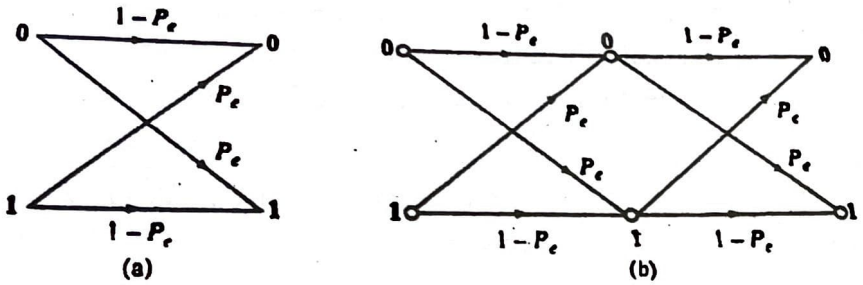
6. (a) Determine the Lempel-ziv code for the given sequence :

AAABABBBAABABAABAB. (10)

(b) Let channel matrix for figure (a) is M then

(i) Determine the channel matrix for the cascaded channel shown in figure (b) is $M^2$.

(ii) Show that the channel matrix for the cascaded of K identical BSCs each with channel matrix M is $M^K$. (5)




7. (a) Consider a binary sequence of 10 bits with a long sequence of 1s followed by a two 0s and then a sequence of three 1s. Draw the waveform for this sequence, using the following line codes :

(i) Unipolar NRZ code.

(ii) Polar NRZ.

(iii) Bipolar RZ.

(iv) AMI RZ.

(v) Split Phase (Manchester) line code. (10)

(b) Among different line codes, which line code/codes has/ have better synchronization at the receiver? Justify your answer. (5)



Roll No. ..... Total Pages : 4

**008604**

**May, 2023**

**B.Tech. (ECE) VI SEMESTER**

**Information Theory & Coding (ECEL-602)**

Time : 3 Hours] [Max. Marks : 75

*Instructions :*

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

**PART–A**

1. (a) Differentiate between Mutual and self-information. What are the conditions when both self and mutual information are same? (1.5)

(b) Define source code efficiency and how can it be improved? (1.5)

(c) What will the channel capacity of deterministic channel? Justify your answer. (1.5)

(d) State Shannon-Hartley theorem for channel capacity and from that derive Shannon's theoretical limit. How can this limit be increased? (1.5)

(e) Differentiate between Fixed length and Variable length coding. Which one is better and why? (1.5)

(f) How universal coding is differed from Lempel Ziv Coding? Explain with an example. (1.5)

(g) What do you mean by Bandwidth and Signal to Noise ratio tradeoff. What is it significance? (1.5)

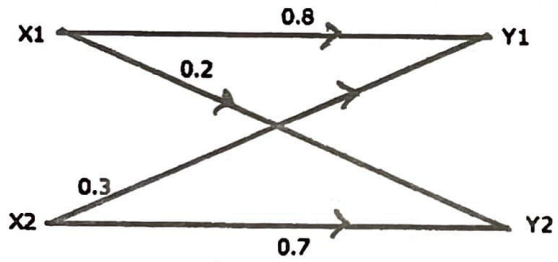
(h) What do you mean by information rate? What are the various factors affecting it? Give upper and lower bound of information rate. (1.5)

(i) "Cascading of channels reduce the channel capacity" is it True. Justify your answer. (1.5)

(j) Differentiate between Polar Quaternary NRZ format and Split Phase Manchaster format of line codes. (1.5)

## PART–B

**2.** (a) Find the mutual information and channel capacity of the channel shown Below in figure. Given P(Xl)= 0.6 and P(X2) = 0.4. (10)




(b) A quartenary source generates information with probabilities P1 =0.1, P2=0.2, P3= 0.3 and P4=0.4. Find the entropy of the system. What percentage of maximum possible information is being generated by this source? (5)



**3.** (a) Draw a noiseless channel with M inputs and N outputs. Write down channel matrix and prove that mutual information of noiseless channel is H(X) = H(Y) = H(X,Y). Give physical significance of this equation. X and Y are the source and receiver respectively. (8)

(b) Prove that mutual information of continuous channel is always non-negative. (7)

**4.** (a) In a certain system the S/N power ratio is 10 and the bandwidth is 10,000 Hz. Find the maximum permissible information rate and channel capacity. What will be the effect on the system if S/N falls to a value of 5? (10)

(b) State and prove Kraft's inequality. Give its significance in coding and decoding a message. (5)

**5.** (a) A source transmits eight messages at the frequency of 1 kHz with the probability given below :

| XI | X2 | X3 | X4 | X5 | X6 | X7 | X8 |
|---|---|---|---|---|---|---|---|
| 0.04 | | 0.15 | 0.10 | 0.06 | 0.4 | 0.02 | 0.03 |

(i) Find entropy and information rate of the source.

(ii) Using two symbols, construct Huffman Coding for this source by assigning highest priority to the combined message.

(iii) Find coding efficiency and redundancy. (10)

(b) "Any irreducible code is always decipherable but the reverse is not true." Justify the statement. (5)