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JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

TEST -1 EXAMINATION- September 2016

B.Tech/ M.Tech 7th / 1st Semester

COURSE CODE: 10M11EC111 MAX. MARKS: 15

COURSE NAME: Advanced Communication System

COURSE CREDITS: 03 MAX. TIME: 1Hr

Note: *All questions are compulsory. Carrying of mobile phone during examinations will be treated as case of unfair means.*

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1. [2 marks] A discrete PAM signal d(t) with symbol period T is modulated using CPM with memory. Answer following questions about modulated signal. (Choose one correct answer)
   a. The modulated signal in the interval $nT<t<(n+1)T$ will have
      i) Discrete phase in t ii) continuous phase in t ½
      iii) Independent phase in t iv) only accumulated phase from $t<nT$
   b. The memory introduced in the modulation is realized by carrier signal having
      i) Phase proportional to d(t) ii) Amplitude proportional to d(t) ½
      iii) Phase proportional to $\int d(t)$ iv) Phase proportional to $4\pi Td(t)$
   c. In CPM modulation of input d(t), additional memory can be introduced by using
      i) Full response CPM ii) Partial response CPM ½
      iii) Both full and partial iv) neither of two
   d. As compared to full response, the partial response CPM provides benefit in
      i) Gradual change of carrier phase within t ii) Constant carrier phase within T
      iii) smoother phase change at symbol transitions iv) none of these ½

2. [4½ marks] Short answers type questions (answer in maximum three 3 lines).
   a. What is the full form of GMSK, and what BT value is used in European Digital cellular communications using GMSK? ½
   b. Sketch phase trajectory of Binary CPFSK for input symbol b_n sequence +1, -1, -1, +1, -1, +1, +1, +1, -1, -1, +1. Assume constant modulation index h for each symbol. ½
   c. What is MSK, and why is it called so? ½

d. Why, as engineers, are we interested in calculating Power Spectral Density (PSD) of digitally modulated signals? ½

e. Prove by formulation that QAM is a combination of PAM and PSK. 1

f. Plot signal space diagram of BPSK, QPSK, Octal PSK, and 8-QAM. 1

g. Write the condition for orthogonality of two signals with frequencies f_1 and f_2. ½

3. [2½ marks] Let a discrete PAM signal d(t) is created for an infinite series of symbols $\{b_n\}$ and pulse shaping g(t), where b_n can take values from ±1, ±3, ±5,….., ±(M-1), and g(t) is the rectangular pulse of amplitude 1/2T and duration T. The PAM signal d(t) is used to modulate a carrier of frequency f_c using CP-FSK to obtain time-varying carrier phase Φ(t; b).

a. Represent d(t) mathematically in terms of b_n and g(t). ½

b. Prove by elaborating each step that the phase at time t (nT<t<(n+1)T) is given by

$\Phi(t; b) = C_1 \sum_{k=-\infty}^{n-1} b_k + C_2 b_n(t - nT)$ Where C_1 & C_2 are constants. 2

4. [6 marks] Consider a baseband discrete PAM system. Assume $\{a_n\}$ is an Independent Identically Distributed random binary sequence where a_n takes value 0 and 1 equally likely, $\{b_n\}$ is the output of a binary pre-coder with input $\{a_n\}$, and $h_T(t)$ is a rectangular pulse shape defined as:

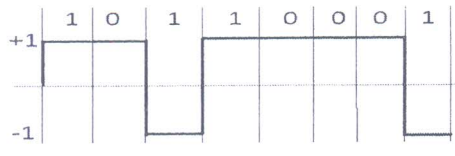
$$h_T(t) = \begin{cases} A & \text{for } t \in [0,T] \\ 0 & \text{otherwise} \end{cases} \quad \left[\text{Fourier transform} |H_T(f)| = ATsinc(fT)\right]$$

where T is symbol duration. Let v(t) be the output discrete PAM signal with power spectral density (PSD) $S_v(f)$. Answer the following.

a. For any band-pass signal s(t) which is a modulated version of the baseband signal v(t), prove that we only need to determine PSD of v(t) to evaluate PSD of s(t). 1

b. Determine $S_v(f)$, for NRZ polar quaternary signaling. 2½

c. Determine $S_v(f)$, if the PAM signal is NRZI as shown below 2½



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