

Name :

Roll No. :

Invigilator's Signature :

CS/M.Tech(ECE)/SEM-1/MCE-102/2012-13

2012

ADVANCED DIGITAL COMMUNICATION

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

*Candidates are required to give their answers in their own words
as far as practicable.*

GROUP – A

(Short Answer Type Questions)

1. Answer any five of the following. 5 × 2 = 10

a) A random variable X has a PDF given by

$$f_x(x) = \frac{1}{\sqrt{8\pi}} \exp\left(-\frac{(x+3)^2}{8}\right). \text{ Express } P(X > 4) \text{ in}$$

terms of Q -function.

b) A random variable X has mean 50 and standard deviation 8. Find the maximum value of $P(|X - 50| \geq 30)$ from Chebyshev's inequality.

c) State Central Limit Theorem.

d) Differentiate between FSK and CPFSK modulation techniques.



- e) Explain what you mean by a stationary random process.
- f) In a base band 16-PAM system, a unit pulse of duration 2 ms is used. Find the average energy per symbol.

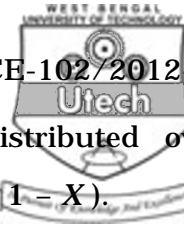
GROUP - B

(Long Answer Type Questions)

Answer any *four* of the following. $4 \times 15 = 60$

2. a) Define the following : $2 + 2$
- i) Wide sense stationary (WSS) process
- ii) Ergodic process.
- b) A random process $Y(t)$ is obtained by modulating a carrier with another random process $X(t)$ and is given by $Y(t) = X(t) \cos(\omega_0 t + \Theta)$ where Θ is uniformly distributed over $[0, 2\pi]$ and independent to $X(t)$. Show that $Y(t)$ will be a WSS process if $X(t)$ is a WSS process. 6
- c) A random process $X(t)$ is defined as $X(t) = A \sin(\omega_0 t + \Theta)$ where Θ is uniformly distributed over $[0, 2\pi]$. Test whether this process is ergodic or not. 5
3. Four signals, $s_0(t)$, $s_1(t)$, $s_2(t)$ and $s_3(t)$ are defined as follows :
- a) $s_0(t) = \exp(-t) u(t)$
- b) $s_1(t) = \exp(-2t) u(t)$
- c) $s_2(t) = \exp(-3t) u(t)$
- d) $s_4(t) = \exp(-4t) u(t)$.

Derive a set of orthonormal basis signals by graham-Schmidt's orthogonalization procedure.



4. a) A random variable X is uniformly distributed over $[0, 1]$. Find the distribution of $Y = \exp(1 - X)$. 4
- b) Explain in detail's how FSK signals are generated from multidimensional signalling scheme. 5
- c) Derive the expression for the minimum distance between two adjacent signal points in PSK modulation scheme involving M symbols and a carrier signal pulse $g(t)$ of energy E_g . 6
5. a) Explain in detail, the CPFSK modulation scheme and how MSK signals can be derived from binary CPFSK signals. 5 + 3
- b) Derive the expression of the power spectral density of linearly modulated signals. 7
6. a) Discuss about the functionality of a MAP detector. Explain when a MAP detector becomes equivalent to an ML detector. 3 + 2
- b) Derive the expression of error probability for optimal detection of binary antipodal signalling. 5
- c) Explain the working principle of correlation receiver. How are matched filters derived from correlation receiver ? 3 + 2

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