Total No. of Questions: 6 *Total No. of Printed Pages:3*

Enrollment No.....

Faculty of Engineering

End Sem Examination Dec-2023

IT3CO27 Information Theory & Data Communication

Programme: B.Tech. Branch/Specialisation: IT

Duration: 3 Hrs. **Maximum Marks: 60**

Note: All questions are compulsory. Internal choices, if any, are indicated. Answers of Q.1 (MCQs) should be written in full instead of only a, b, c, or d. Assume suitable data if necessary. Notations and symbols have their usual meaning.

Q.1 i. The maximum rate at which nearly error free data can be theoretically transmitted over a communication channel is defined as: **1**

(a) Channel capacity (b) Signal to noise ratio

(c) Modulation (d) Frequency bandwidth

ii. If the probability of a message is 1/4, then the information in bits is: **1**

(a) 4 bits (b) 8 bits (c) 1 bit (d) 2 bits

iii. The channel capacity of a noise free channel is given by: **1**

(a) 2^m (b) $\log_2 m$ (c) m^2 (d) m

iv. For a given channel, if the conditional entropy is H(X/Y) = 0 then the channel can be: **1**

(a) Lossless

(b) Lossless or noiseless

(c) Distortion less or noiseless

(d) Distortion less

v. The negative statement for Shannon's theorem states that- **1**

(a) If R > C, the error probability increases towards Unity

(b) If R < C, the error probability increases towards Unity

(c) None of these

(d) Not applicable

vi. The Shannon's Theorem sets limit on the- **1**

(a) Highest frequency that may sent over channel

(b) Minimum Capacity of a Channel with a given noise level

(c) Maximum Capacity of the channel with a given noise level

(d) None of these

P.T.O.

vii. Which of the following techniques is used for allocating capacity on a satellite channel using fixed-assignment FDM? **1**
(a) Frequency-shift keying
(b) Frequency modulation
(c) Frequency division multiple access
(d) Amplitude modulation

viii. Many low-shaped channels are interwoven into one high-speed transmission by- **1**
(a) Frequency division multiplexer
(b) Time division multiplexer
(c) Both (a) and (b)
(d) None of these

ix. In CRC if the data unit is 100111001 and the divisor is 1011 then what is dividend at receiver? **1**
(a) 100111001101 (b) 100111001011
(c) 100111001 (d) 100111001110

x. Which of the following is/are the popular techniques for error detection? **1**
(a) Cyclic redundancy check (b) Checksum
(c) Simple parity check (d) All of these

Q.2 i. Define mutual information and its properties. **2**

ii. What do you understand by information? What are its units? How does it relate to the entropy? **3**

iii. What is the significance of Markov Statistical Model for Information Sources? Explain in detail. **5**

OR iv. Consider a discrete memoryless source with a source alphabet A = $\{s_0, s_1, s_2\}$ with respective probs. $p_0 = ¼$, $p_1 = ¼$, $p_2 = ½$. Find the entropy of the source. **5**

Q.3 i. What is the joint entropy H(X, Y), and what would it be if the random variables X and Y were independent? **3**

ii. A source emits one of four symbols S_0, S_1, S_2 and S_3 with probabilities 1/3, 1/6, 1/4, 1/4 respectively. The successive symbols emitted by the source are statistically independent. Calculate the entropy of the source. **7**

OR iii. A zero memory source has a source alphabet, S = $\{s_1, s_2, s_3\}$ with P = {0.5, 0.3, 0.2}. Find the entropy of the source. Find the entropy of its second extension and verify. **7**

Q.4 i. Define simplex, half duplex and full duplex transmission. **2**

ii. An information source produces sequences of independent symbols A, B, C, D, E, F, G with corresponding probabilities 1/3, 1/27, 1/3, 1/9, 1/9, 1/27, 1/27. Construct a binary code and determine its efficiency and redundancy using Shannon –Fano coding procedure **8**

OR iii. How would you represent the following bit sequence 101000110 in: **8**
(a) NRZ-L (b) NRZ – I
(c) Biphase Manchester (d) Differential Manchester

Q.5 i. What are the techniques to encode digital data into analog signals? Explain in detail. **4**

ii. Compare the techniques of multiplexing. Which technique is used when? **6**

OR iii. What do you understand by FHSS, DSSS and CDMA? How does it relate with GSM? **6**

Q.6 Attempt any two:

i. What is a perfect code? Explain the features of (7, 4) Hamming code. **5**

ii. Explain decoder for cyclic code with the help of a block diagram. **5**

iii. Explain maximum likelihood decoding of convolutional codes. **5**

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