Ref No.: Ex/EE/PC/B/T/315/2024(S)

B .E. ELECTRICAL ENGINEERING
THIRD YEAR FIRST SEMESTER SUPPLEMENTARY EXAMINATION 2024

INTRODUCTION TO STATISTICAL AND PROBABILISTIC METHODS

Time: Three hours **Full Marks 100**
(√50 marks for each part)

Part-I

Use a separate Answer-Script for each part

Answer Any Three Questions.

Two marks reserved for neat and well organised answers.

Q1a) Introduce the concept of joint probability and of conditional probability of two random events. What is the relation between the two? 08

Q1b) A manufacturing plant makes radios that contains an integrated circuit (IC) supplied by three sources A, B and C. The probability that the IC in a radio came from one of the sources is 1/3, same for all sources. ICs are known to be defective with probabilities 0.001, 0.003 and 0.002 for sources A, B, C respectively.

i) What is the probability that any given radio will contain a defective IC?
ii) If a radio contains a defective IC, find the probability that it came from source A. Repeat for sources B and C.

08

Q2a) Enumerate and justify the properties of a cumulative distribution function. 08

Q2b) A random variable X is known to have a distribution function

$$F_X(x) = u(x)[1 - e^{\frac{-x^2}{b}}],$$

where b>0 is a constant. Find its density function. 04

Q2c) Find the value of the constant k such that

$$f(x) = \begin{cases} kx(1-x), & 0 \le x \le 1 \\ 0, & otherwise \end{cases}$$

is a proper density function of a continuous random variable. 04

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Q3a) Prove that Poisson distribution can be derived as the limit of the Binomial distribution. 05

Q3b) What is a characteristic function? Discuss how moments can be generated using characteristic function. 05

Q3c) Derive the characteristic function for a Gamma distributed random variable. From the characteristic function find the expectation of a Gamma distributed random variable. 06

Q4a) Enumerate the properties of joint density function. 07

Q4b) When two random variables are said to be statistically independent? If two random variables are statistically independent will they be uncorrelated too? Explain citing suitable reasons. 04

Q4c) Let X be a random variable that has a mean value E[X]=3 and variance $\sigma_X^2 = 2$. Determine the second moment of X about the origin. Let Y be another random variable defined as Y=-6X+22. Find the values of E[Y] and R_{XY}. Discuss how the random variables X and Y are related. 05

Q5) Write short notes on any two. 8+8

i) Stationary Random Process
ii) Markov's and Chebyshev's inequality
iii) Bivariate Gaussian distribution

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B.E. ELECTRICAL ENGINEERING THIRD YEAR FIRST SEMESTER SUPPLEMENTARY EXAM - 2024

SUBJECT: INTRODUCTION TO STATISTICAL AND PROBABILISTIC METHODS

Time: Three Hours

Full Marks: 100
(50 Marks for each part)

Use a separate Answer-Script for each part
Two marks for neat and well-organized answers

Question No.	Part-II	Marks

Answer any three questions

To answer the following questions, you can use (with linear interpolation and extrapolation if necessary) the following standard normal distribution table where ever required:

z:	1.6	1.65	1.70	1.80	1.90	1.95	2.0	2.5
P (z):	0.9452	0.9505	0.9554	0.9641	0.9713	0.9744	0.9772	0.9938

z:	2.55	2.60	2.65	2.70
P (z):	0.9948	0.9953	0.9960	0.9965

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1. (a) Establish the relations between the expectation and the variance of the sample mean and the corresponding quantities of the population. Also discuss the significance of the central limit theorem. 8

   (b) An insurance company has 25,000 automobile policy holders. If the yearlyclaim of a policy holder is a random variable with mean 320 and standard deviation 540,approximate the probability that the total yearly claim exceeds 8.3 million? 8

2. (a) Explain with the help of a suitable example, what is 'two-sided percentage confidence interval estimate' of the mean μ of a normal population with known variance σ^2. 8

(b) A Signal having value μ is transmitted from station A and the value received at station B is normally distributed with mean μ and variance 4. If the successive values received are
5, 8.5, 12, 15, 7, 9, 7.5, 6.5, 10.5
Find the 95% confidence interval for μ. 8

3. (a) What is "continuity correction"? Explain it with a suitable example. 7

(b) The ideal size of a first-year class at a particular college is 150 students. The college, knowing from past experience that, on the average, only 30 percent of those accepted for admission will actually attend, uses a policy of approving the applications of 450 students. Compute the probability that more than 150 first-year students attend this college. 9

4. (a) Derive the expressions for the Least Square Estimators of the Regression Parameters of a simple linear regression model. 8

(b) Determine the expected values of Regression Parameters of a simple linear regression model. 8

5. (a) Derive the expression of sample size requirement to meet certain specifications concerning type-II error. 10

(b) Suppose it is known that if a signal of value μ is sent from station A, then the value received at station B is normally distributed with mean μ and variance 4. It is suspected that the signal value μ=8 will be sent today from A. Test this hypothesis if the same signal value is independently sent five times and the average value received at B is $\overline{X}$=9.5. Consider 5% significance level. 6