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M.Tech.(ECE) (2018 Batch) (Sem.–1)

STATISTICAL INFORMATION PROCESSING

Subject Code : MTEC-PE1X-18-3

M.Code : 75176

Time : 3 Hrs. **Max. Marks : 60**

INSTRUCTIONS TO CANDIDATES :

1.Attempt any FIVE questions out of EIGHT questions.

2.Each question carries TWELVE marks.

Q1. a) Describe cumulative distribution function (CDF) and probability density function (PDF) and their properties. (6)

b) Let X be a continuous random variable with the following PDF (6)

$$f_x(x)=\begin{cases} cx^2 & |x|\le 1 \\ 0, & otherwise \end{cases}$$

where c is a positive constant.

Find the value of constant c, $E(X)$ and $P\left(X \ge \frac{1}{2}\right)$.

Q2. a) U(t) is the input to an LTI system with impulse response $h(t) = \delta(t) + t\, e^{-at}$. U(t) is a WSS process with mean of 3. Find the mean of the output of the system. (6)

b) Briefly explain the characteristics of a hidden Markov model (HMM). Why such model is called ‘‘hidden’’? Mention some application areas for HMM. (6)

Q3. a) Explain the following in brief : (6)

i) Tchebycheff inequality theorem.

ii) Ergodicity

b) What is the relation between autocorrelation and power spectral density? Describe various properties of power spectral density. (6)

Q4. a) Explain the Neyman-Pearson decision criterion in detail. (6)

b) Consider the binary decision problem with :

$$p(z/m_1)=\frac{1}{\sqrt{2\pi}}\exp\frac{-z^2}{2}$$

$$p(z\,|\,m_2)=\frac{1}{\sqrt{2\pi}}\exp\frac{-(z-1)^2}{2}$$

Determine the Neyman-Pearson decision rule for $P\{d_2|m_1\} = 0.25$. (6)

Q5. a) Explain the Maximum A Posteriori (MAP) estimation in detail. (6)

b) Suppose that we have observed the random sample $X_1, X_2, X_3, \ldots, X_n$, where $X_i \sim N(\theta_1, \theta_2)$, so

$$f_{x_i}(x_i;\theta_1,\theta_2)=\frac{1}{\sqrt{2\pi\theta_2}}e^{-\frac{(x_i-\theta_1)^2}{2\theta_2}}$$

Find the maximum likelihood estimators for θ_1 and θ_2. (6)

Q6. a) Write a short note on (6)

i) Bartlett Method ii) Welch Modification

b) Define Mutual information. List the various properties of Mutual information and prove that $I(X;Y) = H(X) + H(Y) - H(X,Y)$ (6)

Q7. a) Write in detail about the Lempel-Ziv-Welch data compression technique. (6)

b) Explain the Shannon-Fano coding with the help of suitable example. (6)

Q8. a) What are the conditions for a set R to be considered a Ring ? (4)

b) What are the merits and demerits of using BCH coding? (4)

c) A Reed-Solomon code is RS(255, 223) with 8-bit symbols. What is the length of data symbol and parity symbol? How many maximum bytes of error can be corrected by the corresponding Reed-Solomon decoder? (4)

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.