

SECTION I : 30 Marks

- Q1. (a) (i) Explain the difference between analog and digital data, and state four advantages and two disadvantages of using digital communication systems for data transfer.. 8 marks
- (ii) The following devices are synonymous with data communication: Modem; Codec; multiplexer/demultiplexer (DMux).
Explain the meaning and / or the significance of each one in data communication. 6 marks
- (ii) Outline the challenges, at least two in each case, of using guided and unguided transmission medium; and state the factors that should be considered while choosing the type of medium for use in data transmission 6 marks
- (b) (i) Name three types of transmission impairment and state their causes and effects in data transmission. 6 marks
- (ii) Explain the fundamental difference(s) between Nyquist and Shannon's formula for channel bit-rate, and state (at least three) factors that affect data transmission rate through a transmission medium 4 marks

SECTION II

Answer any TWO complete questions from this section.

Question 2: (20 marks)

- (a) Explain, using relevant sketch / block diagram, the principles of digitization of an analog signal using pulse code modulation (PCM) techniques. Clearly explain the function(s) of each block 10 marks
- (b) State the Nyquist signal sampling theorem. 2 marks

Data signal occupying a bandwidth of 3 KHz (including guard band) is sampled at Nyquist rate and digitized for transmission using PCM techniques. The samples are then encoded using 8 bits including parity bit.

- (i) Explain the significance of guard band and parity bit in signal transmission?
prevent error 2 marks
- (ii) Determine the data sampling rate in bits per second. 4 marks
- (iii) Determine the signal-to -quantization error ratio (or Carrier-to-Noise power ratio), in dB, of the PCM system, provided its predetermined voltage boundaries are not exceeded.
2 marks

Question 3: (20 marks)

- (a) (i) What is a Public Data Network (PDN)? 1 marks
- (ii) Name the THREE Data Network configurations and explicitly state their characteristics. 9 marks
- (b) Name and explain the characteristics of the THREE switching techniques used with public Data Networks
N & Z 6 marks
- (c) Define "Ethernet" with reference to Data Communication; and explain the meaning of the following standards as applied to Ethernet base-band transmission:
single signal at a time.
10 BASE-5; and 100 BASE-T 4 marks

Question 4: (20 marks)

- (a) (i) Explain, giving at least four reasons, why standardization is necessary in communication systems; and differentiate between "de facto" and "de jure" standards 5 marks
- (ii) Name two Standards Organizations in communications and briefly explain

their functions.

4 marks

- (b) (i) Explain the functional difference between Universal Asynchronous Receiver/Transmitter (UART) and Universal Synchronous Receiver/Transmitter (USRT), and state their primary functions

8 marks

- (ii) Explain the essence of serial and parallel interfaces in data communication.

3 marks

QUESTION 5: (20 marks)

- (a) Explain the use of redundancy as a means of error detection in data communication; and state the advantages and disadvantages of the method in general.

6 marks

- (b) Determine the Block Check Sequence (BCS) and Cyclic Redundancy Checking (CRC)- generating polynomials for the following data:

$$G(x) = x^7 + x^4 + x^2 + x^0$$

$$P(x) = x^5 + x^4 + x^1 + x^0$$

6 marks

- (c) State three disadvantages and one advantage of Hamming code as a technique for error correction.

A 12 bit data string of **101100110010** was transmitted using Hamming code technique:

- (i) Determine the Hamming code bits

4 marks

- (ii) If the received code was: **11010100111101010**, analyse the data for error.

4 marks