

# National University of Computer and Emerging Sciences, Lahore Campus

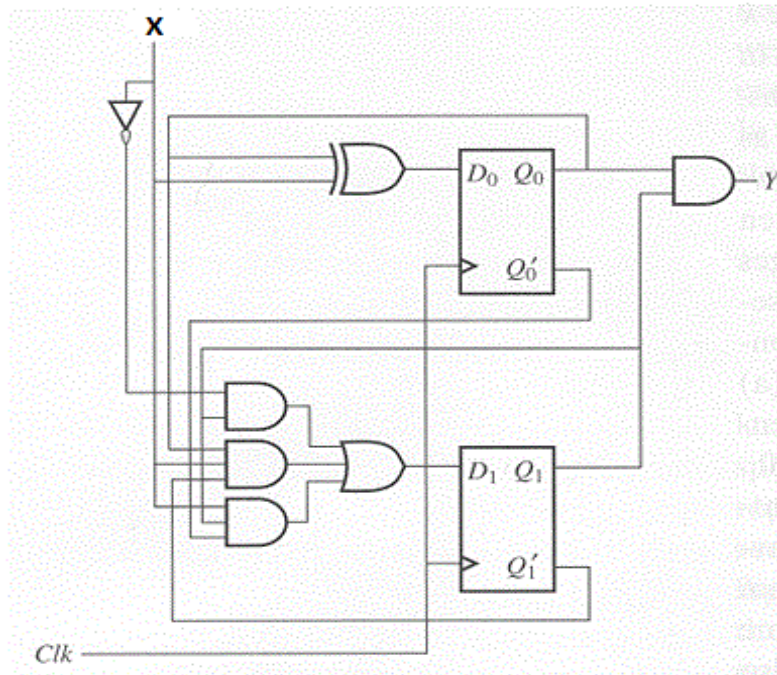


**Course:** Digital Logic Design  
**Program:** BS(Computer Science)  
**Duration:** 60 Minutes  
**Paper Date:** 15-Nov-18  
**Section:** ALL  
**Exam:** Midterm-II

**Course Code:** EE227  
**Semester:** Fall 2018  
**Total Marks:** 40  
**Weight:** 15%  
**Page(s):** 4  
**Roll No.:**  
**Section:**

**Instruction/Notes:** • Attempt all the questions on this answer booklet. You can use extra sheets for your scratch work but **they will not be collected and marked.**

**Question 1[10 Marks]: Consider given diagram**



**i. Complete the truth table [5 marks, 1 mark for each column]**

Present states		X (Input)	D <sub>0</sub>	D <sub>1</sub>	Next states		Y (Output)
Q <sub>0</sub> (t)	Q <sub>1</sub> (t)				Q <sub>0</sub> (t+1)	Q <sub>1</sub> (t+1)	
0	0	0					
0	0	1					
0	1	0					
0	1	1					
1	0	0					
1	0	1					
1	1	0					

1	1	1					
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ii. Write next state equations [3]

$Q_0$  \_\_\_\_\_

$Q_1$  \_\_\_\_\_

$Y$  \_\_\_\_\_

iii. Draw state diagram [2]

**Question 2 [10 Marks]:** Design a 4-bit mini-Process Unit that works according to the given functionality:

$M_1$	$M_0$	$F(A,B) = S_3S_2S_1S_0$	Function Description
0	0	$A - 2*B$	Subtract 2 times B from A
0	1	$A + 4*B$	Add 4 times B and A
1	0	$A + B$	Add A and B
1	1	$A + 1$	Increment A

Where A and B are two 4-bit numbers. M inputs to your mini-processor are control inputs. Partial design of the mini-processor is given below. **Your task is to add required logic in the design given below in order to make mini-processor fully functional.**

**Note:** Assume that you already have Decoder(s), Encoder(s), MUX(s), DMUX(s) and Multiplier(s) blocks available. **Properly label all blocks and inputs/outputs to get credit.**



**Question 3:** Implement the function given below

$$F(A,B,C,D) = \sum m(0,2,4,5,6,12,14)$$

- (a) [10 Marks] Using a 4x1 MUX and external Gates only. Take C and D as Selection Inputs and A and B as Data Inputs
- (b) [10 Marks] Using Decoder(s) and external NAND Gates only

**Note:** Properly label inputs and outputs to get credit

Input				Output
A	B	C	D	F
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

a)

b)