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MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

FIRST SEMESTER M.Tech. (DEAC) DEGREE END SEMESTER EXAMINATION
NOV 2017
SUBJECT: ADVANCED DIGITAL COMMUNICATION (ECE - 5101)

TIME: 3 HOURS **MAX. MARKS: 50**

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

1A. The Low pass representation of a PAM signal is given as u(t)= $\sum_n I_n g(t-nT)$ and if g(t) is a rectangular pulse and $I_n = a_n - a_{n-2}$ where { a_n } is a sequence of uncorrelated binary valued (1,-1) random variable that occur with equal probability. Determine the autocorrelation function of sequence { I_n } and PSD of u(t)

1B. The signals s_1(t) and s_2(t) are given by s_1(t) are given by $s_1(t) = \begin{cases} 3, & 0 \le t \le 2 \\ 0, & otherwise \end{cases}$ and $s_2(t) = \begin{cases} -3, & 2 \le t \le 4 \\ 0, & otherwise \end{cases}$. Apply Gram Schmidt procedure to obtain an orthonormal basis functions for the given signals.

1C. Draw the Manchester waveform for the binary sequence 11010011.

(5+3+2)

2A. The two equivalent lowpass signals are given as $s_1(t) = \{A, \ 0 \le t \le T$ and $s_2(t) = \begin{cases} A, & 0 \le t \le T \\ -A, & \frac{3T}{4} \le t \le T \end{cases}$ are used to transmit a binary information sequence. The transmitter signals which are equally probable are corrupted by AWGN noise having an equivalent lowpass representation z(t) with autocorrelation function given as $\phi_{zz}(\tau) = 0.5E\left[z^*(t)z(t+\tau)\right] = N_0\delta(\tau)$ .Determine the transmitted signal energy.

2B. What is the probability of a binary digit error for the system in Q 2A if coherent detection is employed at the receiver.

2C. What is the probability of a binary digit error as given in Q 2A if non coherent detection is employed at the receiver.

(5+3+2)

3A. Derive the outputs r_1 and r_2 for a correlation type demodulator. Assume that a signal $s_{l1}(t)$ is transmitted. Let $r_l(t) = s_{l1}(t)e^{j\phi} + z(t)$. where $z(t) = n_c(t) + jn_s(t)$ is additive Gaussian noise

3B. Prove the relation $Q\left(\sqrt{\frac{2\varepsilon_b}{N_0}}\right) = \frac{1}{2}erfc\left(\sqrt{\frac{E_b}{N_0}}\right)$.

3C. State the properties of matched filter.

(5+3+2)

4A. Apply Viterbi Algorithm to the received sequence [1111111101] for a ½ convolution encoder with constraint length 3 and whose paths are [1,1,1] and [1,0,1]. Decode the errors and give the corresponding message. (Initial states are a=00, b=10, c=01 and d=11).

4B. Illustrate with mathematical expressions that an of optimum detector maximizes the probability of correct decision.

4C. Explain the properties of cyclic codes.

(5+3+2)

5A. Illustrate the advantage of diversity as a means for overcoming the severe penalty in SNR caused by Rayleigh fading with appropriate mathematical expressions.

5B. Derive the expressions for spaced time frequency correlation function and scattering function of channel.

5C. Write down the characteristics of fading multipath channels.

(5+3+2)