National University of Computer and Emerging Sciences (Lahore Campus)

Quiz 6: Link Layer (Chapter 6)

Name: ______________ **Roll No:** ______________ **Section:** BSE-6B1 (Spring 2026)

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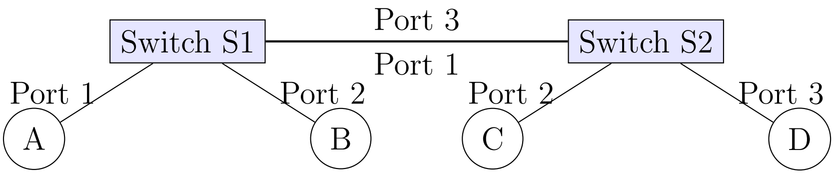
1. (5 points) **Switch Tables**

   Consider the switched LAN topology shown below. The switch tables are initially empty. The following sequence of frame transmissions occurs:

   1. Node A sends a frame to Node D.
   2. Node D replies with a frame to Node A.
   3. Node C sends a frame to Node D.

   Show the state of the Switching Table for **Switch S2** after these three events. Format: (MAC Address, Interface). Also, show the same for **Switch S1**.



Solution:

- **Switch S1 Table:**

MAC Address	Interface
A	Port 1
D	Port 3

Note: S1 learns A from step 1. S1 learns D from step 2. S1 never sees the frame from C (step 3) because S2 knows D is on Port 3 and does not flood the frame back to S1.

- **Switch S2 Table:**

MAC Address	Interface
A	Port 1
D	Port 3
C	Port 2

Note: S2 learns A from step 1 (incoming on Port 1). S2 learns D from step 2 (incoming on Port 3). S2 learns C from step 3 (incoming on Port 2).

2. (10 points) **Cyclic Redundancy Check (CRC) and Burst Errors**

Consider a data transmission scenario using a CRC generator polynomial $G(x) = x^4 + x + 1$. The data string to be transmitted is $D = 101101$.

$$\overbrace{\boxed{1}\ \boxed{0}\ \boxed{1}\ \boxed{1}\ \boxed{0}\ \boxed{1}}^{\text{Data } D}\quad \overbrace{\boxed{?}\ \boxed{?}\ \boxed{?}\ \boxed{?}}^{R \text{ (CRC Bits)}}$$

1. Analytically calculate the 4-bit CRC remainder R. Show the long division in binary modulo-2 arithmetic. What is the actual bit-string transmitted by sender?
2. A "burst error" of length k is a contiguous sequence of bits in which the first and last bits are errors, and the intermediate bits may or may not be errors. Can this specific generator $G(x)$ can detect **all** burst errors of length $k = 3$. Give reason?
3. Suppose a burst error occurs during transmission such that the received bit string has the 3rd and 4th bits (counting from the left, 1-based index) inverted. Does the receiver accept or reject this frame?

Solution:

1. **CRC Calculation:**
   - Generator $G(x) = x^4 + x + 1 \Rightarrow$ **10011** (5 bits).
   - Data $D = 101101$. Append 4 zeros: 101101**0000**.
   - Perform Binary Division (XOR):

```
         101101
       ----------
10011 ) 1011010000
        10011
        -----
         01011
         00000
         -----
         10110
         10011
         -----
          01010
          00000
          -----
          10100
          10011
          -----
           01110
           00000
           -----
           1110  <-- Remainder (R)
```

   The remainder R is **1110**.
   The transmitted string is 101101**1110**.

2. **Burst Error Detection:**
   Yes. A generator polynomial of degree r (here $r = 4$) detects **all** burst errors of length $k \leq r$. Since the burst length $k = 3$ and $3 \leq 4$, this error is guaranteed to be detected.

3. **Receiver Check:**
   The 3rd and 4th bits are inverted.
   Original Transmitted: 10**11**011110
   Received Frame: 10**00**011110
   Performing the division of 1000011110 by 10011:
   $1000011110 \div 10011$ yields a remainder of **1011**.
   Since the remainder is non-zero ($\neq 0000$), the receiver **rejects** the frame.