

Question 1 (Two-Dimensional Parity Check – Sender & Receiver)

A sender wants to transmit the following 4 datawords (each 4 bits) using a **two-dimensional parity check** with **even parity** for both rows and columns:

Datawords:

1010

0111

1100

1001

a) Calculate the two-dimensional parity check and show the complete transmitted block.

b) The receiver gets the following block. Show the accuracy of the transmitted message

Received block:

1 0 1 0 | 0

0 1 1 1 | 1

1 1 0 0 | 0

1 0 0 1 | 1

1 0 1 1 | 0

Question 2 (Simple Parity Check – Sender & Receiver)

A sender uses **even parity** for each 7-bit dataword to create an 8-bit codeword.

a) Encode the following datawords into codewords:

- 1010101
- 1111000

- 0000000

b) The receiver gets these codewords. Which are valid and which are invalid? If invalid, can the receiver correct the error?

- 10101010
- 11110001
- 00000001

Question 3 (Checksum – Sender & Receiver)

A sender uses the **Internet checksum** to send two 16-bit words:

Sender words: 1100110011001100 and 1010101010101010

a) Calculate the checksum and show the transmitted packet

b) The receiver gets these three 16-bit words. Verify if the packet is error-free. Show the receiver's calculation.

Word1: 1100110011001100

Word2: 1010101010101010

Checksum: 0110010101100101

Question 4 (Checksum – Error Detection)

A sender transmits the following 16-bit words and checksum:

Word1: 1111000011110000

Word2: 0000111100001111

Checksum: 0000000000000000

a) Verify if this packet has an error. Show all calculations.

b) If the receiver gets the checksum as 1111111111111111 instead, what would the receiver conclude?

Question 5 (CRC – Sender & Receiver)

A sender uses **CRC** with generator 1011.

a) Calculate the CRC for dataword 11010011. Show the full division and the transmitted codeword.

b) The receiver gets 11010011101. Perform the division and determine if the frame is accepted or rejected.

Question 6 (CRC – Error Detection)

A sender transmits codeword 10101010101 using generator 1101.

a) The receiver gets 10101010111. Perform CRC division and determine if an error is detected.

b) If the receiver gets 10101010101 (same as transmitted), show the division result.

Question 7 (CRC – Full Sender & Receiver with Error)

A sender wants to send data 101110 using generator polynomial $x^3 + x + 1$.

- a) Calculate the CRC and show the transmitted frame.
- b) The receiver gets 101110101. Perform the division and state whether the frame is accepted or not.
- c) If the receiver gets 101110100, what would the receiver conclude?
-

Question 8 (Two-Dimensional Parity – Sender & Receiver with Burst Error)

Sender transmits the following 3x3 data block (each dataword 3 bits) with even parity for rows and columns:

Data:

111
000
101

- a) Show the full two-dimensional parity check.
- b) The receiver gets this block. Detect if there are any errors in the send message.

text

Received:

1 1 1 | 1
0 0 0 | 0
1 0 1 | 0

0 1 0 | 0

Question 9 (Checksum – Sender Calculation with Multiple Words)

A sender has four 8-bit words to transmit using a **checksum**:

Word1: 10101010

Word2: 01010101

Word3: 11110000

Word4: 00001111

- a) Calculate the 8-bit checksum.
 - b) The receiver gets the four words and checksum. Verify the packet.
-

Question 10 (Mixed – Compare All Three Methods)

A sender has dataword 1101.

- a) Using **even parity**, show the codeword and what the receiver checks.
 - b) Using **CRC** with generator 1011, show the transmitted frame and receiver division.
 - c) Using **checksum**, where the dataword is split into two 2-bit words 11 and 01, calculate the checksum and verify.
-