



# Final Exam

## Digital Design

Computer and Syst. Dept.  
 Time Allowed: 3 Hrs.  
 2<sup>nd</sup> Year Students.  
 Total Marks: 90  
 2011 - 2012



Solve the following Questions:

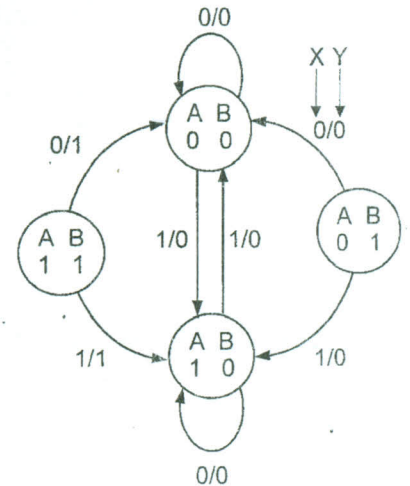
• يسمح باستخدام القلم الرصاص (شرط وضوح الخط).

• الرجاء وضوح الرسم قدر المستطاع (ليس شرطاً استخدام المسطرة).

• الامتحان في وقتين.

(1) Design the sequential circuit for the shown state diagram using R-S flip flop.

(5 marks)



(2) Draw (**ONLY**) the following circuits:

- Ripple counter that counts from 15 to 0 at +ve edge.
- 3-bit synchronous up-down counter.
- 4-bit register with load input.
- 5 bit shift right register.
- A circuit showing how to transfer the contents of a shift register A to another shift register B (keeping the contents of register A). Then Compare between serial and parallel loading.
- Serial Adder circuit.
- Block diagram for the processor unit.

(15 marks)

(3) Design a counter with the following sequence 0, 1, 3, 7, 6, 4 (using T- flip flop).

(5 marks)

(4) A building consists of 4 stages with an underground stage (مبنى من أربعة طوابق مع دور أرضي), labeled 0, 1, 2, 3, 4. It is needed to design the counter circuit for its lifter (مصعد), hence;

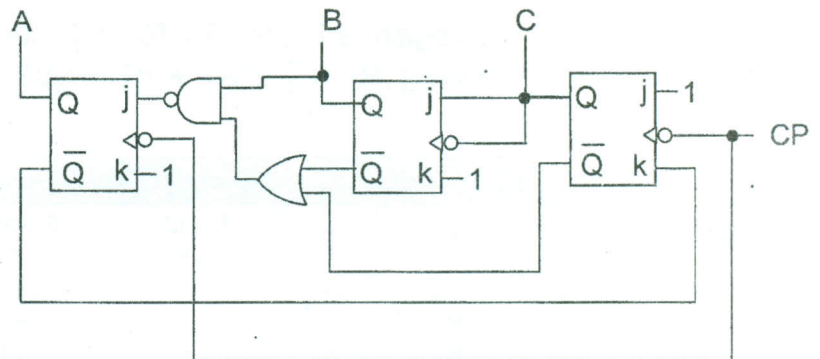
- Draw the state diagram for the counter count sequence.
- Design the counter circuit using (J-K flip flop).

(6 marks)

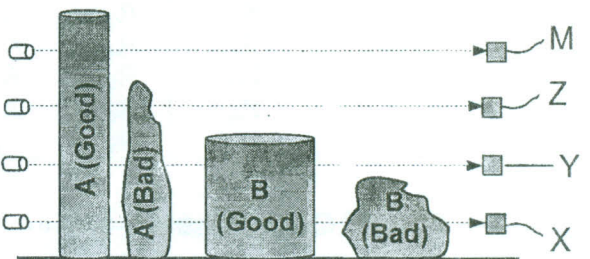
(5) For the shown ripple counter:

- What is the count sequence?
- Is the counter self starting?

(8 marks)



(6) A company produces two types of products; A and B. However, during the production process, the products may be defected (فَسُوه) as shown in the figure. It is needed to design a digital system to calculate the money that the company will lose due to the bad products (of both types A and B). assume the price of product A is stored in register PA and the price of product B is stored in register PB, while the money lost due to bad products is stored in register C.



(10 marks)

اقلب الورقة

(7) Design a digital system with 3 registers A, B, C and a flip flop E (of J-K type) to perform the following:

- When a start signal  $S=1$ , Transfer three numbers to A, B, and C.
- If  $A=B=C$ : Clear register C and shift A to right.
- If  $A=B \geq C$ : Multiply A by 2 then transfer results to B and Clear flip flop E.
- If  $A > B < C$ : Set flip flop E to 1, then increment B in the next clock pulse.
- Else: Add the contents of A to B and transfer results to C.

(15 marks)

(8) Design an ALU to perform the following functions:

S <sub>2</sub>	S <sub>1</sub>	S <sub>0</sub>	C <sub>in</sub> =0	C <sub>in</sub> =1
0	0	0	F=A	F=A+1
0	0	1	F=A-B-1	F=A-B
0	1	0	F=A+B	F=A+B+1
0	1	1	F=A-1	F=A
1	0	0	A ∧ B	(AND)
1	0	1	A ⊕ B	(XOR)
1	1	0	(A ∧ B)'	(NAND)
1	1	1	A'	(NOT)

(10 marks)

(9) Design an Accumulator to perform the following functions:

Terminal	Function
P <sub>1</sub>	A ← 0 (Clear)
P <sub>2</sub>	A ← ShL A (Shift left)
P <sub>3</sub>	A ← A ⊙ B (XNOR)

(6 marks)

(10) Design 4-bit universal shift register to perform the following functions:

S <sub>1</sub>	S <sub>0</sub>	Function
0	0	Shift left
0	1	
1	0	Clear
1	1	Load External Inputs

(5 marks)

(11) In the processor unit registers R<sub>1</sub>, R<sub>2</sub>, R<sub>3</sub>, R<sub>4</sub> store four numbers. Write the control words required to find the following  $R_5 = [2 \cdot R_1 + (R_2 + R_3) / 2 - R_4 - 1]$ . Use registers R<sub>6</sub>, R<sub>7</sub> for intermediate results.

(5 marks)

Binary Code	Function of selection variables					
	A	B	D	F with C <sub>in</sub> =0	F with C <sub>in</sub> =1	H
0 0 0	Input Data	Input Data	None	A, C ← 0	A + 1	No Shift
0 0 1	R <sub>1</sub>	R <sub>1</sub>	R <sub>1</sub>	A + B	A + B + 1	Shift Right
0 1 0	R <sub>2</sub>	R <sub>2</sub>	R <sub>2</sub>	A - B - 1	A - B	Shift Left
0 1 1	R <sub>3</sub>	R <sub>3</sub>	R <sub>3</sub>	A - 1	A, C ← 1	0's to output bus
1 0 0	R <sub>4</sub>	R <sub>4</sub>	R <sub>4</sub>	A ∨ B	--	--
1 0 1	R <sub>5</sub>	R <sub>5</sub>	R <sub>5</sub>	A ⊕ B	--	Circulate right with carry (CRC)
1 1 0	R <sub>6</sub>	R <sub>6</sub>	R <sub>6</sub>	A ∧ B	--	Circulate left with carry (CLC)
1 1 1	R <sub>7</sub>	R <sub>7</sub>	R <sub>7</sub>	A'	--	-

----- End Of Questions -----



**With Best Wishes**  
**Dr: Ahmed Saleh**



PLZ, send your comments about the exam to:  
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