

Total No. of printed pages = 3

ECE1817OE22

Roll No. of candidate

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28/2/22 2021

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B.Tech. 7<sup>th</sup> Semester End Term Examination

INFORMATION THEORY AND CODING

(New Regulation & New Syllabus)

Full Marks – 70

Time – Three hours

The figures in the margin indicate full marks  
for the questions.

Answer question No. 1 and any *four* from the rest.

1.

(1 × 10 = 10)

- (a) In Information Theory, BSC stands for:
- (i) Binary systematic channel
  - (ii) Binary symmetric channel
  - (iii) Bipolar symmetric channel
  - (iv) None of the above
- (b) Having observed the output with error probability  $(p) =$  \_\_\_\_\_, we have no information on what was transmitted.
- (i) 0      (ii) 0.25      (iii) 0.5      (iv) 1
- (c) The primary motivation of the source coding is the \_\_\_\_\_ of the data.
- (i) encoding      (ii) decoding      (iii) compression      (iv) expansion
- (d) A \_\_\_\_\_ encoding algorithm was suggested by Huffman in 1952.
- (i) Fixed length
  - (ii) Variable length
  - (iii) Differential
  - (iv) Convolutional
- (e) Source coding \_\_\_\_\_ redundancy to improve efficiency and the channel coder \_\_\_\_\_ redundancy to improve reliability.
- (i) increases, increases

(ii) increases, reduces

(iii) reduces, reduces

(iv) reduces, increases

(f) Name one of the most powerful known classes of linear cyclic block codes.

(g) What is a Block Code?

(h) Define minimal polynomial.

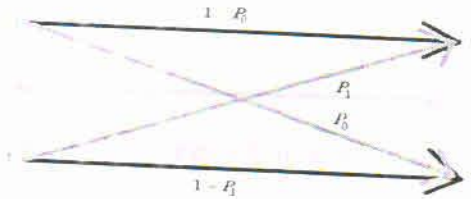
(i) What is channel transition probability?

(j) Mention any two properties of Galois Field.

2.

(a) "A high probability event conveys less information than a low probability event." Explain. (3)

(b) Find the mutual information of the events described by the following image shown below where the input symbols are equally likely. (5)



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3. (c) Explain the efficiency of VLC with an example. (7)

(a) State source coding theorem. Prove its lower bound of inequality. Also, state its condition for holding equality. (5)

(b) What is soft decision decoding? (2)

(c) List the multiple channels between the transmitter and receiver. Represent MIMO in matrix format. (4)

(d) List the steps of the Huffman coding algorithm (4)

4.

(a) Prove  $C = 1 - H(P)$  where  $C$  and  $H(P)$  represent capacity and entropy respectively. [5]

(b) "Channel encoding is also referred as Error Control Coding." Explain. (4)

(c) Explain briefly the Shannon limit of a communication system. (4)

(d) What is the significance of a parity check matrix? (2)

5.

(a) State the difference between a complete and incomplete decoder. (1)

(b) Form all the possible binary codewords with the following generator matrix: (5)

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

(c) State a necessary but not a sufficient condition for linearity of a code. (1)

(d) List the eight properties of a field  $F$  with addition and multiplication. (8)

6.

(a) What is Hamming Code? Explain the error detection and correction capability of the Hamming code. (6)

(b) What do you mean by congruent modulo  $f(x)$ ? Give suitable example. (4)

(c) Frame  $g(x)$  and  $h(x)$  for the expression:

$$x^4 - 1 = (x - 1)(x^3 + x^2 + x + 1) = (x - 1)(x + 1)(x^2 + 1). \quad (5)$$

7.

(a) What is a primitive polynomial? Explain briefly with an example. (5)

(b) Explain *any two* of the following with neat diagrams: (5 × 2 = 10)

- (i) RS codes
- (ii) ARQ
- (iii) Adaptive Huffman coding
- (iv) CRC encoding and decoding

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