

CBCS SCHEME - Make-Up Exam

USN

| | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|
| | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|

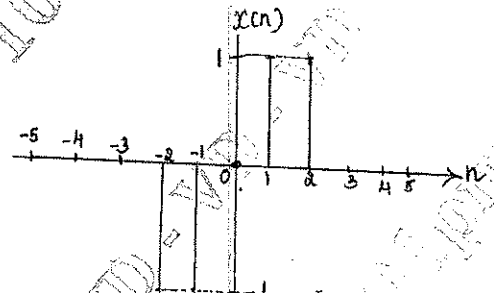
BEC502

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025 Digital Signal Processing

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 signals and systems. Briefly explain any two classifications of signals. | 6 | L1 | CO1 |
| | b. | Determine whether the following signals are periodic or not? If periodic determine the fundamental period. i) $x(n) = \cos \frac{\pi n}{2} \cos \frac{\pi n}{4}$ ii) $x(n) = \cos(100\pi n) + \sin(5\pi n)$ | 8 | L2 | CO1 |
| | c. | Determine the even and odd components of figure Q1(c) <div style="text-align: center;">  <p style="text-align: center;">Fig Q1(c)</p> </div> | 6 | L2 | CO1 |
| OR | | | | | |
| Q.2 | a. | Define the following with an example causal system, memoryless system and linear system. | 6 | L1 | CO1 |
| | b. | Verify the following system are Linear, time in variant, causal stable $y(n) = ax(n)+b$ | 6 | L2 | CO1 |
| | c. | Determine the response of the system if $x(n) = \{1, 2, 3, 1\}$ $h(n) = \{1, \frac{1}{2}, 0, -1\}$ | 8 | L2 | CO2 |
| Module - 2 | | | | | |
| Q.3 | a. | Analyze the given function to calculate the Z-transform and indicate ROC. $x(n) = \alpha^n u[n], \alpha < 1.$ | 8 | L3 | CO2 |
| | b. | Write a program to compute N-point DFT of a given sequence (without using built in function) and to plot the magnitude and phase spectrum. | 8 | L3 | CO3 |
| | c. | Find the DFT of the sequence $x(n) = \cos\left(\frac{n\pi}{4}\right).$ | 4 | L2 | CO3 |

| OR | | | | | |
|------------|----|--|----|----|-----|
| Q.4 | a. | Find the Z-transform of the signal $x(n) = n \left(\frac{1}{3}\right)^n u(n)$ | 8 | L2 | CO2 |
| | b. | Write a program to compute linear and circular convolution of any two sequences using DFT and IDFT. | 8 | L3 | CO3 |
| | c. | Compute the IDFT of sequence $x(k) = \{10, -2 + 2j, -2, -2 - 2j\}$ | 4 | L3 | CO3 |
| Module - 3 | | | | | |
| Q.5 | a. | State and prove the multiplication property of DFT. | 10 | L2 | CO3 |
| | b. | Let $h(n) = \{1, 1, 1\}$ and $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$. Obtain the output $y(n)$ using overlap save method. | 10 | L3 | CO3 |
| OR | | | | | |
| Q.6 | a. | State and prove the property of Parseval's theorem. | 10 | L2 | CO3 |
| | b. | Compute the 8-point DFT of the sequence $\{1, 2, 3, 4, 4, 3, 2, 1\}$ using DIT FFT. | 10 | L3 | CO3 |
| Module - 4 | | | | | |
| Q.7 | a. | For the given system function. Draw the direct form and cascade form. $H(z) = 1 + 5/2z^{-1} + 2z^{-2} + 2z^{-3}$ | 10 | L2 | CO4 |
| | b. | Design a high pass FIR filter using hamming window. Give $W_c = 1$ rad/sec and $M = 7$. | 10 | L3 | CO4 |
| OR | | | | | |
| Q.8 | a. | The linear phase FIR filter frequency response is $H[e^{j\omega}] = e^{j3\omega} [2 + 1.8 \cos 3\omega + 1.2 \cos 2\omega + 0.5 \cos \omega]$. Find impulse response sequence of the filter. | 10 | L3 | CO4 |
| | b. | With the equations, sketch the spectrum of following windows. i) Rectangular ii) Bartlett iii) Hanning | 10 | L2 | CO4 |
| Module - 5 | | | | | |
| Q.9 | a. | From the given difference equation obtain the equation for $H(z)$ and Also, realize it using Direct form - I and Direct form - II $y(n) = -0.1y(n-1) + 0.2y(n-2) + 3x(n) + 3.6x(n-1) + 0.6x(n-2)$. | 10 | L2 | CO5 |
| | b. | Explain the Analog filters translation using Low pass prototype transformation. | 10 | L2 | CO5 |
| OR | | | | | |
| Q.10 | a. | Write a program to Design and Implement i) IIR Butterworth low pass filter ii) IIR Butterworth high pass filter | 10 | L3 | CO5 |
| | b. | Design a digital Butterworth filter with the following specifications. $0.707 \leq H(e^{j\omega}) \leq 1; 0 \leq \omega \leq 0.5\pi$ $ H(e^{j\omega}) \leq 0.2; 0.75\pi \leq \omega \leq \pi$ Determine system function $H(z)$ for a Butterworth filter using bilinear transformation. | 10 | L3 | CO5 |

CBCS SCHEME - Make-Up Exam

USN

| | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|
| | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|

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-Schmidt orthogonalization procedure calculate a set of 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. | 8 | L3 | CO1 |
| | | <p style="text-align: center;">Fig.Q1(b)</p> | | | |
| | c. | Describe the correlation receiver with 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). | 6 | L3 | CO1 |
| | | <p style="text-align: center;">Fig.Q2(b)</p> | | | |
| | c. | Discuss the operation of matched filter receiver with necessary diagram. | 8 | L2 | CO1 |
| 1 of 4 | | | | | |

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 : (i) Sketch the resulting waveform at the transmitter output (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 BFSK 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 : (i) Binary PSK using coherent detection (ii) DPSK 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 : (i) Self information of a dot and a dash (ii) An average information content of a dot-dash code (iii) Average rate of information. | 6 | L3 | CO3 |
| | c. | An information source produces a sequence of independent symbols having the following probabilities. $S = \{s_1, s_2, s_3, s_4, s_5, s_6, s_7\}$; $P = \left\{ \frac{1}{3}, \frac{1}{27}, \frac{1}{3}, \frac{1}{9}, \frac{1}{9}, \frac{1}{27}, \frac{1}{27} \right\}$ Construct the binary and ternary code using Huffman encoding procedure. Find its efficiency and redundancy. | 8 | L3 | CO3 |

OR

| | | | | | |
|-----|----|--|---|----|-----|
| Q.6 | a. | Define mutual information. Derive the expression for mutual information and joint entropy in terms of probabilities. | 6 | L2 | CO3 |
| | b. | For the JPM given below compute individuality $H(X)$, $H(Y)$, $H(X, Y)$, $H(X/Y)$, $H(Y/X)$. $P(X, Y) = \begin{bmatrix} 0.05 & 0 & 0.2 & 0.05 \\ 0 & 0.1 & 0.1 & 0 \\ 0 & 0 & 0.2 & 0.1 \\ 0.05 & 0.05 & 0 & 0.1 \end{bmatrix}$ | 7 | L3 | CO3 |
| | c. | A binary symmetric channel has the following noise matrix with source probabilities of $P(x_1) = \frac{1}{3}$, $P(x_2) = \frac{1}{3}$, $P(Y/X) = \begin{bmatrix} 3/4 & 1/4 \\ 1/4 & 3/4 \end{bmatrix}$ Determine : i) $H(X)$, $H(Y)$, $H(X, Y)$, $H(Y/X)$, $H(X/Y)$ and $I(X, Y)$ ii) Channel capacity iii) Channel efficiency and redundancy. | 7 | L3 | CO3 |

Module - 4

| | | | | | |
|-----|----|---|----|----|-----|
| Q.7 | a. | Calculate the generator matrix G and parity check matrix H for a linear block code with matrix H for a linear block code with minimum distance three and a message block size of eight bits. | 4 | L3 | CO4 |
| | b. | Draw the general block diagram of syndrome calculation circuit for cyclic codes and explain its operation. | 6 | L2 | CO4 |
| | c. | For a systematic (7, 4) linear block code, the parity matrix P is given by $[P] = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 1 \end{bmatrix}$ (i) Calculate all possible valid code vectors (ii) Draw the corresponding encoding circuit (iii) A single error has occurred in each of these received vectors. Detect and correct those errors. a) $R_A = [0 1 1 1 1 1 0]$ b) $R_B = [1 0 1 1 1 0 0]$ c) $R_C = [1 0 1 0 0 0 0]$ (iv) Draw syndrome calculation circuit. | 10 | 3 | CO4 |

OR

| | | | | | |
|-----|----|--|---|----|-----|
| Q.8 | a. | The generator polynomial for a (15, 7) cyclic code is $g(x) = 1 + x^4 + x^6 + x^7 + x^8$ (i) Compute the code = vector is systematic form for the message $D(x) = x^2 + x^3 + x^4$ (ii) Assume that the first and last bit of the code vector $V(x)$ for $D(x) = x^2 + x^3 + x^4$ suffer transmission errors. Calculate the syndrome of $V(x)$. | 6 | L3 | CO4 |
| | b. | With a neat block diagram and suitable example, describe error – control – based communication system. | 6 | L2 | CO4 |
| | c. | Consider a (6, 3) linear code whose generator matrix is $G = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \end{bmatrix}$ Calculate : i) All code vectors ii) All the hamming weights and distances iii) Minimum weight parity check matrix iv) Draw the encoder circuit for the above codes. | 8 | L3 | CO4 |

Module – 5

| | | | | | |
|-----|----|--|----|----|-----|
| Q.9 | a. | Describe decoding of convolution codes using viterbi algorithm with a suitable example. | 10 | L2 | CO5 |
| | b. | Consider the convolution of encoder shown in Fig.9(b). The code is systematic i) Represent the state diagram ii) Relate the code tree iii) Calculate the encoder output produced by the message sequence 1 0 1 1 iv) Verify the output using time-domain approach. | 10 | L3 | CO5 |

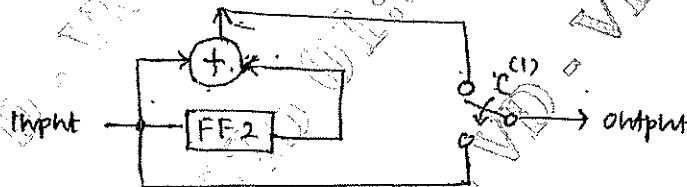


Fig.Q9(b)

OR

| | | | | | |
|------|----|--|----|----|-----|
| Q.10 | a. | Illustrate recursive systematic convolution codes with a suitable example. | 6 | L2 | CO5 |
| | b. | Consider a (3, 1, 2) convolution encoder with $g^{(1)} = 110$, $g^{(2)} = (101)$, $g^{(3)} = 111$. (i) Encoder block diagram (ii) State table (iii) State transition table (iv) State diagram (v) Compute encoder output traversing through the state diagram for input message sequence of (11101) (vi) Draw the code trellis and obtain the output of the encoder for the same input sequence of (11101). | 14 | L3 | CO5 |

CBCS SCHEME

USN

| | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|
| | | | | | | | | | |
|--|--|--|--|--|--|--|--|--|--|

BEC515D

Fifth Semester B.E./B.Tech. Degree Examination, June/July 2025 Satellite and Optical 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. | Explain the following parameters : i) Ascending and descending node ii) Solstices iii) Equinoxes. | 6 | L1 | CO1 |
| | b. | Explain the types of satellite orbits. | 7 | L1 | CO1 |
| | c. | Define and explain the following terms : i) Azimuth angle ii) Elevation angle. | 7 | L2 | CO1 |
| OR | | | | | |
| Q.2 | a. | Explain the Kepler's law of planetary motion in detail. | 9 | L1 | CO1 |
| | b. | Explain the types of stabilization and mention its advantages. | 5 | L1 | CO1 |
| | c. | Define the Eclipse and also explain its types. | 6 | L1 | CO1 |
| Module – 2 | | | | | |
| Q.3 | a. | Explain with Diagram Telemetry Tracking command. | 10 | L2 | CO2 |
| | b. | Explain Earth Station Architecture in detail. | 10 | L2 | CO2 |
| OR | | | | | |
| Q.4 | a. | Explain types of earth station. | 10 | L2 | CO2 |
| | b. | Define and explain the following : i) Testing ii) Satellite Tracking. | 10 | L2 | CO2 |
| Module – 3 | | | | | |
| Q.5 | a. | Mention the advantage of Satellite Vs Terrestrial networks. | 10 | L2 | CO3 |
| | b. | Explain the typical satellite TV networks. | 10 | L2 | CO3 |
| OR | | | | | |
| Q.6 | a. | Mention different types of frequency bands and its range? Also explain the any one payload of satellite communication. | 10 | L2 | CO3 |
| | b. | Write short notes on : i) Regional satellite system ii) National satellite system. | 10 | L1 | CO3 |
| Module – 4 | | | | | |
| Q.7 | a. | Draw a schematic of fiber optic structure and explain its parts. | 10 | L2 | CO4 |
| | b. | Define the following terms : i) Attenuation ii) Absorption iii) Scattering loss. | 10 | L2 | CO4 |
| OR | | | | | |
| Q.8 | a. | Explain Propagation modes in single mode fibers. | 10 | L1 | CO4 |
| | b. | Explain while selecting optical fiber material what are the requirement must be satisfied. | 10 | L2 | CO4 |
| Module – 5 | | | | | |
| Q.9 | a. | Explain the LED structure in detail with cross section drawing. | 10 | L2 | CO5 |
| | b. | Explain the laser diode modes and its threshold conditions. | 10 | L2 | CO5 |
| OR | | | | | |
| Q.10 | a. | Explain the key features of WDM | 10 | L2 | CO5 |
| | b. | Explain the operational principles of WDM. | 10 | L2 | CO5 |