Roll No.: .....

National Institute of Technology, Delhi

Name of the Examination: B.Tech

Branch : ECE **Semester :VI**

Title of the Course : Digital Communication **Course Code : EC 351**

Time: 3 Hours **Maximum Marks: 50**

Note:

- **Questions are printed on BOTH sides. Answers should be CLEAR, TO THE POINT AND LEGIBLE.**
- **In total there are ~~Eight~~ NINE (9) questions with their marks shown individually. All questions are compulsory.**
- **All parts of a single question must be answered together and in the same sequence as given in question paper. ELSE QUESTION SHALL NOT BE EVALUATED.**
- **NOTE: ALL QUESTIONS ARE COMPULSORY.**

Section A (10 Marks)

Q.1 Answer the following question to the point . No need to write the details. Just the important points you need to write.

(a) Arrange PSK, FSK, ASK in increasing order of Bandwidth requirement.

(b) Draw the Waveforms for the sequence of bits 10110 for the case of Manchester Coding and RZ coding .

(c) What are Regenerative Repeaters. Explain its working.

(d) What is the difference between baseband modulation and bandpass modulation? Name some of these modulation schemes.

(e)What is white Noise? What is the shape of its Probability density function and Power spectral density.

(f) What are the main differences between FDM and TDM

(g) What are the main differences between Analog Communication and Digital Communication?

(h)What is Matched Filter and why it is used?

(i) What is the main difference between PCM, DM, and DPCM in terms of Bitrate?

(j) A source is generating 4 symbols with probability 1/8, 1/8, 1/4, 1/2. Find Entropy and Information rate if the source is generating 1 symbol in 1 mille second. **(10×1)**

Section B (16 Marks)

Q. 2 Find the error probability(Pe) expression for the following line codes in terms of Tb,No,Ac.

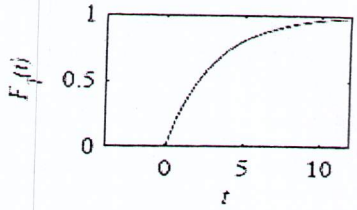
(1)ON-OFF

(2)NRZ **(4)**

Q.3 Pulse rate of delta modulation is 56000 samples/sec. If input signal is $m(t)=5\cos(2\pi*1000t) +2\cos(2\pi*2000t)$ where "t" is in seconds. Calculate minimum value of delta to avoid slope overload problem. **(4)**

Q.4 Draw block diagram of a Digital Communication system and briefly explain basic elements of it. **(4)**

Q.6 The probability that a telephone call lasts no more than "t" minutes is often modeled as exponential CDF.



$$F_T(t) = \begin{cases} 1 - e^{-t/3} & t \geq 0, \\ 0 & \text{otherwise.} \end{cases}$$

(a)What is the PDF of the duration in minutes of telephone conversation?
(b)What is the probability that a conversation will last between 2 and 4 minutes?
(c)What is $E[T]$, the expected duration of a telephone call?
(d)What is the probability that a call duration is within ±1 standard deviation of the expected call duration?

(4)

Section C (24 Marks)

Q.6

(a) Draw the 4-PSK and 8- PSK signal constellation. **(2)**

(b) For the constraint that the minimum distance between pairs of signal points be "d" for both constellations. Then what are the radii r1 (for 4 PSK), and r2(for 8PSK) of the circles in terms of "d". **(2)**

(c) Assuming high SNR and that all signals are equally probable, then what additional average transmitted signal energy is required by the 8-PSK signal to achieve the same error probability as the 4-PSK signal. **(2)**

Q7. A speech signal band limited to 4Khz and peak voltage varying between 5V and -5V is sampled at nyquist rate. If each sample is quantized and represented by 8 bits, then find the following:
(a)If bits 0 and 1 are transmitted using bipolar pulses , minimum B.W required for distortion less transmission is?
(b)Assuming signals to be uniformly distributed between its peak to peak value, what is the SNR at output?
(c)Number of quantization levels required to reduce the Quantization noise by a factor of 4? **(6)**

Q8. Consider the signal

$$h(t) = \begin{cases} \frac{A}{T} t\cos 2\pi f_c t & 0<t<T \\ 0 & \text{otherwise} \end{cases}$$

(a) Determine the impulse response h(t) corresponding of the matched filter of the signal. **(3)**

(b) Determine the output of the matched filter at t=T. **(3)**

Q.9

(a) Consider a digital source X that produces three symbols with following probabilities:
P(X = A) = 2/3 , P(X = B) = 1/6 , P(X = B) = 1/6
Generate Huffman Code for the above digital source and find the efficiency of the code. **(2)**

(b) In an extended version of above digital source, we combine two symbols and send them together. Therefore, we have 9 symbols from S_1 to S_9 as follows:
S_1 = AA, S_2 = AB, S_3 = AC, S_4 = BA, S_5 = BB, S_6 = BC, S_7 = CA, S_8 = CB, S_9 = CC
Assuming symbol A,B and C are mutually independent, generate the Huffman Code for the above symbol set S. **(3)**

(c) Which efficiency is higher between part A and part B? **(1)**