a Poisoon process, find the probability that **04**

(i) in a given week, there will be at least 1 request;

(ii) in a given 4-week period there will be at least 3 requests.

OR

Q.3 **(a)** Find moment generating function for Poisoon distribution. Also, obtain its mean and variance. **07**

(b) A company fabricates special - purpose robots, and records show that the probability is 0.10 that one of its new robots will require repairs during confirmation tests. What is the probability the eighth robot it builds in a month is the first one to require repairs? **03**

(c) If the joint probability density of two random variables is given by **04**

$$f(x_1, x_2) = \begin{cases} 6e^{-2x_1-3x_2} & x_1 > 0,\ x_2 > 0 \\ 0 & elsewhere \end{cases}$$

find the probabilities that

(i) the first random variable will take on a value between 1 and 2 and the second random variable will take on a value between 2 and 3;

(ii) the first random variable will take on a value less than 2 and the second random variable will take on a value greater than 2.

Q.4 **(a)** An experiment was designed to study the performance of 4 different detergents for cleaning fuel injectors. The following cleanness readings were obtained with specially designed equipment for 12 tanks of gas distributed over 3 different model of engines: **10**

	ENGINE 1	ENGINE 2	ENGINE 3
Detergent A	45	43	51
Detergent B	47	46	52
Detergent C	48	50	55
Detergent D	42	37	49

(i) Obtain sum of squares and degree of freedom for each component.

(ii) Consider detergents as treatments and the engines as blocks prepare the analysis of variance table and test at the $\alpha = 0.01$ level of significance whether there are differences in the detergents or in engines.

(b) Explain any two methods for multiple comparisons. **04**

OR

Q.4 **(a)** To compare the effectiveness of three methods of teaching programming of a certain computer language will be compared.Teaching methods A, B, & C with random sample of size 4 are given as follows: **10**

Method A	Method B	Method C
73	91	72
77	81	77
67	87	76
71	85	79

(i) Obtain sum of squares and degree of freedom for each component.
(ii) Test at the $\alpha = 0.05$ level of significance whether there are differences in the methods of teaching programming.

(b) For above example use the Duncan test with $\alpha = 0.05$ to compare the effectiveness of the 3 methods of teaching programming. **04**

Q.5 **(a)** As a part of the investigation of the collapse of the roof of a building, a testing laboratory is given all the available bolts that connected the steel structure at 3 different positions on the roof. The forces required to shear each of these bolts (coded values) are as follows: **08**

Position 1	90	82	79	98	83	91	
Position 2	105	89	93	104	89	95	86
Position 3	83	89	80	94			

Perform an analysis of variance to test at the 0.05 level of significance whether the differences among the sample means at the 3 positions are significant?

(b) Give an example to illustrate a 2^2 factorial design experiment. **04**

(c) Write the model equation for Latin square method with interpretation of each term in the equation. **02**

OR

Q.5 **(a)** A Latin square design was used to compare the bond strengths of god semiconductor lead wires bonded to the lead terminal by 5 different methods A, B, C, D, and E. The bonds were made by 5 different operators and the devices were encapsulated using 5 different plastics, with following results, expressed as pounds of force required to break the bond. Prepare ANOVA table and analyze the experiment at the $\alpha = 0.01$ level of significance. **10**

Operator

Plastic		O_1	O_2	O_3	O_4	O_5
	P_1	A 3.0	B 2.4	C 1.9	D 2.2	E 1.7
	P_2	B 2.1	C 2.7	D 2.3	E 2.5	A 3.1
	P_3	C 2.1	D 2.6	E 2.5	A 2.9	B 2.1
	P_4	D 2.0	E 2.5	A 3.2	B 2.5	C 2.2
	P_5	E 2.1	A 3.6	B 2.4	C 2.4	D 2.1

(b) The time required to assemble a piece of machinery is a random variable having a normal distribution with $\mu = 12.9$ minutes and $\sigma = 2.0$ minutes. What are the probabilities that the assembly of a piece of machinery of this kind will take **04**

(i) at least 11.5 minutes

(ii) anywhere from 11.0 to 14.8 minutes?

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