Q. Code: 978310

B.E./B.TECH. Degree Examination, December 2020

Fifth Semester

EC18501 – Digital Communication

(Regulation 2018)

Time: Three hours Maximum: 80 Marks

Answer **ALL** questions

PART A - (8 X 2 = 16 marks)

1. The information rate R for the given average information H= 2.0 bits for an analog signal which is band limited to 100 Hz is _____.

   (a) 800 bits/sec

   (b) 400 bits/sec

   (c) 200 bits/sec

   (d) 1600 bits/sec

2. An analog voltage in the range 0 to 8 V is divided into equal intervals for conversion to 5-bit digital output. The maximum quantization error (in V) is _____.

   (a) 0.625

   (b) 0.5 V

   (c) 0.25 V

   (d) 0.125 V

3. For a Binary FSK signal with mark frequency 61 KHz and space frequency of 57 KHz and input bit rate of 3 kbps, the (i) Peak frequency deviation and (ii) Minimum Bandwidth is ____ and ___ respectively.

   (a) 2 khz and 10 khz

   (b) 2 khz and 57 khz

   (c) 4 khz and 61 khz

   (d) 4 khz and 57 khz

4. If the generator polynomial is 1+x+x3, what is the syndrome of the received codeword 1011101.

   (a) 100

   (b) 110

   (c) 101

   (d) 111

5. Compute the entropy of the Discrete Memoryless Source (DMS) with source alphabet S = {s0, s1, s2, s3}, with probabilities p(s0)=p1=1/4; p(s1)=p2=1/2; p(s2)=p3=1/8 ; p(s3)=p4=1/8.

6. The American Standard Code for Information Interexchange (ASCII) has 128 binary coded

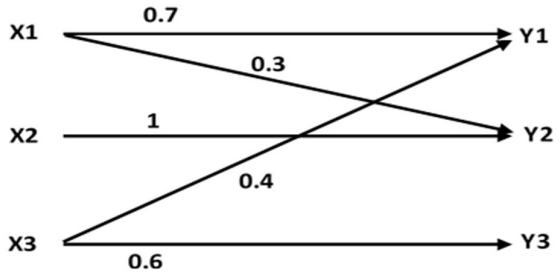
characters. ASCII codes represent text in computers, telecommunications equipment, and other devices. If a computer generates 125,000 characters per second, determine the number of bits per second required to transmit the computer output, and the minimum bandwidth required to transmit this signal.

7. In a single integration DM scheme, the voice signal is sampled at a rate of 64 kHz. The maximum signal amplitude is 2 Volts. Voice signal bandwidth is 3.5 kHz. Determine the minimum value of step size to avoid slope over-load and granular noise power.

8. A convolutional encoder with constraint length 4 is specified by (3,1,3). Determine the number of modulo-2 adders, number of shift registers and the number of impulse responses needed to design the convolution encoder. What is the code rate?

PART B - (4 X16 = 64 marks)

09. (a) Compute the Mutual Information for the given Discrete Memoryless input – output channel with probabilities of the source symbols x1, x2, x3 as 0.4, 0.25 and 0.35 respectively **(16)**



(OR)

(b) Encode the symbols {S1, S2, S3, S4, S5, S6, S7, S8}, whose probability of occurrence respectively are given as {0.25, 0.2, 0.125, 0.125, 0.1, 0.1, 0.05, 0.05} using Huffman method and Shannon Fano method. Also compare them with respect to the Coding Efficiency, Variance and Redundancy. **(16)**

10. (a) (i) Compare Delta Modulation system and Differential Pulse Code Modulation system. **(12)**

(ii) Using an illustration highlight the advantages and disadvantages of both the above systems. **(4)**

(OR)

(b) (i) With suitable block diagram describe Direct Sequence Spread Spectrum with coherent Binary PSK system. **(12)**

(ii) Derive the relation between Jamming Margin and Processing gain for spread spectrum system. **(4)**

11. (a) Derive the Power Spectral Density of NRZ Polar and NRZ - bipolar Line Coding Format and analyze the same. **(16)**

(OR)

(b) Prove that any set of M energy signals $\{s_i(t)\}$ can be represented as linear combination of N orthonormal basis functions φ_j, where $N \leq M$ using Gram Schmidt Orthogonalization Procedure. **(16)**

12. (a) (i) Consider a (7,4) cyclic code with generator polynomial $g(D) = 1 + D^2 + D^3$. Draw and explain the operation of the encoder and decoder. **(8)**

(ii) Obtain the codewords for the message sequences 1101 and 1010 **(4)**

(iii) Determine, if the given codeword is error free or not 1001111 and 1001110 **(4)**

(OR)

(b) (i) Design a convolutional encoder with a code rate of 1/2 and constraint length of 3. The generator sequences of the encoder are (1,0,1) and (0,1,1). **(4)**

(ii) Derive the code words using **time domain approach** and **transform domain approach** for the input message sequence (110010). **(8)**

(iii) Draw the state diagram and trellis diagram for this encoder. **(4)**