Seat No.: ________ *Enrolment No.___________*

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – I • EXAMINATION – WINTER • 2013

Subject code: 714601N **Date: 23-12-2013**

Subject Name: Statistics For Engineers

Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 (a) 1) Explain various types of correlations. **02**

2) Define Time series and write any two uses of Time series? **02**

3) Find k so that the following can serve as the probability density of a random variable $f(x)=\begin{cases} 0 & x \le 0 \\ k\,x\,e^{-x^2} & x>0 \end{cases}$ **03**

4) Mean and variance of a Poisson distribution are ---, ---- respectively. **01**

(b) 1) Check whether $h(x)=\dfrac{x^2}{25}$, for $x=0,1,2,3,4$ can serve as probability distribution. **02**

2) What is the value of the finite population corrector factor when $n = 100$ and $N = 10{,}000$? **02**

3) Find $\sum_{k=6}^{20} b(k;20,0.15)$ **02**

Q.2 (a) 1) If the probability is 0.05 that a certain wide – flange column will fail under a given axial load, what are the probabilities that among 16 such columns (a) at most two will fail; (b) at least four will fail? **04**

2) Suppose that the probabilities are 0.4, 0.3, 0.2, and 0.1 that there will be 0, 1, 2 or 3 car(s) fails certain test. Use the formula which define μ and σ^2 to find mean and variance of this probability distribution. **03**

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

OR

(b) Find the moment generation function of the binomial random variable X and then use it to verify that $\mu = np$ and $\sigma^2 = np(1-p) = npq$. **07**

Q.3 (a) 1) Over a 10 – minute period, a counter record an average of 1.3 gamma particles per millisecond coming from a radioactive substance. To a good approximation, the distribution of the count, X, of gamma particles during the next millisecond is Poisson. **05**

Determine (a) λ (b) the probability of one or more gamma particles (c) the variance.

2) If the probability density of a random variable is given by **05**

$$f(x) = \begin{cases} x & 0 < x < 1 \\ 2 - x & 1 \le x < 2 \\ 0 & elsewhere \end{cases}$$

1) find the probabilities that a random variable having this probability density will take on a value (a) between 0.2 and 0.8 (b) between 0.6 and 1.2

(b) If a random variable has a normal distribution, what are the probabilities that it will take on a value within **04**
(a) 1 standard deviation of the mean;
(b) 2 standard deviations of the mean;
(c) 3 standard deviations of the mean

OR

Q.3 (a) 1)A research worker wants to determine the average time it takes a mechanic to rotate the tires of a car, and she wants to be able to assert with 95% confidence that the mean of her sample is off by at most 0.50 minute. If she can presume from past experience that $\sigma = 1.6$ minutes, how large a sample will she have to take? **05**

2)Let X_1 and X_2 have the joint probability distribution **05**

		x_1		
		0	1	2
x_2	0	0.1	0.4	0.1
	1	0.2	0.2	0

(a) Find $P(X_1 + X_2 > 1)$
(b) Find the probability distribution $f(x_1) = P(X_1 = x_1)$ of the individual random variable X_1

(b) The probability that an electronic component will fail in less than 1000 hours of continuous use is 0.25. Use the normal approximation to find the probability that among 200 such components fewer than 45 will fail in less than 1000 hours of continuous use. **04**

Q.4 The following are the weight losses of certain machine parts (in milligrams) due to friction, when 3 different lubricants were used under controlled conditions.

Lubricant A:	12.2	11.8	13.1	11.0	3.9
Lubricant B:	10.9	5.7	13.5	9.4	11.4
Lubricant C:	12.7	19.9	13.6	11.7	18.3

Use this data to answer the just following sub-questions (a), (b), (c).

(a) Considering the three lubricants as treatments, calculate the treatment sum of squares, total sum of squares and the error sum of squares. **07**

(b) Find mean sum of squares for the treatments. **02**

(c) Calculate F - ratio for the treatments and test at $\alpha = 0.05$ level of significance whether the null hypothesis that the three means corresponding to the three lubricants are same. **05**

OR

Q.4 **(a)** Calculate sum of squares for the treatments and blocking for the following data pertaining to a randomized-block design of experiment. **04**

	Block 1	Block 2	Block 3	Block 4
Treatment 1	13	7	9	3
Treatment 2	6	6	3	1
Treatment 3	11	5	15	5

(b) A Latin square design was used to compare the bond strengths of gold 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. **04**

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

Calculate the sum of squares for the treatments (methods of bonding A to D).

(c) Mention two methods for multiple comparisons. **02**

(d) Giving an example, explain a 2^3 factorial design of experiment. **04**

Q.5 **(a)** 1) The following table shows the ages(x) and blood pressure (y) of 8 persons. **07**

X:	52	63	45	36	72	65	47	25
Y:	62	53	51	25	79	43	60	33

Obtain the linear regression of y on x (y=a + b x) and find the expected blood pressure of a person who is 49 years old.

(b) A manager wants to forecast the demand for deliveries of some items during the next month. From the records of previous orders, management has accumulated the following data for the past 10 months: **07**

Months	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.
Orders	120	90	100	75	110	50	75	130	110	90

1. Compute the monthly demand forecast for April through November using a 3-month moving average.
2. Compute the monthly demand forecast for June through November using a 5-month moving average.

OR

Q.5 (a) Compute the value of the Karl Pearson coefficient of correlation from the following table: **07**

Age X:	43	21	25	42	57	59
Weight Y:	99	65	79	75	87	81

(b) Use multiple linear regression to fit **07**

X_1	0	0	1	2	0
X_2	0	2	2	4	4
y	15	19	12	11	24

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