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

Total Number of Pages: 02 **M.TECH**

ETPC101

1st Semester Back Examination 2016-17
MODERN DIGITAL COMMUNICATION TECHNIQUE
BRANCH: CE,CS,ECE,ETE
Time: 3 Hours
Max Marks: 70
Q.CODE:Y934

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

1. Answer the following questions: [2x10]
   a) What is the advantage of low pass representation of a bandpass signal?
   b) How is the Hilbert transform of a signal obtained?
   c) What is a pre-envelope? Write the expression for the pre-envelope of a real signal x(t).
   d) State Markov Inequality and give its significance as bounds of tail probability.
   e) What do you understand by a cyclostationary random process?
   f) What is meant by optimal decision in communication receivers?
   g) Give a mathematical expression reflecting that the sub-carriers in OFDM systems are orthogonal over the symbol interval *T*.
   h) Define chip rate in a CDMA sytem.
   i) What do you inderstand by an ideal communication channel?
   j) What is the significance of symbol synchronisation?

2.
   a) Prove that a real energy signal *x(t)* and its *Hilbert transform* $\hat{x}(t)$ are orthogonal to each other. [5]

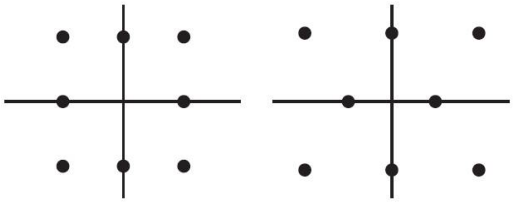
   b) Let x(t) and y(t) denote two bandpass signals, and let $x_l(t)$ and $y_l(t)$ denote their lowpass equivalents with respect to some frequency f_0. We know that in general $x_l(t)$ and $y_l(t)$ are complex signals. Show that :

   $$\int_{-\infty}^{\infty} x(t)y(t)dt = \frac{1}{2}Re\left[\int_{-\infty}^{\infty} x_l(t)\ y^*{}_l(t)dt\right]$$ [5]

3.
   a) For a set of four finite energy signal waveforms, derive the equations for the Gram-Schmidt procedure that will result in a set *N≤4* orthonormal signal waveforms. [5]

   b) Define a *wide sense stationary* process. Given a random process *V(t)* expressed as: $V(t) = Xcos(2\pi f_c t) + Ycos(2\pi f_c t)$, where *X* and *Y* are two random variables. Show that V(t) is wide sense stationary if and only if E[X]=E[Y]=0, $E[X^2] = E[Y^2]$, and E[XY]=0. [5]

4.
   a) Explain how QAM is different than PAM. Consider the two 8-point QAM signal constellations shown in figure. The minimum distance between adjacent points is 2A. Determine the average transmitted power for each constellation, assuming that the signal points are equally probable. Which constellation is more power-efficient? [5]



(a) (b)

b) Explain and give the general expression for M signal waveforms of *digital PAM* in baseband. Also give mathematical expressions for energy of the signal, average signal energy and average bit energy. Hence write the expression for bandpass digital PAM having carrier frequency f_c. [5]

5.

a) Draw and explain *eye pattern* showing the key indicators in the eye pattern diagram for a received signal. What is the effect of inter symbol interference to the eye pattern? Draw a typical eye patterns for QAM signals. [5]

b) A channel is said to be distortionless if the response *y(t)* to an input x(t) is $Kx(t - t_0)$, where K and t_0 are constants. Show that if the frequency response of the channel is $A(f)e^{j\theta(f)}$, where $A(f)$ and $\theta(f)$ are real, the necessary and sufficient conditions for distortionless transmission are :

$A(f) = K$ and $\theta(f) = 2\pi f t_0 \pm n\pi$, $n = 0, 1, 2, \ldots$ [5]

6.

a) With neat block diagram and supporting mathematical expressions explain the coherent detection in multichannel digital communication in AWGN channels. [5]

b) Discuss the motivation and need to go for multiple carrier modulation techniques than single carrier modulation techniques. Hence discuss OFDM as a special case of a multiple carrier modulation technique. [5]

7.

a) With neat block diagram, explain the frequency hopped spread spectrum technique. Emphasise *block hopping* in such a system. [5]

b) A total of 30 equal-power users are to share a common communication channel by CDMA. Each user transmits information at a rate of 10 kbits/s via DS spread spectrum and binary PSK. Determine the minimum chip rate to obtain a bit error probability of 10^{-5}. Additive noise at the receiver may be ignored in this computation. [5]

8. Write short notes on any **two**: [5x2]

I. Matched Filter
II. Nyquist criterion for zero Inter symbol interference
III. Direct Sequence Spread Spectrum Signals

****