Ref. No.: Ex/ET/T/313/2018(S)

BE Electronics and Telecommunication Engineering
Third Year, First Semester, Supplementary Exam-2018
Subject: Digital Communication Systems

Time: 3 hours **Full Marks: 100**

Answer any 5 questions
Answer must be written at one place for each attempted question

Q.1 a) Considering a 3D vector space, draw the analogy between vector and signal. Define the completeness of the vector. From this concept define orthogonality of signal. 08

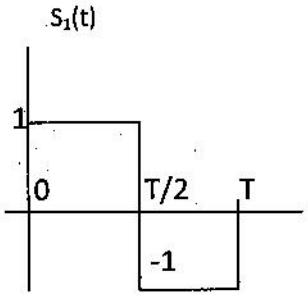
b) How are signals geometrically represented? What is the significance of such representation? From this representation, show that set of signal vectors may be defined in N-dimensional Eucledian spaces for M sets of points on $\{s_i\}$ with mutually perpendicular axes $\varphi_1, \varphi_2, \varphi_3, \ldots\ldots \varphi_N$. 08

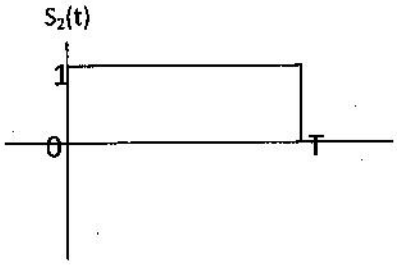
c) A pair of signals si(t) and sk(t) have a common duration T. Show that the inner product of this pair of signals is given by,

$$\int_0^T si(t)\, sk(t)\, dt = siT\, sk\ ,$$

where si and sk are the vector representation of si(t) and sk(t) respectively. 04

Q2. A) What is the purpose of Gram-Schmidt orthogonalization procedure? Show that Gram-Schmidt procedure, set of basis fn, $\{\varphi_i(t)\}$ are orthonormal set. 08
b) Construct the signal constellation for the bi-orthonormal signal corresponding to the pair of orthogonal signals. 08





c) Considering a Binary Communication channel with $P(m_0)$ and $P(m_1)$ as the a priori transmission probability for the message m_0 and m_1 respectively, design the receiver decision rule based on MAP criterion for optimum receiver. 04

Q.3 a) Assume an analog signal, as shown, which has to be quantized using at most 8-bits per sample. How many different quantization levels are allowed? 05

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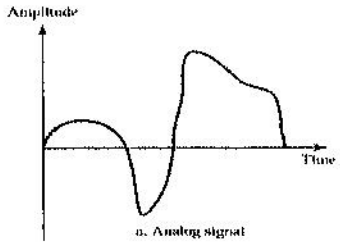


b) Delta-Modulation is the most popular alternative to PCM. If this analog signal is delta modulated what will be the delta modulated output in binary pulses? 04

c) In a single integration DM system, the voice signal is transmitted at a rate of 64 kHz. The maximum signal amplitude Amax = 1 06

(i) Determine the minimum value of step size Δ to avoid slope overload.

(ii) Determine the granular noise power N_0 if the voice signal bandwidth is 3.5 kHz.

d) A message signal m(t) is transmitted by binary PCM without compression, if the SNR is required to be at least 47 dB , determine the minimum value of L required, assumed that m(t) is sinusoidal. Determine the SNR obtained with this minimum L. 05

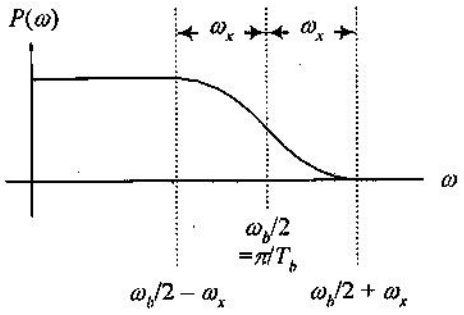
Q.4 a) Show that the coding efficiency in converting the output of a Discrete Memory less source (DMS) into a binary sequence is given by $\eta = H(\zeta) / L$, where the symbols have the usual meaning. 07

b) An analog signal is band limited to B Hz, sampled at the Nyquist rate, and the samples are quantized into 4-levels. The quantization levels Q1, Q2, Q3 and Q4 (message) are assumed independent and occur with probs. $P_1=P_2=1/8$ and $P_2=P_3=3/8$. Find the information rate of the source. 07

C. Why is source coding required? Write Shannon's law for Channel and explain its significance. 06

Q5. a) Write a 7 bit PN sequence and convert the same into bipolar and Manchester codes. Find the power spectrum for Manchester coded signal you have obtained. 12

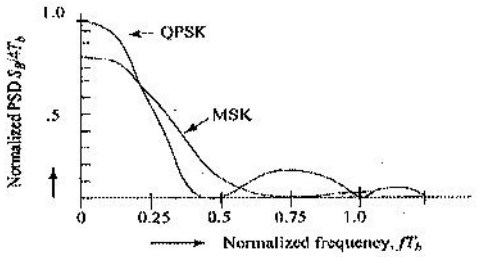
b) Why is spectral pulse shaping required? The spectrum of pulse shaping filter is shown below, what will be the roll of factor? 08



Q6. a) Describe the generation of QPSK modulation scheme by taking a bit sequence of your choice. Draw the signal constellation diagram for QPSK. 12

b) The extent of amplitude fluctuation for QPSK can be reduced by offset QPSK – How? 04

c) The PSD curves for MSK and QPSK are shown in the picture. What are the observations that contrast both of the modulation? 04



8. Write short notes on (4x5=20)

a) Nyquist zero crossing criteria b) BFSK modulation c) Source coding limit d) Optimum receiver