Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

ME – SEMESTER I (NEW) – • EXAMINATION – SUMMER 2016

Subject Code: 2714601 **Date:17/05/2016**

Subject Name: Statistics for Engineers

Time:02:30 pm to 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 permitted**

Q.1 **14**

1. The probability that a consumer testing service will rate a new antipollution device for cars very poor, poor, fair, good, very good, or excellent are 0.07, 0.12, 0.17, 0.32, 0.21, and 0.11. What are the probabilities that it will rate the device (a) very poor, poor, fair, or good; (b) good, very good, or excellent?
2. 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 one or the other or both kinds of repairs under the warranty?
3. Check whether the function $h(x) = x^2/25$ for x = 0, 1, 2, 3, 4 can serve as probability distribution?
4. Use proper Table or otherwise to find b(7; 19, 0.45).
5. For the binomial distribution having parameter n = 16 and p = 0.5, find the mean and variance.
6. Use proper Table to find the value of $\sum_{k=3}^{12} f(k;\ 7.5)$.
7. Find the value of $z_{0.01}$.

Q.2 **(a)** When n is large and p is small prove that binomial probabilities are approximated by the Poisson distribution with $\lambda = np$. **07**

(b) (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) In the inspection of tin plate produced by a continuous electrolytic process, 0.2 imperfections are spotted per minute, on average. Find the probabilities of spotting (a) one imperfection in 3 minutes; (b) at least two imperfections in 5 minutes; (c) at most one imperfection in 15 minutes. **03**

OR

(b) (1) The function f: [0, 1] $\rightarrow$R defined by $f(x) = 3kx^2$ is known to be a probability density function. Obtain the value of k. Obtain also the probability that if an observation were chosen at random it would be (a) less than 1/2 (b) between 1/4 and 1/2 . **04**

(2) A random variable X is normally distributed with mean 0 and variance 1. Obtain the probability that a sample chosen at random will be (a) greater than 2.12 (b) between 0.55 and 2.15 (c) greater than -1.34 but less than 2.43. **03**

Q.3 **(a)** A large insurance agency services a number of customers who have purchased both a homeowner's policy and an automobile policy from the agency. For each type of policy, a deductible amount must be specified. For an automobile policy, the choices are \$100 and \$250, whereas for a homeowner's policy, the choices are 0, \$100, and \$200. Suppose the joint pmf is given in the accompanying joint probability table: **07**

		Y		
X	P(X,Y)	0	100	200
	100	0.20	0.10	0.20
	250	0.05	0.15	0.30

Find (a) $P(X + Y > 200)$ (b) $P(Y \geq 100)$.

(b) (1) Find the probabilities that a random variable having the standard normal distribution will take on a value (a) between 0.87 and 1.28; (b) between –0.34 and 0.62; (c) greater than 0.85; (d) greater than –0.65. **04**

(2) The time required to assemble a piece of machinery is a random variable having approximately 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 (a) at least 11.5 minutes; (b) anywhere from 11.0 to 14.8 minutes? **03**

OR

Q.3 **(a)** A manufacturing process produces dry cell batteries which have a mean shelf life of 2.25 years and a standard deviation of 3.5 months. Assuming the distribution is normal: (a) Obtain the probability that an item selected at random will have a shelf life of at least 2.5 years. (b) If three items are selected at random, obtain the probability that at least two will have a shelf life more than 2.5 years. **07**

(b) (1) Obtain the mean and variance of the probability density function $f: [0, 1] \rightarrow R$ defined by $f(x) = 3x^2$. **04**

(2) Of the fire extinguishers produced by a factory, 25% are known to be faulty. If 30 extinguishers are selected at random, what is the probability that at least 17 will be satisfactory? **03**

Q.4 **(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: **10**

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) Giving an example to illustrate a 2^3 factorial design experiment. **04**

OR

Q.4 **(a)** A laboratory technician measures the breaking strength of each of 5 kinds of linen thread by means of 4 different instruments and obtains the following results (in ounces): **10**

	M1	M2	M3	M4
Thread 1	20.6	20.7	20	21.4
Thread 2	24.7	26.5	27.1	24.3
Thread 3	25.2	23.4	21.6	23.9
Thread 4	24.5	21.5	23.6	25.2
Thread 5	19.3	21.5	22.2	20.6

Use Duncan test with level of significant 0.01 to compare the strength of 5 linen threads.

(b) Explain any two fundamental concepts on which Taguchi method is based on. **04**

Q.5 **(a)** An experiment was performed to judge the effect of 4 different fuels along with the effects of 2 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	62.5	49.3	33.8	43.6
Launcher Y	40.4	39.7	47.4	59.8

Consider 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 or not.

(b) A random sample of size n = 100 is taken from a population with σ = 5.1. Given that the sample mean is $\bar{x}$ = 21.6, construct a 95% confidence interval for the population mean μ. **04**

OR

Q.5 **(a)** Two tests are made for the compressive strength of each of 6 samples of poured concrete. The force required to crumble each of 12 cylindrical specimens, measured in kg, is as follows: **10**

SAMPLE

	A	B	C	D	E	F
Test-1	110	125	98	95	104	115
Test-2	105	130	107	91	96	121

Test at 0.05 level of significant whether these samples differ in compressive strength.

(b) 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 grams. Construct a 99% confidence interval for the true mean weight loss of such grinding balls under the stated conditions. **04**

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