Instructions: (1) All questions are compulsory.
(2) Answer each next main Question on a new page.
(3) Illustrate your answers with neat sketches wherever necessary.
(4) Assume suitable data, if necessary.
(5) Use of non-programmable Electronic Pocket Calculator is permissible.
(6) Mobile phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

1. A) Attempt any three:

   a) State Shannon Hartley theorem. What is its implications?
   b) State Sampling Theorem. Explain aliasing effect with neat diagram.
   c) How does FDM technique combines multiple signals into one?
   d) Compare DSSS and FHSS system w.r.t.
      i) definition
      ii) chip rate
      iii) modulation technique used
      iv) effect of fading.

B) Attempt any one:

   a) Draw the block diagram of digital communication system. What is need of channel modelling? Explain any one model in brief.
   b) Generate CRC code for data word 1101101001 by using divisor as 1101. State 2 advantages of CRC method.
2. Attempt any two:
   a) Draw the neat block diagram of PCM transmitter and receiver. Explain the same with waveforms.
   b) Draw the block diagram of QPSK transmitter and receiver. Explain its working principle. Draw its constellation diagram.
   c) With neat sketch describe the working of OFDM multi carrier system.

3. Attempt any four:
   a) With the help of relevant block diagram, explain the working principle of adaptive delta modulation transmitter.
   b) Describe the concept of slope-overload distortion in a DM system. Draw neat waveform. How it can be avoided.
   c) Compare TDMA, FDMA and CDMA techniques based
      i) definition
      ii) bandwidth available
      iii) synchronization
      iv) application.
   d) Draw the DPSK transmitter and outline its working principle.
   e) Write the bandwidth requirement for BASK, BFSK, BPSK, QPSK.

4. A) Attempt any three:
   a) Discuss the characteristics of communication channels w.r.t.
      i) bit rate
      ii) bandwidth
      iii) repeater distance
      iv) application.
b) Explain companding. Sketch the input-output characteristics of a compressor and an expander.

c) What are maximal-length sequence? Generate maximum-length sequence of length 7 with feedback taps = [3, ⊥].

d) Draw NRZ–I, manchester, differential manchester and AMI waveforms of line codes for data stream 1101001.

4. B) Attempt any one:

   a) A discrete memory less source has the letters A, B, C, D, E, F and G with corresponding probabilities {0.08, 0.2, 0.12, 0.15, 0.03, 0.02, 0.4}.

      i) Derive Huffman code for the above source and determine the average length of the code word.

      ii) Determine the coding efficiency of the Huffman code designed.

   b) Draw the block diagram of a BFSK/FHSS transmitter and explain its working. State any two advantages.

5. Attempt any two:

   a) Describe the North American digital multiplexing hierarchy with neat diagram.

   b) With the help of block diagram explain the working principle of QAM system.

   c) Draw block diagram of direct sequence spread spectrum and explain its working principle.
6. **Attempt any four:**

   a) State any two advantages and two disadvantages of PCM system.

   b) State the principle of orthogonality. Explain the concept of single carrier and multi carrier system.

   c) Describe M-ary encoding. State any two advantages and one disadvantage of it.

   d) With example explain how hamming code is used for single bit error correction.

   e) Compare QAM and QPSK (any four points).