17881

BRAINWARE UNIVERSITY

Term End Examination 2025-2026
Programme – B.Tech.(RA)-2022
Course Name – Information Theory and Coding
Course Code - PEC-ECR702A
(Semester VII)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Entropy represents:
a) amount of information b) rate of information
c) measure of uncertainty d) probability of message

(ii) What does entropy represent in the context of information theory?
a) Average information per message b) Maximum possible information
c) Minimum information possible d) Probability of a message

(iii) If a source emits four symbols with equal probabilities, identify the value of entropy of the source
a) 2 bits b) 4 bits
c) 1 bit d) 0.5 bits

(iv) If the entropy of a source is zero, it indicates:
a) Complete predictability b) Complete randomness
c) Equal likelihood of all outcomes d) Maximum information content

(v) Indicate the goal of source coding.
a) Reduce the redundancy of the source b) Increase the entropy of the source
c) Increase the redundancy d) Generate errors

(vi) Identify mutual information between two random variables.
a) Non-negative b) Zero
c) Negative d) Infinite

(vii) The minimum distance of a linear block code is determined by:
a) The number of rows in the generator matrix b) The weight of the generator matrix
c) The minimum weight of any non-zero code word d) The length of the codewords

(viii) Identify how many error can correct for a linear block code with minimum distance 3:
a) 2 error b) 1 error

c) 3 errors
d) No errors

(ix) If the syndrome of a received vector is zero, it indicates:

a) An error has occurred
b) No error
c) Multiple errors
d) A codeword with errors

(x) The parity check matrix is useful in identifying:

a) The code rate
b) The location of errors
c) The original message
d) The channel noise

(xi) Tell, a code word in a cyclic code is a multiple of:

a) Parity-check polynomial
b) Generator polynomial
c) Identity matrix
d) Error polynomial

(xii) The roots of the generator polynomial are called:

a) Code word roots
b) Error patterns
c) Syndromes
d) Error locators

(xiii) Indicate the application of trellis codes :

a) Modulation schemes
b) Data compression algorithms
c) Cryptographic systems
d) Random coding techniques

(xiv) In Turbo decoding, extrinsic information is represented as:

a) the error-detecting bits
b) a guide to improve the decoding of the next iteration
c) the parity check bits
d) none of these

(xv) Determine the minimum distance of a BCH code of length n=15 and capable of correcting 3 errors:

a) 3
b) 5
c) 7
d) 9

Group-B

(Short Answer Type Questions) 3 x 5=15

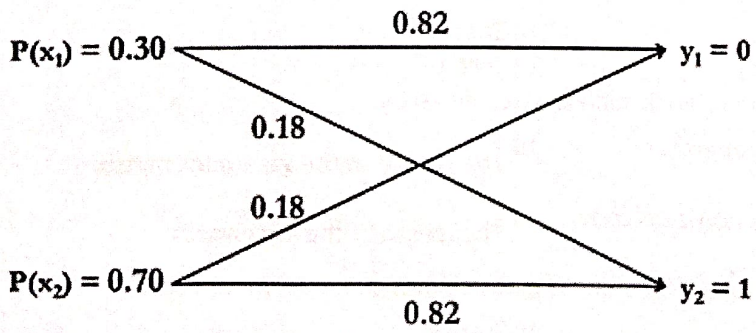
2. Describe BCH code. (3)

3. Show that the channel capacity of deterministic channel is given by $C = \log_2 n$ where n is total the number of receiver messages. (3)

4. Define Entropy. (3)

5. Illustrate parity check matrix of linear block code. (3)

6. Calculate the source entropy, and the capacity of the binary symmetric Channel (BSC) shown below. (3)



OR

A low pass channel has a suitable bandwidth of 3 KHz and S/N ratio of 20 dB at the channel output. Assuming white Gaussian Channel noise, calculate the capacity of the Channel. (3)

Group-C

(Long Answer Type Questions) 5 x 6=30

7. An internet service provider gives internet dial-up connection at 56 Kbps. If the telephone line provides a bandwidth of 3.5 KHz, calculate minimum SNR required in dB to support this. (5)

8. Show that the upper limit of channel capacity is given by $R_{max} = 1.44\frac{S}{\eta}$ (5)

9. Explain the applications of Convolutional codes. (5)

10. Calculate the generator polynomial of a double error correcting BCH code with block length n = 15. (5)

11. A source emits 2000 symbol/sec selected from alphabets A, B, C, and D with probability probabilities P_A=1/2, P_B = 1/4, P_C = 1/8, P_D = 1/8. Calculate the source entropy and the information rate. (5)

12. The generator matrix for a (7,4) block code is given below. (5)

$$G = \begin{bmatrix} 1 & 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 & 1 & 1 & 0 \end{bmatrix}$$

Calculate all the code vectors of this code.

OR

The generator matrix for a (6,3) block code is given below. Evaluate all the code vectors of this code. (5)

$$G = \begin{bmatrix} 1 & 0 & 0 & 1 & 1 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 & 1 & 1 \end{bmatrix}$$

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