GATE

Computer Science & Information Technology

Computer Networks

Error Control

Q1 Consider ASCII character 'B' (ASCII value = 66) is transmitted by transmitter, but ASCII character 'A' (ASCII value = 65) is received by receiver. Identify the type of error ?

(A) No any error
(B) Single bit error
(C) Burst Error
(D) Data insufficient

Q2 Consider ASCII character 'A' (ASCII value = 65) is transmitted by transmitter, but ASCII character 'T' (ASCII value = 84) is received by receiver. Count the number of corrupted bits ?

Q3 Let suppose, even parity is used in single-bit parity error detection technique. If transmitter finds total 91 one's in the data (excluding parity) then what should be parity bit value set by the transmitter ?

(A) 0
(B) 1
(C) Can be any 0 or 1
(D) Data insufficient

Q4 Let suppose, even parity is used in single-bit parity error detection technique. If receiver find total 93 one's in the received block (including parity) then what receiver concluded ?

(A) No any error detected
(B) Error detected
(C) Unable to detect error
(D) Data insufficient

Q5 Consider single-bit parity error detection technique, the number of data bits are 6 (excluding parity). Count the number of valid code words ?

Q6 Consider the degree of generator polynomial function is n, what should be length of divisor (in bits) ?

(A) n
(B) n + 1
(C) n – 1
(D) 2n

Q7 Consider generator polynomial function is $x^3 + 1$, if data is 1011010110 then calculate CRC ?

(A) 001
(B) 011
(C) 101
(D) 110

Q8 Consider generator polynomial function is $x^3 + x + 1$, if received codeword by receiver is 1101011010100 then what receiver concluded ?

(A) No any error detected
(B) Error detected
(C) Unable to detect error
(D) Data insufficient

Q9 Identify correct statement(s) regarding CRC error detection technique

(A) CRC can detect any length burst error up-to the degree of generator polynomial function G(X)
(B) If (1 + X) is a factor of generator polynomial function G(X) then CRC can detect all odd number bits error.
(C) If generator polynomial function G(X) does not divide $1 + X^k$, for any k upto frame length

then CRC can detect any two bit error.
(D) To ensure correct operation of CRC the generator polynomial function G(X) should not be completely divisible by X.

Q10 Consider error control method has code words with 'd' hamming distance, receiver can detect upto ________ bits errors.
(A) d (B) d – 1
(C) d + 1 (D) d/2

Q11 To correct upto 5 bits error minimum hamming distance should be _______ .

Q12 Consider an error control method has the following code words :
00000000, 00001111, 11110000, 11111111
What is maximum number of bit errors that can be corrected ?

Answer Key

Q1	(C)
Q2	3~3
Q3	(B)
Q4	(B)
Q5	64~64
Q6	(B)
Q7	(D)
Q8	(B)
Q9	(A, B, C, D)
Q10	(B)
Q11	11~11
Q12	1~1

Hints & Solutions

Q1 Text Solution:

Transmitted data = 'B' = 66
= 01000010

Received data = 'A' = 65
= 01000001

Two-bit error

[Multiple bit error]

Burst error

Q2 Text Solution:

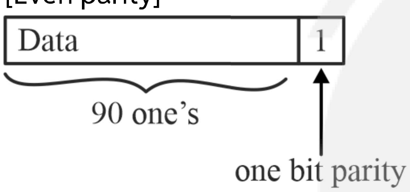
Transmitted data = 'A' = 65 = 01000001

Received data = 'T' = 84 = 01010100

Number of corrupted bits = 3

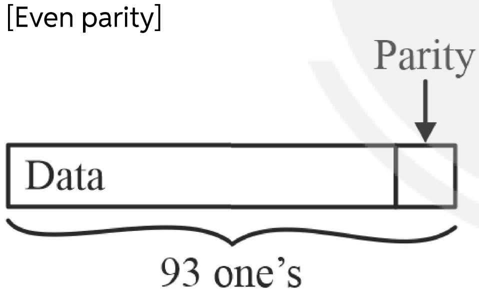
Q3 Text Solution:

[Even parity]



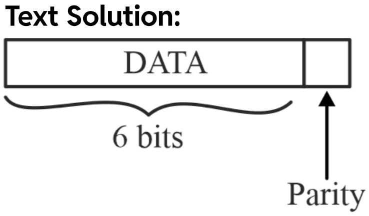
Q4 Text Solution:

[Even parity]



$\Rightarrow$ Error detected

Q5 Text Solution:



Single bit parity:-

Number of data bits = 6

Number of valid code words = $2^6 = 64$

Q6 Text Solution:

$G(X) = x^n + ,,,,,, +1$

degree (G(x)) = n

Divisor = $\underbrace{1.........1}_{(n+1)\text{ bits}}$

Q7 Text Solution:

```
1001 ) 1011010110000
       1001
       -------------
          10010110000
          1001
          -----------
              110000
              1001
              ------
               10100
               1001
               -----
                 110
```

$G(X) = x^3 + 1$

Divisor = 1001

Q8 Text Solution:

```
1011 ) 1101011010100
       1011
       -------------
        110011010100
        1011
        ------------
         11111010100
         1011
         -----------
          1001010100
          1011
          ----------
            10010100
            1011
            --------
              100100
              1011
              ------
                1000
                1011
                ----
                  11
```

$G(X) = x^3 + x + 1$

Divisor = 1011

If receiver finds non-zero remainder afer divisor then receiver concluded "error detected".

Q9 Text Solution:

CRC can detect any length burst error up-to the degree of generator polynomial function G(X) **[True]**

If (1 + X) is a factor of generator polynomial function G(X) then CRC can detect all odd number bits error. **[True]**

If generator polynomial function G(X) does not divide 1 + X**k**, for any k upto frame length then CRC can detect any two bit error.**[True]**

To ensure correct operation of CRC the generator polynomial function G(X) should not be completely divisible by X.**[True]**

Q10 Text Solution:

Min^m Hamming Distance = d

→ it can detect upto (d–1) bit error

→ it can correct upto $\left\lfloor \frac{(d-1)}{2} \right\rfloor$ bit error.

Q11 Text Solution:

To detect x bit error

→ Min^m H.D. should be (x+1).

To correct y bit error

→ Min^m H.D. should be (2y+1)

(2 × 5 +1) = 1

Q12 Text Solution:

Min^m = Hamming distance (d) = min [d(c_1, c_2), d(c_1, c_3), d(c_1, c_4), d(c_2, c_3), d(c_2, c_4), d(c_3, c_4)]

= min[4, 4, 8, 8, 4, 4]

d = 4

Max^m number of bits error that can be corrected

= $\left\lfloor \frac{(d-1)}{2} \right\rfloor = \left\lfloor \frac{(4-1)}{2} \right\rfloor = 1$