



TIME: 3 HOURS

MAX. MARKS: 50

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. Answer briefly in a few sentences each:

- A dice is thrown 2 times. The probability that the sum of the two throws is -----
a) 3 b) 9 c) 13
- Explain Bayes Rule
- Define the term “probability of false alarm”.
- Give the expression for probability of error in a binary detection problem
- What is an ROC curve? Explain its dependence on the SNR.

1B. Distinguish between estimation and detection

1C. List out any four properties of receiver operating characteristics

(5+3+2)

2A. Consider the following detection problem: Under hypothesis H_0 , the measured data is $x[0] = w[0]$; where $w[0]$ is zero mean Gaussian noise with variance 1. Under hypothesis H_1 , $x[0] = 2 + w[0]$. A detector decides H_1 if $x[0] > 1$ and H_0 otherwise. What is the probability of false alarm in this case? Under what criteria is the detector optimal? Explain.

2B. Discuss briefly what you understand by Multiple Hypothesis Testing.

2C. Explain Markov and Chebyshev Inequality.

(5+3+2)

3A. The probability that a telephone call lasts no more than t minutes is often described by an

$$\text{exponential CDF} \quad F_r(t) = 1 - e^{-\frac{t}{3}} \quad t > 0$$

$$= 0 \quad t < 0$$

What is the PDF for the duration in minutes of telephone conversation? What is the probability that a conversation will last between 2 and 4 minutes

What is the expected duration of a telephone call? What is the variance and standard deviation of T ? What is the probability that call duration is within ± 1 standard deviation of the expected call duration?

3B. Explain confidence interval Estimation. What is Confidence interval and confidence coefficient?

3C. Suppose you test one circuit. With probability p , the circuit is rejected. Let X be the number of rejected circuits in one test. What is $P_X(x)$?

(5+3+2)

4A. Explain blind estimation? What is the mean square error of a Blind estimation?

- 4B. Prior to rolling a six-sided die, what is the mean square error estimate of the number of spots that will appear?
- 4C. Obtain the mean of a uniform random variable using moments. (5+3+2)
- 5A. With necessary equation, explain MAP and ML detection.
- 5B. Distinguish between Kalman and Weiner filter.
- 5C. Describe central limit theorem. (5+3+2)