Reg. No.



MANIPAL INSTITUTE OF TECHNOLOGY Manipal University

FIRST SEMESTER M. TECH (DEAC) DEGREE END SEMESTER EXAMINATION NOV/DEC 2016 SUBJECT: ADVANCED DIGITAL COMMUNICATION (ECE - 5101)

TIME: 3 HOURS

MAX. MARKS: 50

Instructions to candidatesAnswer ALL questions.

- Missing data may be suitably assumed.
- 1A. A convolutional encoder is described by $g_1 = [0 \ 0 \ 1]$ and $g_2 = [1 \ 1 \ 0]$. (a) Find the transfer function (b) Find d_{free} (c) If the crossover error probability is 10^{-6} , find the upper bound on the average bit error probability of the code.
- 1B. Determine PSD for unipolar RZ signalling with pulse width of $\frac{3}{4}T_{b}$.

(6+4)

2A. Apply GSOP procedure to the set of signals given below to obtain orthonormal basis functions.

(a) $S_1(t) = A$ for $0 \le t \le 2$ (b) $S_2(t) = A$ for $0 \le t \le 1$ and -1 for $1 \le t \le 2$ (c) $S_3(t) = -A$ for $0 \le t \le 3$. All signals are having zero value elsewhere.

2B.		[1	1	1	1	0	0	0	
	Consider a (7, 4) code with generator matrix	1	1 0 1 0 1	1	0	0			
		0	1	1	0	0	1	0	•
		1	1	0	0	0	0	1	

(a) Find all code words.(b) F ind parity check matrix. (c) Find syndrome for received vector 1101101. Is this a valid code vector? (d) What is error correcting and detecting capability of the code?

(5+5)

- 3A. Let the signal be encoded with a rate $\frac{1}{2}$, V = 3 convolutional encoder with vectors $g_1 = [1 \ 1 \ 1]$ and $g_2 = [1 \ 0 \ 1]$ and the signal is coherently detected using BPSK technique. Write Trellis diagram and find upper bound on the bit error probability, if bit energy to noise PSD is 6 dB. Compare your answer with that of uncoded signal and find improvement factor.
- 3B.
 - A baseband binary communication system employs signal $s(t) = \begin{cases} A & 0 \le t < T/2 \\ -A & T/2 \le t < T \end{cases}$ to transmit over

an AWGN channel and the receiver is implemented using a matched filter. Find the noise free response.

(5+5)

- 4A. A channel with binary ASK system is corrupted by AWGN. The data is transmitted at the rate of 1 Mbps. The average received signal energy is 1 femto Joules. Find the amplitude of the received signal. Repeat your calculation for binary FSK and PSK systems, if the data rate and probability of error are same as that of ASK.
- 4B. The PSK signal is applied to correlator supplied with a phase reference of φ radians of the carrier phase. Find the effect of the phase error φ on the average probability of error of the system.

(5+5)

- 5A. (a) Discuss the similarities/ non-similarities between MSK and offset QPSK. (b) For a system, the data rate is 2.5×10⁶ bps, AWGN PSD is 10⁻²⁰ W/Hz and received signal amplitude in absence of noise is 1 mV. Find the average symbol error probability for (i) binary FSK coherent detection (ii) MSK coherent detection (iii) BFSK noncoherent detection.
- 5B. Determine the amount of improvement in error probability relative to an un-coded (24, 12) double error correcting linear block code. BPSK modulation is used with SNR of 10 dB.
- 5C. Explain Catastrophic error. Are rate $\frac{1}{2}$ codes $1+X^4+X^6+X^7$ and $1+X^3+X^4$ Catastrophic?

(5+3+2)