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B.Sc. Engg. (EE), 7th Sem. Date: 23 December, 2023(Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Semester Final Examination — Winter Semester, A. Y. 2022-2023
Course No.: EEE 4703 — Time: 3 Hours
Course Title: Communication Engineering II — Full Marks: 150

There are **6 (six)** questions. Answer **all 6 (six)** questions. The symbols have their usual meanings. Marks of each question and corresponding CO and PO are written in brackets.

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1. a) Distinguish between coherent and non-coherent demodulation. List different modulation schemes under the two headings. **10** **(CO2, PO2)**

   b) Using generator polynomial for the (15, 5) cyclic code below, encode the message sequence 1 1 0 1 1 in systematic form. Show the resulting codeword polynomial. Write the property characterizes the degree of the generator polynomial. **15** **(CO2, PO2)**

$$g(X) = 1 + X + X^2 + X^5 + X^8 + X^{10}$$

2. a) Deduce the condition for high SER for MPSK. **10** **(CO2, PO2)**

   b) Consider a (7,4) code whose generator matrix is $\begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 & 1 & 0 \\ 1 & 1 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$ **15** **(CO2, PO2)**

   (i) Find all the codewords of the code
   (ii) Find **H**, the parity-check matrix of the code.
   (iii) Compute the syndrome for the received vector 1 1 0 1 1 0 1. Is this a valid code vector?
   (iv) Find the error-correcting capability of the code.
   (v) Find the error-detecting capability of the code.

3. a) Show that the probability of error of a BPSK signaling system is equal to M-PAM signaling system. **10** **(CO2, PO2)**

   b) Consider a systematic block code whose parity-check equations are **15** **(CO2, PO2)**

$$P_1 = m_1 + m_2 + m_4$$
$$P_2 = m_1 + m_3 + m_4$$
$$P_3 = m_1 + m_2 + m_3$$
$$P_4 = m_1 + m_3 + m_4$$

   where m_i are message digits and p_i are check digits.
   i) Find the generator matrix and the parity-check matrix for this code.
   ii) Find, how many errors can the code correct.

4. a) Derive the overall probability of symbol error of QPSK scheme. **10** **(CO2, PO2)**

b) Figure 4(b) is a representation of convolutional encoder. Assume that a received message from this encoder is 1 1 0 0 1 0. Using Viterbi algorithm (trellis diagram) find the transmitted sequence. **15** **(CO2, PO2)**

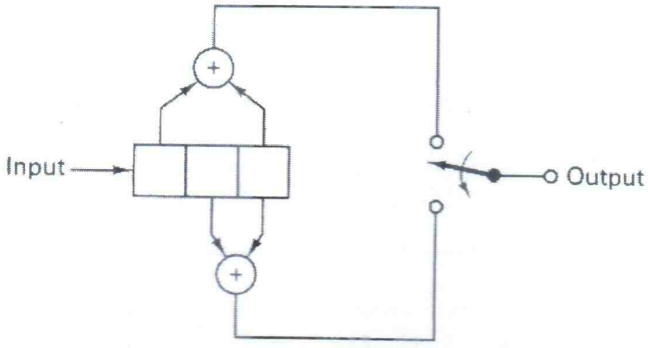

Figure 4(b)

5. a) Consider a (7,4) code whose generator matrix is **15** **(CO2, PO2)**

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

i) Find all the codewords of the code,
ii) Find **H**, the parity-check matrix of the code.

b) Construct a triple error-correcting BCH code with block length n = 31 over GF (2^5). [Hints: (n, k) = (31,16)] **10**

6. a) Construct a systematic cyclic code (7, 4) using generator polynomial g(x) = x3+x2+1, with message (1 0 1 0). **15**

b) Determine binary trees and Huffman codes for the following source statistics: **10** **(CO2, PO2)**

Symbol	S0	S1	S2	S3	S4	S5	S6	S7
Probability1	0.20	0.20	0.15	0.15	0.1	0.1	0.05	0.05
Probability2	0.3	0.25	0.1	0.1	0.075	0.075	0.05	0.05