ADVANCED DIGITAL COMMUNICATION TECHNIQUES
(ECEN 5201)

Time Allotted: 2½ hrs   **Full Marks: 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 4 (four)</u> from Group B to E, taking <u>one</u> from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Maximum quantization error in binary PCM is
(a) $\pm S/2$ (b) $\pm S$ (c) $\pm 2S$ (d) S^2 ;   where S= Step size

(ii) Coding efficiency is given by
(L_{avg} represents the average no. of bits/symbol)
(a) L_{max}/ L_{avg} (b) L_{min}/ L_{avg}
(c) L_{min}/ L (d) L_{max}/ L

(iii) An encoder for a (4, 3, 5) convolution code, maximum number of memory elements present in an individual shift register is
(a) 1   (b) 3   (c) 4   (d) 5

(iv) Companding is used
(a) to overcome quantization noise in PCM
(b) in PCM transmitters, to allow amplitude limiting in the
(c) to protect small signals in PCM from quantization distortion
(d) in a PCM receiver, to overcome impulse noise.

(v) Thermally generated noise in a piece of register follows one distribution given below
(a) Binomial   (b) Poisson's
(c) Laplacian   (d) Gaussian.

(vi) In eye pattern, as eye closes
(a) Timing jitter increases   (b) ISI decreases
(c) Timing jitter increases   (d) ISI increases.

(vii) In QPSK modulation, the dibits depend on
(a) Frequency only   (b) Amplitude only
(c) Amplitude and frequency   (d) Amplitude and phase.

(viii) MIMO stands for
(a) Multiple Input Minimum Output   (b) Multiple Input More Output
(c) Multiple Input Multiple Output   (d) More Input More Output.

(ix) Number of elements in GF (2^5) field is
(a) 5   (b) 16   (c) 31   (d) 32

(x) Piconet in Bluetooth networks can consist of
(a) 6 slaves and two masters   (b) 8 slaves
(c) 1 master and 7 slaves   (d) None of these.

Fill in the blanks with the correct word

(xi) In a GSM system the uplink frequency is 935 MHz. The downlink frequency will be _____.

(xii) The number of distinct symbols present in 8-PSK system _____.

(xiii) For a block code with d_{min} = 5, the error correction capability is _____.

(xiv) In QPSK, a symbol is represented by a _____.

(xv) Quantization error can be decreased if the sampling clock is made _____.

Group - B

2. (a) Draw the block diagram for a basic digital communication system.
[(CO1)(Remember/LOCQ)]
(b) Explain the functions of 'Source Encoding' and 'Channel Encoding'.
[(CO5)(Understand/IOCQ)]
(c) Show the schematic diagram for Linear Gaussian Channel model and write the Expression for the output, Y(t).   *[(CO1)(Remember/IOCQ)]*
4 + 3 + 5 = 12

3. (a) What is ISI in digital communication and why does it occur? How do you visualize the effect of ISI in the received data?   *[(CO6)(Analyse/IOCQ)]*
(b) Explain the ISI phenomenon using the baseband equivalent channel model.
[(CO6)(Analyse/IOCQ)]
(c) What is the function of the equalizer?Draw the equivalent transmission system model with the equalizer.   *[(CO4)(Analyse/IOCQ)]*
(2 + 2 + 1) + 3 + (1 + 3) = 12

Group - C

4. (a) For a bit sequence of 100011 draw the resulting waveform for (i) B-ASK (ii) B-FSK (iii) PSK modulation scheme.   *[(CO2)(Apply/IOCQ)]*
(b) To transmit a bit sequence of 1100110, draw the resulting waveform using following line code format (i) Polar-RZ (ii) Unipolar NRZ (iii) Manchester Coding.   *[(CO2)(Apply/IOCQ)]*
(c) With suitable diagrams, explain the working principle of the QPSK transmitter and draw its signal space diagram.   *[(CO2)(Understand/LOCQ)]*
3 + 3 + (4 + 2) = 12

5. (a) How does multi-carrier CDMA system work? *[(CO3)(Understand/IOCQ)]*
   (b) Explain the working principle of OFDM transmitter and OFDM receiver with the help of a block diagram. *[(CO3)(Remember/LOCQ)]*
   (c) Discuss the advantages of OFDM over FDM. *[(CO3)(Analyse/IOCQ)]*

   4 + 5 + 3 = 12

Group - D

6. (a) Derive the equation for system bandwidth as a function of channel capacity and SNR. *[(CO4)(Analyse/IOCQ)]*
   (b) Show with diagram how DS-SS is generated. Create a spread spectrum signal using Barker sequence. Use any data sequence signal as input. *[(CO4)(Create/HOCQ)]*

   4 + 8 = 12

7. (a) Discuss the working principle of slotted ALOHA. *[(CO1)(Remember/LOCQ)]*
   (b) Explain how RAKE receivers help quality reception in CDMA systems. Explain the operation of a RAKE receiver with the help of a block diagram. *[(CO3)(Analyse/IOCQ)]*

   4 + (4 + 4) = 12

Group - E

8. (a) Why in data communication, addition and subtraction (involving 1 and 1) results are same? Explain clearly. *[(CO5)(Analyse/IOCQ)]*
   (b) A discrete memory less source has 5 messages S_1, S_2, S_3, S_4, S_5 with probability matrix {0.3,0.29,0.16,0.15,0.1}. Construct the Huffman Code and calculate the code efficiency. *[(CO5)(Analyse/HOCQ)]*

   4 + 8 = 12

9. (a) Parity check matrix of a linear block code is

   $$H = \begin{bmatrix} 1110100 \\ 0111010 \\ 1101001 \end{bmatrix}$$

   (i) Determine the generator matrix.
   (ii) Write down the parity bit generating equations.
   (iii) Assuming that a vector [1010101] is received, find the correct data. *[(CO5)(Apply/IOCQ)]*
   (b) Explain with the help of the coding gain curve, how a minimum values of (E_b/N_0) is important. *[(CO6)(Analyse/HOCQ)]*

   6 + 6 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	19.79	57.29	22.92

Course Outcome (CO):

After the completion of the course students will be able to
1. Learn about the transmission techniques, synchronization in digital communication.
2. Know about the modulation schemes, OFDM etc.
3. Acquire knowledge about the CDMA in details
4. Have clear idea about estimation and detection schemes. They will be able to design reliable channel codings.
5. Understand the differences between coding schemes.
6. Analyse the digital communication quality.

LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question.