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Reg. No. : ....

Name : ....

First Semester M.Tech. Degree Examination, March 2015
(2008 Scheme)
Branch : Electronics & Communication Engineering
Stream : Telecommunication Engineering
TTC1003 : MODERN DIGITAL COMMUNICATION TECHNIQUES

Time : 3 Hours Max. Marks : 100

Instructions : *i) Answer **any five** questions.*
*ii) **All** questions carry **equal** marks.*

1. a) A binary digital communication system employs the signals

$s_0(t) = 0$ for $0 \le t \le T$

and $s_1(t) = 5$ for $0 \le t \le T$

respectively for transmitting 0's and 1's. The demodulator cross-correlates the received signal with $s_1(t)$ and samples the output of the correlator at t = T. **12**

i) Determine the optimum detector for an additive white Gaussian noise channel and the optimum threshold, assuming that the probability of transmitting 0's and 1's are equal.

ii) Determine the probability of error as a function of the SNR.

b) Determine the matched filter for the following signal :

$s(t) = 0.5$ for $0 \le t \le 0.5$

-0.5 for $0.5 \le t \le 1$

Sketch the matched filter output as a function of time. **8**

2. Consider the detection of two equilikely signals in additive zero-mean coloured Gaussian noise with autocorrelation $R_v(t, s)$ where

$H_0 : y(t) = s_0(t) + v(t),\ 0 \le t \le T$

versus

$H_1 : y(t) = s_1(t) + v(t),\ 0 \le t \le T$

P.T.O.

Suppose that the signals are given by

$$s_0(t) = \sum_{n=1}^{N} \sqrt{E_n}\,\varphi_n(t) \text{ and } s_1(t) = -\sum_{n=1}^{N} \sqrt{E_n}\,\varphi_n(t)$$

where $\varphi_n(t)$ for $n = 1, 2, \ldots, N$, are eigenfunctions corresponding to the eigenvalues λ_n for $n = 1, 2, \ldots, N$, satisfying

$$\int_0^T R_v(t,s)\,\varphi_n(s)\,ds = \lambda_n\,\varphi_n(t),\quad 0 \le t \le T,\ n = 1, 2, \ldots, N$$

Find an expression for the error probability as a function of $\lambda_1, \lambda_2, \ldots, \lambda_N$ and E_1, E_2, ..., E_N. Simplify your answer for the special case where $\lambda_n = N_0/2$ for all n

and $E = \sum_{n=1}^{N} E_n$ denotes the total signal energy. **20**

3. a) Derive the optimum non-coherent receiver for the Rician channel. **12**

   b) A binary non-coherent receiver is required to operate in a Rayleigh fading channel with a bit error probability of 10^{-5}, using binary orthogonal FSK signal. Design a diversity system such that the 10^{-5} bit error rate can be met if an $E_b/N_o \le 15$ dB available. **8**

4. a) Explain the performance of non-coherent receivers in random amplitude and random phase channels. **10**

   b) Explain decision feedback equalization with block diagram. **10**

5. a) State and prove Nyquist pulse shape criterion for zero ISI. **10**

   b) A communication channel has a frequency response $H_c(f) = 1+0.3\cos(2\pi fT)$. Determine the frequency-response characteristics of the transmitting and receiving filters that yield zero ISI at a rate of 1/T symbols/s and have a 50% excess bandwidth. Assume that the additive noise spectrum is flat. **10**

6. a) Explain direct sequence spread spectrum system with block diagram and derive expression for processing gain. **12**

   b) Explain why a maximal length L-stage linear feedback shift register can produce a PN sequence with a period not greater than $2^L - 1$. **8**
