

CCG ~~VIII~~ sem  
2023

**Indian Institute of Information Technology Nagpur**  
**Department of Electronics and Communication Engineering**  
**Digital Communication (ECL 320)**

Time: 3 hour

**End Sem Examination**

Maximum marks: 50

**Important instructions:**

1. All questions are compulsory.
2. Indicate the important steps of reasoning/calculations.
3. Maximum marks for each question are indicated on the right-hand side.

Q. 1. A compact Disk CD recording system samples each of two stereo signals with a 16-Bit analog-to-digital converter at 44.1 kbps.

- a. Determine the output signal to quantization ratio on a full scale.
- b. The bit stream of digitized data is augmented by the addition of error-correcting bits, clock extraction bits, and display and control bits. This additional bit represents 100 per cent overhead. Determine the output bit rate of the CD recording system.
- c. The CD can record an hour's worth of music. Determine the number of bits recorded on a CD.

(CO - 2) [2 + 2 + 1]

Q. 2. A linear delta modulator is designed to operate on speech signals limited to 3.4 kHz. The specifications of the modulator are as follows:

- Sampling rate =  $10 \cdot f_{\text{Nyquist}}$ , where  $f_{\text{Nyquist}}$  is the Nyquist rate of the speech signal.
- Step size  $\Delta = 100$  mV.

The modulator is tested with a 1 kHz sinusoidal signal. Determine the maximum amplitude of this test signal required to avoid slope-overload distortion.

(CO - 2) [5]

Q. 3. A source emits one of four messages randomly every microsecond. The probabilities of these messages are 0.5, 0.3, 0.1, and 0.1. Messages are generated independently.

- a) What is the source entropy?
- b) Obtain a compact binary code and determine the average length of the code word, the efficiency, and the redundancy of the code.

(CO - 3) [5]

Q. 4. What is Line coding? For the binary stream 011010 sketch the following line codes :

- (i) Unipolar NRZ (ii) Polar NRZ (iii) Unipolar RZ (iv) Bipolar RZ (v) Manchester

(CO - 5) [5]

Q. 5. With a neat block diagram; explain the generation and coherent detection of QPSK signals.

(CO - 3) [5]

Q. 6. (a) Explain the generation and demodulation of DSSS with the necessary equation and block diagram.

(b) Compare slow FHSS and Fast FHSS.

(CO - 4) [3 + 2]

Q. 7. Derive the optimum filter's impulse response  $h(t)$  (Match Filter).

(CO - 2) [5]

Q. 8. (a) The M-Ary PSK digital communication system requires transmitting data with a 100 Mbps bit rate within the maximum allowable channel bandwidth of 20 MHz. What will be the value of M?

(b) What are the advantages of modern digital wireless communications?

(CO - 4, 5) [2 + 3]

Q. 9. Figure displays the waveforms of four signals  $s_1(t)$ ,  $s_2(t)$ ,  $s_3(t)$ , and  $s_4(t)$ .

(a) Using the Gram-Schmidt orthogonalization procedure, find an orthonormal basis for the given set of signals.

(b) Construct the corresponding signal-space diagram.

(CO-3, 4) [5 + 5]

