Registration no: | | | | | | | | | | |

Total Number of Pages: 2 **M.TECH**
ETPC101

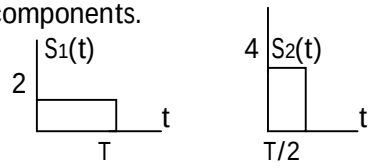
1st Semester Regular/Back Examination – 2015-16
MODERN DIGITAL COMMUNICATION TECHNIQUES
BRANCH(S): CE,CS
Time: 3 Hours
Max marks: 70
Q.CODE-T941

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 Answer the following questions: (2 x 10)

a) What type of WSS random process be treated as a strictly stationary process? Name one such process which is also Ergodic.
b) What is the band width of a sequence of stationary random pulses which happen to be impulses of strength I ?
c) What are the basis functions for orthonormal Fourier series expansion of a periodic function g(t) of period T ?
d) Find the autocorrelation of a white noise band limited to BHz. Hence find its power content if P S D of noise is 1microwatt/Hz and B=10KHz.
e) What are the Nyquist criteria for shaping the transmitted pulse in digital communication to have ISI immunity ?Does the detector block go ISI-free totally with Nyquist pulses?
f) How E_b/η (figure of merit) in digital communication is mathematically related to SNR?
g) How Spread Spectrum technique combats the multipath fading effect? What is gold code?
h) What are the MAP and ML criteria in signal parameter estimation? When are the two criteria identical?
i) A 24-dimensional signal is to be transmitted by using three orthonormal carriers f_o, $f_o+\Delta f$ and f_o, $f_o+2\Delta f$. How many minimum no of time slots are required?
j) Show the signal-space diagram of a digital 8-ary PAM signal. What sort of coding is used for mapping of information bits to 8 possible signal amplitudes and why?

Q2 a) Two functions $S_1(t)$ and $S_2(t)$ are shown below in the time interval of interest 0 to T. Use Gram-Schmidt procedure to express these functions in terms of orthonormal components. (5)



b) Derive an expression for a band-pass signal in terms of its complex low-pass equivalent. (5)

Q3 a) Show that the probability of bit error for a general binary detection using matched-filter receiver is of the form $P_{be}=Q(\sqrt{E_d/2\eta})$.(the symbols carry their usual meaning). Hence find the bit error for (a) unipolar (b)orthogonal signaling system. (5)

b) Polar signals $g_i(t)$,(i=1,2) of amplitude ± 2V are received in presence of AWGN that has a variance of 0.2 square volt. Determine the optimum detection threshold of a MAP detector if the a-priori probability $p(g_1)=0.7$ (5)

Q4 a) Write the expression for a QAM signal and show the signal constellation as a combined PAM and PSK signal. What is the Euclidian distance between adjacent signals hence compare its performance with that of a PAM signal. Why QPSK is superior to all other PSK signaling ? (5)

b) Derive the error probability expression for an M-ary baseband signal with equally likely symbols in terms of the average transmitted symbol power . (5)

Q5 a) How do you mathematically represent M-ary FSK signals? What should be the frequency separation between adjacent signals to call it a MSK signal? Establish analytically. (5)
Draw the approximate PSD spectrum of a MSK signal and find its bandwidth. Why is it viewed as a modulation with memory ?

b) Eqi-energy binary data is transmitted using polar signaling over an AWGN channel with noise PSD $\eta/2$. Show the signal space representation with decision regions if the symbol probabilities P(1) and P(0) are unequal. Find the error probability and decision threshold I terms of the decision region parameters. (5)

Q6 a) What do you mean by Carrier and Symbol synchronization? Discuss the ML carrier phase estimation method. Show that a PLL could be used for estimating the phase of a Un-modulated carrier. Show the model for PLL with and without channel noise. (6)

b) Show after due derivation the block diagram for a decision-directed ML estimation of symbol timing of a baseband PAM signal. (4)

Q7 a) What are the merits of Spread Spectrum communication? Derive an expression for the error probability of a BPSK signal of power P_s in presence of a jammer sinusoid with power P_j using a spread spectrum with processing gain N. (5)

b) A DS-SS system transmits at a rate of 1Kbps in presence of a tone jammer with power P_j. The jammer power is 20 dB greater than the signal power and the required E_b/J_{eff} (J_{eff} =effective jammer power and E_b = bit energy) is 10 dB for proper operation. Determine the chip rate used. (5)

Q8 Write brief explanatory notes on any **TWO** of the following :

a) FH/SS system (5)

b) Zero forcing Equalizer (5)

c) Optimum Receiver (5)