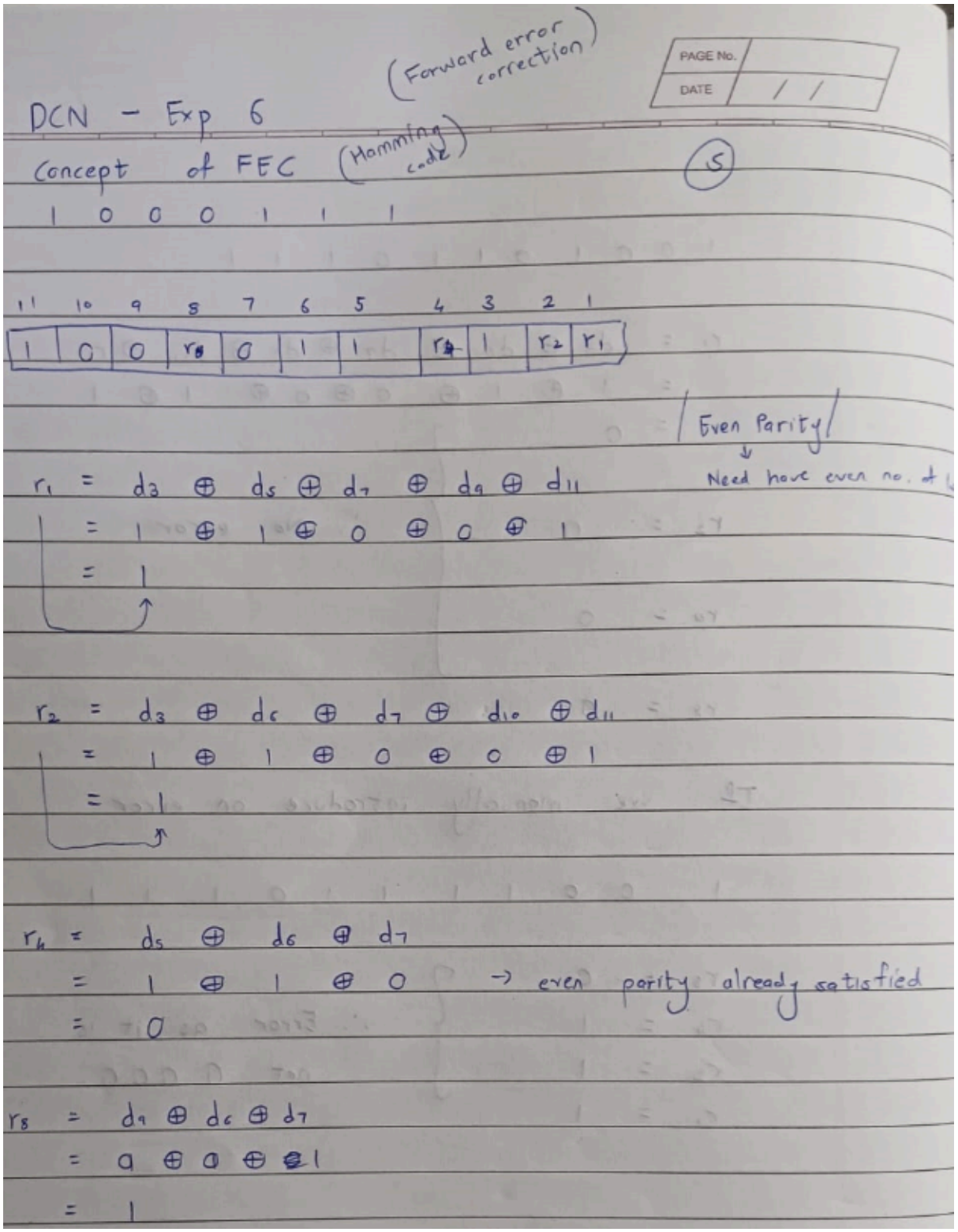
Most Important :

1)Hamming code correction



DCN - Exp 6 (Forward error correction)

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Concept of FEC (Hamming code) (5)

1 0 0 0 1 1 1

11	10	9	8	7	6	5	4	3	2	1
1	0	0	r_8	0	1	1	r_4	1	r_2	r_1

Even Parity

↓

Need have even no. of 1

$r_1 = d_3 \oplus d_5 \oplus d_7 \oplus d_9 \oplus d_{11}$

$= 1 \oplus 1 \oplus 0 \oplus 0 \oplus 1$

$= 1$

$r_2 = d_3 \oplus d_6 \oplus d_7 \oplus d_{10} \oplus d_{11}$

$= 1 \oplus 1 \oplus 0 \oplus 0 \oplus 1$

$= 1$

$r_4 = d_5 \oplus d_6 \oplus d_7$

$= 1 \oplus 1 \oplus 0$ → even parity already satisfied

$= 0$

$r_8 = d_9 \oplus d_6 \oplus d_7$

$= 0 \oplus 0 \oplus 1$

$= 1$

1 0 0 1 0 1 1 0 1 1 1

$r_1 = d_3 \oplus d_5 \oplus d_7 \oplus d_9 \oplus d_{11} \oplus r_1$

$= 1 \oplus 1 \oplus 0 \oplus 0 \oplus 1 \oplus 1$

$= 0$

$r_2 = 0$

$r_4 = 0$

$r_8 = 0$

} ∴ No error

If we manually introduce an error

1 0 0 1 1 1 1 0 1 1 1

$r_8 = 0$

$r_4 = 1$

$r_2 = 1$

$r_1 = 1$

} ∴ Error as it is not 0 0 0 0.

2)UDP (Asked in previous Exam)

Example 1 :

The following is the contents of a UDP header in hexadecimal format.

CB84000D001C001C

a. What is the source port number?
b. What is the destination port number?
c. What is the total length of the user datagram?
d. What is the length of the data?
e. Is the packet directed from a client to a server or vice versa?
f. What is the client process?

Solution

a. The source port number is the first four hexadecimal digits $(CB84)_{16}$ or 52100
b. The destination port number is the second four hexadecimal digits $(000D)_{16}$ or 13.
c. The third four hexadecimal digits $(001C)_{16}$ define the length of the whole UDP packet as 28 bytes.
d. The length of the data is the length of the whole packet minus the length of the header, or $28 - 8 = 20$ bytes.
e. Since the destination port number is 13 (well-known port), the packet is from the client to the server.
f. The client process is the Daytime (see Table 3.1).

Example 2 :

The following is a dump of a UDP header in the hexadecimal format.

06 32 00 0D 00 1C E2 17

(i) What is the source port number?
(ii) What is the destination port number?
(iii) What is the length of the data?
(iv) Is the packet directed from a client to server or vice versa? Justify the answer.
(v) List any two fields in the TCP header that are missing in UDP header.

Solution :

UDP Header: 06 32 00 0D 00 1C E2 17

1. **What is the source port number?**
   - The source port is represented by the first 4 hexadecimal digits: `06 32`.
   - Converting `06 32` from hexadecimal to decimal gives **1586**.
2. **What is the destination port number?**
   - The destination port is represented by the next 4 hexadecimal digits: `00 0D`.
   - Converting `00 0D` from hexadecimal to decimal gives **13**.
3. **What is the length of the data?**
   - The length field is represented by the next 4 hexadecimal digits: `00 1C`.
   - Converting `00 1C` from hexadecimal to decimal gives **28** bytes (this includes the header size, so the data size may vary based on that).
4. **Is the packet directed from a client to server or vice versa? Justify the answer.**
   - Based on the source port `1586` (higher value) and destination port `13` (well-known, low-value port), it is likely that this packet is directed **from a client to a server**, as clients often use ephemeral (higher) port numbers while sending requests to a server using a well-known service port.
5. **List any two fields in the TCP header that are missing in UDP header.**
   - **Sequence number**: Used to track the order of packets in TCP.
   - **Acknowledgment number**: Used to acknowledge receipt of packets in TCP.

3)TCP

Q) The following is a dump of a TCP header in hexadecimal format:

00CD0018 80000EF1 000005D5 502200D1 01BF0010

1. **What is the source port number?**
2. **What is the destination port number?**
3. **What is the sequence number?**
4. **What is the acknowledgement number?**
5. **What is the length of the header?**
6. **What is the window size?**

(i) Source Port:

First 4 hex digits → 00CD (hex)
Source Port: 00CD = **205** (decimal)

(ii) Destination Port:

Next 4 hex digits → 0018 (hex)
Destination Port: 0018 = **24** (decimal)

(iii) Sequence Number: 80000EF1

Hex: 80000EF1 → Decimal: **2147484273**

(iv) Acknowledgment Number:

8th-15th hex digits (32 bits) → 000005D5 (hex)
Acknowledgment Number: 000005D5 = **1493** (decimal)

(v) Header Length:

The 32-bit segment starting at 5022 includes the header length in the upper nibble:

- 5022 → Convert to binary:
- Header Length=Upper Nibble×4
  0x5 (upper nibble) → 5 × 4 bytes = **20 bytes** (standard TCP header size)

(vi) Window Size:

Hex value after header flags → 01BF
Window Size: 01BF = **447** (decimal)

Hexadecimal to binary Conversion