ADVANCED DIGITAL COMMUNICATION TECHNIQUES
(ECEN 5201)

Time Allotted : 3 hrs   **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

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

   (ii) To avoid slope overload in delta modulation, the maximum value of
         signal amplitude will be
         (a) sf_s (b) w/s (c) sf_s/w (d) f_s/w
         s = Step size f_s = sampling frequency   w = Signal frequency

   (iii) The binomial coefficient in binomial distribution is given by

         (a) $\dfrac{n!}{k!(n-k)!}$ (b) $\dfrac{n!}{(n-k)!}$

         (c) $\dfrac{n!}{k!}$ (d) $\dfrac{1}{n!(n-k)!}$.

   (iv) In T1 carrier system output bit rate is
         (a) 2.9 Mbps   (b) 3.5 Mbps
         (c) 1.536 Mbps   (d) 1.9 Mbps.

   (v)   In QPSK the transmission bandwidth required is
         (a) f_b (b) $2 f_b$ (c) $f_b/2$ (d) $4 f_b$
         f_b = Bit frequency

   (vi) SSBSC used in FDM is the abbreviation for
         (a) sequential side band small channel
         (b) synchronized separate band symbol channel
         (c) single side band suppressed carrier
         (d) symmetric subscriber base station channel.

   (vii) For hamming distance d_{min} and t errors in the received word, the
         condition to be able to correct the errors is
         (a) $2t + 1 \le d_{min}$ (b) $2t + 2 \le d_{min}$
         (c) $2t + 1 \le 2d_{min}$ (d) both (a) and (b)

   (viii) A bit in spreading signal in DSSS is called
         (a) block   (b) datagram   (c) chip   (d) quantile.

   (ix) In FHSS modulation commonly used is
         (a) MASK   (b) MPSK   (c) MFSK   (d) MSK.

   (x)   Which is better for avoiding jamming?
         (a) Direct sequence spread spectrum
         (b) Frequency hopping spread spectrum
         (c) Time hopping spread spectrum
         (d) None of the mentioned.

Group – B

2. (a) Name the important types of digital pulse modulation techniques. In
        PCM, explain the functions of the different stages. What is
        'Quantization error'? How can it be reduced?

   (b) Draw the spectrum of a signal sampled by PCM when: (i) $f_s \ge 2f_m$; (ii) f_s
        $= 2f_m$ and (iii) $f_s < 2f_m$, Where f_s = sampling rate and f_m = maximum
        frequency of the modulating signal.

                                                      6 + 6 = 12

3. (a) What is ISI in digital communication and why does it occur?

   (b) Explain the ISI phenomenon using the baseband equivalent channel model.

   (c) Draw the equivalent transmission system model with the equalizer.
        What is the function of the equalizer?

                                                      2 + 4 + (3 + 3) = 12

Group – C

4. (a) What is the difference between uni-polar and polar formats of binary
        representation? Draw the waveforms for: (i) 01011001 and (ii)
        10100010 in both the formats.

   (b) Give mathematical representation for ASK. Draw the ASK waveform
        for 110010.

   (c) Draw and explain the block diagram for ASK detection circuit.
                                                      4 + 3 + 5 = 12

5. (a) How does multi-carrier CDMA system work?

   (b) Explain with block diagrams for OFDM transmitter and OFDM receiver.

   (c) How is OFDMA derived from OFDM?

$$2 + (4 + 4) + 2 = 12$$

Group – D

6. (a) State the important features of TDMA. Why does GSM use FDMA/TDMA technique?

   (b) Draw the block diagram of a UMTS uplink transmitter. Consider channelization is scrambling codes. Briefly explain their functions.

$$6 + 6 = 12$$

7. (a) How does slotted ALOHA work?

   (b) How does MAI limit number of CDMA users?

   (c) State the important features of CDMA. How does Bluetooth work? Explain briefly for a piconet.

$$2 + 3 + (4 + 3) = 12$$

Group – E

8. (a) Why is source coding applied in digital communication? Name at least 3 algorithms applied. Define mathematically discrete, memory less source.

   (b) A source emits seven symbols with probabilities of {0.25, 0.25, 0.125, 0.125, 0.125, 0.0625, and 0.0625}. Find out the Shannon Fano Code and calculate the efficiency.

$$4 + 8 = 12$$

9. (a) Explain with the help of the coding gain curve, how a minimum values of (E_b/N_0) is important.

   (b) What are the characteristics of a 'Finite Field' or 'Galois Field'?

   (c) The generator matrix for a (6,3) block code is given below. Find all the code vectors of this code.

$$G = \begin{bmatrix} 100110 \\ 010011 \\ 001111 \end{bmatrix}$$

$$2 + 3 + 7 = 12$$