Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER-1 (NEW) EXAMINATION – WINTER 2016

Subject Code: 2714601 **Date:04/01/2017**

Subject Name: Statistics For Engineers

Time: 2:30 pm to 5:00 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. If the probabilities are 0.87, 0.36 and 0.29 that, while under warranty, a new car will require repairs on the engine, drive train, or both, what is the probability that a car will require repairs on the engine, drive train, or both kinds of repairs under the warranty? **02**

2. Check whether the function $f(x) = \frac{x-2}{2}$ for $x = 1, 2, 3, 4$ can serve as a probability distribution? **01**

3. Use Table 1 to find b(8; 10, 0.95). **02**

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

5. If a random variable has the probability density $f(x) = \begin{cases} 2e^{-2x}, & x > 0 \\ 0, & x \leq 0 \end{cases}$ find the probabilities that it will take on a value (a) between 1 and 3; (b) greater than 0.5. **02**

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

7. Find the value of $z_{0.05}$. **02**

8. If a random variable has a normal distribution, what is the probability that it will take on a value within 2 standard deviations of the mean? **02**

Q.2 (a) A chemical company, wishing to study the effect of extraction time on the efficiency of an extraction operation, obtained the data shown in the following table: **07**

Extraction Time x (min)	27	45	41	19	35	39	19	49	15	31
Extraction efficiency y %	57	64	80	46	62	72	52	77	57	68

Fit a straight line to these data by the method of least squares and use it to estimate the extraction efficiency one can expect when the extraction time is 35 minutes.

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

X	56	75	45	71	62	64	58	80	76	61
Y	66	70	40	60	65	56	59	77	67	63

OR

(b) Calculate correlation coefficient from the following table: **07**

Age X	43	21	25	42	57	59
Glucose level Y	99	65	79	75	87	81

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Q.3 **(a)** The probability that a patient recovers from a rare blood disease is 0.4. If 15 people are known to have contracted this disease, what is the probability that (a) at least 10 survive, (b) from 3 to 8 survive, and (c) exactly 5 survive? (Use Binomial Distribution) **03**

(b) (1) The weekly demand for Amul buttermilk in thousands of liters, from a local chains of efficiency stores, is a continuous random variable *X*having the probability density **04**

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

Find the mean and variance of *X*.

(2) A quality control engineer inspects a random sample of 3 batteries from each lot of 24 car batteries ready to be shipped. If such a lot contains 6 batteries with slight defects, what are the probabilities that the inspector's sample will contain (a) none of the batteries with defects? (b) only one of the batteries with defects? (c) at least two of the batteries with defects? **03**

(c) A manufacturing firm employs three analytical plans for design and development of a particular product. For cost reasons, all three are used at varying times. In fact, plans 1, 2, and 3 are used for 30%, 20% and 50% of the products respectively. The "defect rate" is different for the three procedures as follows: **04**

$$P(D/P_1) = 0.01, \quad P(D/P_2) = 0.03, \quad P(D/P_3) = 0.02$$

where $P(D/P_j)$ is the probability of a defective product, given plan j. If a random product was observed and found to be defective, which plan was most likely used and thus responsible?

OR

Q.3 **(a)** Let the random variable *X* represent the number of automobiles that are used for official business purposes on any given workday. The probability distribution for company A is **07**

x	1	2	3
$f(x)$	0.3	0.4	0.3

and for company B is

x	0	1	2	3	4
$f(x)$	0.2	0.1	0.3	0.3	0.1

Show that the variance of the probability distribution for company B is greater than that of company A. Use the formula as $\sigma^2 = \sum_x (x - \mu)^2 f(x)$.

(b) The number of gamma rays emitted per second by a certain radioactive substance is a random variable having the Poisson distribution with $\lambda = 5.8$. If a recording instrument becomes inoperative when there are more than 12 rays per second, what is the probability that this instrument becomes inoperative during any given second? **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 performed to judge the effect of 4 different fuels along with the effects of 3 different launchers on the range of a certain rocket. The data (in nautical miles) is given in following table: **10**

	Fuel I	Fuel II	Fuel III	Fuel IV
Launcher X	45	47	48	42
Launcher Y	43	46	50	37
Launcher Z	51	52	55	49

Considering fuels as treatments and launchers as blocks prepare the ANOVA table and test at $\alpha = 0.05$ significance level whether the differences among the means corresponding to fuels are significant. Also test whether the blocking has been effective.

(b) Explain major advantage of Design of Experiment using Taguchi method. **04**

OR

Q.4 **(a)** The internal bonding strengths of 3 different resins ED, MD, PF, need to compare. Five specimens were prepared with each of the resins. **10**

Resin	Strength					Mean
ED	0.99	1.19	0.79	0.95	0.90	0.964
MD	1.11	1.53	1.37	1.24	1.42	1.334
PF	0.83	0.68	0.94	0.86	0.57	0.776

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

(ii) Construct the analysis of variance table and test at the 0.05 level of significance whether the internal bonding strengths of 3 different resins are significant.

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

Q.5 **(a)** 1) The time required to assemble a piece of machinery is a random variable having approximately a normal distribution with μ = 12.9 minutes and σ = 2.0 minutes. What are the probabilities that the assembly of a piece of machinery of this kind will take (i) at least 11.5 minutes; (ii) anywhere from 11.0 to 14.8 minutes? **04**

2) From experience Mr. Harris has found that the low bid on a construction job can be regarded as a random variable having the uniform density **04**

$$f(x) = \begin{cases} \frac{3}{4C}, & \frac{2C}{3} < x < 2C, \\ 0, & elsewhere. \end{cases}$$

where C is his own estimate of the cost of the job. What percentage should Mr. Harris add to his cost estimate when submitting bids to maximize his expected profit?

(b) The following are the times between 6 calls for an ambulance in certain city and the patient's arrival at the hospital: 27, 15, 20, 32, 18 and 26 minutes. Use these figures to judge the reasonableness of the ambulance service claim that it takes on average of 20 minutes between the call for an ambulance and the patient's arrival at the hospital. **04**

(c) What do you mean by Type I and Type II errors? **02**

OR

Q.5 **(a)** (1) The mean weight loss of n = 16 grinding balls after a certain length of time in mill slurry is 3.42 grams with a standard deviation of 0.68 gram, Construct a 99% confidence interval for the true mean weight loss of such grinding balls under the stated conditions. **04**

(b) (1) Fit a linear trend to the following data by using least square method $\sum(y - y_e) = 0$ where y_e is the corresponding value of y. **04**

Year	1990	1992	1994	1996	1998
Production	18	21	23	27	16

Also, estimate the production for the year 1999.

(c) A trucking firm is suspicious of the claim that the average lifetime of certain tires is at least 28,000 miles. To check the claim, the firm puts 40 of these tires on its trucks and gets a mean lifetime of 27,463 miles with a standard deviation of 1,348 miles. What can it conclude if the probability of type I error is to be at most 0.01? **06**

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