# CBCS SCHEME - Make-Up Exam

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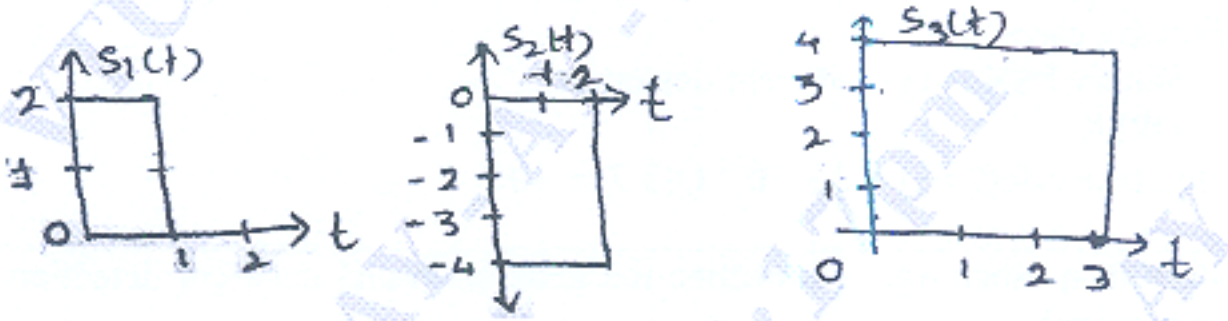
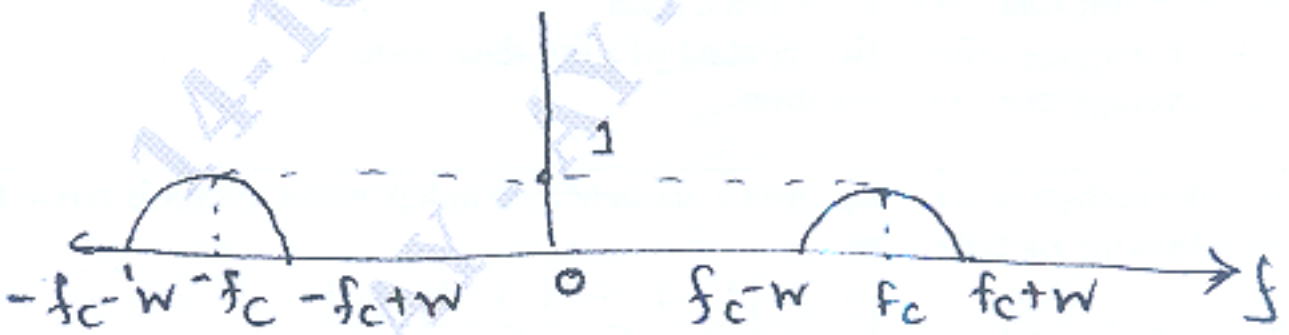
BEC503

## Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025
## Digital Communication



Time: 3 hrs. Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.*
*2. M : Marks , L: Bloom's level , C: Course outcomes.*

| | | Module – 1 | M | L | C |
|---|---|---|---|---|---|
| Q.1 | a. | Define Hilbert transform. Mention its applications. Show that a signal g(t) and its Hilbert transform are orthogonal over the entire time interval $(-\infty, \infty)$. | 6 | L2 | CO1 |
| | b. | Using Gram-Schmidth orthogonalization proceducer calculate a set orthonormal basis functions to represent the three signals $S_1(t)$, $S_2(t)$ and $S_3(t)$ shown in Fig.Q1(b). Also express each of these signals in terms of the set of basis functions.   Fig.Q1(b) | 8 | L3 | CO1 |
| | c. | Describe the correlation receiver with the neat diagrams and the maximum – likelihood decoder. | 6 | L2 | CO1 |
| | | OR | | | |
| Q.2 | a. | Express band pass signal s(t) in canonical form. Represent the in phase and quadrature components of the bandpass signal s(t). | 6 | L2 | CO1 |
| | b. | Determine pre-envelope and complex – envelope of the signal shown in Fig.Q2(b).   Fig.Q2(b) | 6 | L3 | CO1 |
| | c. | Discuss the operation of matched filter receiver with necessary diagram. | 8 | L2 | CO1 |

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| | | **Module – 2** | | | |
| Q.3 | a. | Describe the generation and reception of BPSK signal with a necessary equation and constellation diagram. | 10 | L3 | CO2 |
| | b. | The binary sequence 1100100010 is applied to the DPSK transmitter :<br>(i) Sketch the resulting waveform at the transmitter output<br>(ii) Applying this waveform to the DPSK receiver show that in the absence of noise, the original binary sequence is reconstructed at the receiver output. | 6 | L2 | CO2 |
| | c. | Explain M-ary QAM. Mention its advantage over M-ary PSK system. Obtain the constellation of QAM for M = 4 and draw signal space diagram. | 4 | L2 | CO2 |
| | | **OR** | | | |
| Q.4 | a. | Derive the expression for error probability of BPSK using coherent detection. | 8 | L3 | CO2 |
| | b. | Binary data are transmitted over a microwave link at the rate of $10^6$ BPS and PSD of noise at the receiver is $10^{10}$ watts/Hz. Compute the average carrier power required to maintain an average probability of error $P_e \leq 10^{-4}$ for the following cases :<br>(i) Binary PSK using coherent detection<br>(ii) DPSK<br>Note : take $\text{erfc}(2.63) = 2 \times 10^{-4}$ $Q(3.7) = 10^{-4}$ | 6 | L2 | CO2 |
| | c. | With a neat block diagram outline the generation and coherent detection of QPSK signal. | 6 | L2 | CO2 |
| | | **Module – 3** | | | |
| Q.5 | a. | Briefly discuss entropy and information rate. Derive the expression of average information content of a zero memory source. | 6 | L2 | CO3 |
| | b. | An international Morse code uses a sequence of symbols of dots and dashes to transmit letters of English alphabet. The dash is represented by a current pulse of duration 2 msec and dot by a duration of 1 msec. The probability of dash is half that of dot. Consider 1 msec duration of gap is given in between symbols. Calculate :<br>(i) Self information of a dot and a dash<br>(ii) An average information content of a dot-dash code<br>(iii) Average rate of information. | 6 | L3 | CO3 |
| | c. | An information source produces a sequence of independent symbols having the following probabilities.<br>$S = \{s_1\ s_2\ s_3\ s_4\ s_5\ s_6\ s_7\}$, $P = \left\{\frac{1}{3}, \frac{1}{27}, \frac{1}{3}, \frac{1}{9}, \frac{1}{9}, \frac{1}{27}, \frac{1}{27}\right\}$<br>Construct the binary and ternary code using Huffman encoding procedure. Find its efficiency and redundancy. | 8 | L3 | CO3 |