Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – WINTER • 2013

Subject code: 1722202 **Date: 27-12-2013**

Subject Name: Advanced Digital Communication

Time: 10.30 am – 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Develop mathematical representation of band pass signal in to low pass signal, Explain significance of "Hilbert transformer" in it. **07**

(b) Explain Envelope and phase representation, complex valued representation of band pass signal. **07**

Q.2 **(a)** Explain method of deriving ortho-normal basis $f_i(t)$, $i=1$ *to* m from given set of waveforms $S_i(t)$, $i=1$ *to* n. where $m \leq n$. **07**

Explain how it is helpful in digital communication system

(b) Let $X(t) = A\cos(2\pi t)$, where A is some random variable . Find out mean, autocorrelation and auto covariance of $X(t)$ **07**

OR

(b) Let $X(t) = a\cos(2\pi f_o t + \Theta)$, where Θ is uniformly distributed in the interval $(0, 2\pi)$. Find Power spectral density of $X(t)$. **07**
Comment on power spectral density of white Gaussian noise process.

Q.3 **(a)** Explain Matched-filter demodulator. Consider the signal: **07**

$s(t) = (A/T)t\cos(2\pi f_C t)$; $(0 \leq t \leq T)$
$= 0$;(Otherwise)

i) Find the impulse response of the matched filter for the signal and the output of the matched filter at t=T.
ii) Suppose the signal is passed through a correlator, find the value of correlator output at $t=T$.

(b) Derive the expression for probability of error of M-ary PAM. Suppose that binary PSK is used for transmitting information over an AWGN with a power spectral density of $(1/2)N_0=10^{-10}$ *W/Hz*. The transmitted signal energy $\varepsilon_b=(1/2)A^2T$, where T is the bit interval and A is the signal amplitude. Determine the signal amplitude required to achieve an error probability of 10-6 when the data rate is *10 kbits/s.* **07**

OR

Q.3 **(a)** Suppose channel has a bandwidth of W. Explain design of pulse $x(t)$ in context of three cases *(a)* $T < 1/(2W)$ *(b)* $T=1/(2W)$ *(c)* $T > 1/(2W)$, where T is symbol time, considering nyquist condition of ISI free design. **07**

(b) What is significance of modified duo binary signal pulse? Explain clearly how it is used to mitigate issue of ISI generated due to channel impairments. **07**

Q.4 **(a)** State the nyquist pulse shaping criterion (Nyquist condition for zero ISI), and prove it. **07**

(b) Describe symbol by symbol detection method for detecting the information symbols at the receiver when the received signal contains controlled ISI. **07**

OR

Q.4 **(a)** Describe maximum likelihood criterion method, for detecting the information symbols at the receiver when the received signal contains controlled ISI. **07**

(b) Determine the optimum transmitting and receiving filters for a binary communication system that transmits data at rate of 4800 bits/s over a channel with frequency magnitude response as follows **07**

$$|C(f)| = \frac{1}{\sqrt{1 + (\frac{f}{W})^2}}, \quad |f| \leq W$$

Where W=4800 Hz. The assistive noise is zero mean, white, Gaussian with spectral density $N_0/2 = 10^{-15}$ W/Hz

Q.5 **(a)** Explain motivation to look at identification of channel based on statistical methods, in context of fading of channel. Explain multipath propagation model for such channel. **07**

(b) Distinguish between coherent and non coherent detectors, in context of multichannel transmission and define corresponding decision variables for each. **07**

OR

Q.5 **(a)** Discuss in brief: Statistical Model for Fading Channels. **07**
Also derived the channel transfer function *C(f)* in terms of multipath delay.

(b) Derive the capacity formula for CDMA. Also justify the statement that the sum of rates of the K users goes infinity with K for FDMA and TDMA while it exceed in CDMA . **07**

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