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 $f_x(x) = \frac{1}{\sqrt{8\pi}} \exp\left(-\frac{(x+3)^2}{8}\right)$. Express $P(X > 4)$ 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 × 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 $X(t) = A \sin \b(\omega_0 t + \Theta)$ 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 siganlling. 5

   c) Explain the working priciple of correlation receiver. How are matched filters derived from correlation receiver ? 3 + 2