UNIVERSITY OF SWAZILAND

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

DIGITAL SYSTEMS II

COURSE CODE – EE324

SUPPLIMENTARY EXAMINATION

JULY 2012

DURATION OF THE EXAMINATION - 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. There are FIVE questions in this paper. Answer any FOUR questions only.
2. Each question carries equal marks.
3. Show all your steps clearly in any calculations.
4. State clearly any assumptions made.
5. Start each new question on a fresh page.

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Question 1

a) Using examples, explain the difference between Moore and Mealy Finites State Machines.
[3]

b) With the aid of a diagram explain how a positive-edge-triggered flip-flop works.
[5]

c) Registers play an important role in electronic systems. They allow data to be transmitted in parallel format or in serial format. Using suitable diagram(s) describe and explain how shift registers function.
[5]

d) Draw circuit diagrams of a clocked R-S Flip-Flop and a clocked J-K Flip-Flop and explain the following:

i. Illustrating with a characteristic table, how a clocked R-S Flip-Flop works.
[9]

ii. Why a clocked J-K Flip-Flop is said to be an improvement to an R-S Flip-Flop?
[3]

Question 2

Derive the state table, state diagram, and Boolean expressions for the outputs O_0 to O_2 in the circuit diagram shown in Figure Q2. Explain the function the circuit performs.
[25]

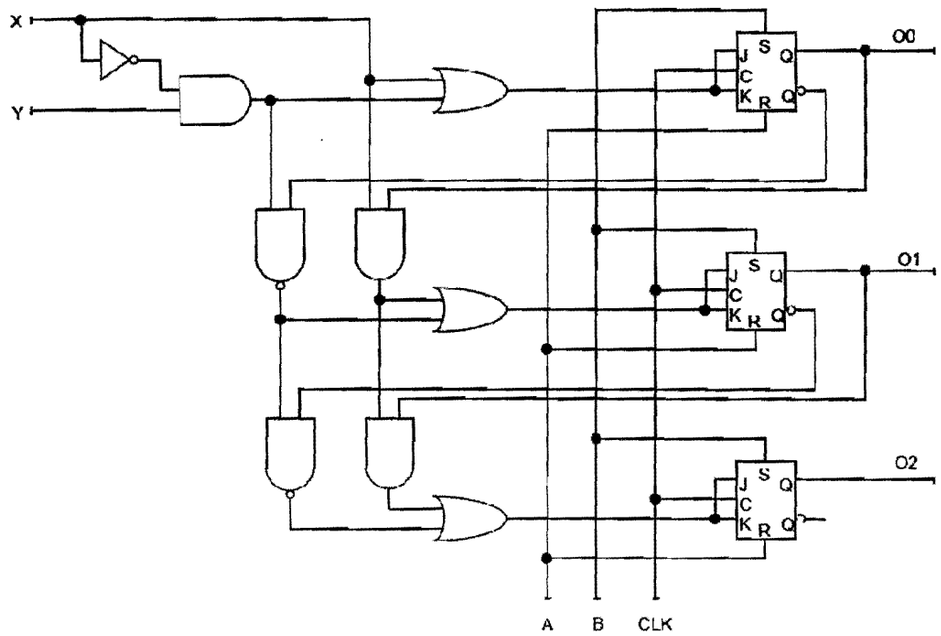

Figure Q2. Circuit diagram for Question 2

Question 3

Using T-Flip Flops, design a sequential circuit that detects the sequence 1001. Use a minimum number of states in your implementation. [25]

Question 4

Figure Q4 shows a two lane busy road that passes over a narrow bridge. Due to the narrow bridge, traffic coming from opposite directions (Traffic A and B) cannot pass over the bridge at the same time. To ensure an orderly flow of traffic over the bridge, the traffic control lights have been introduced. Each traffic light has a RED, AMBER, and GREEN lamps.

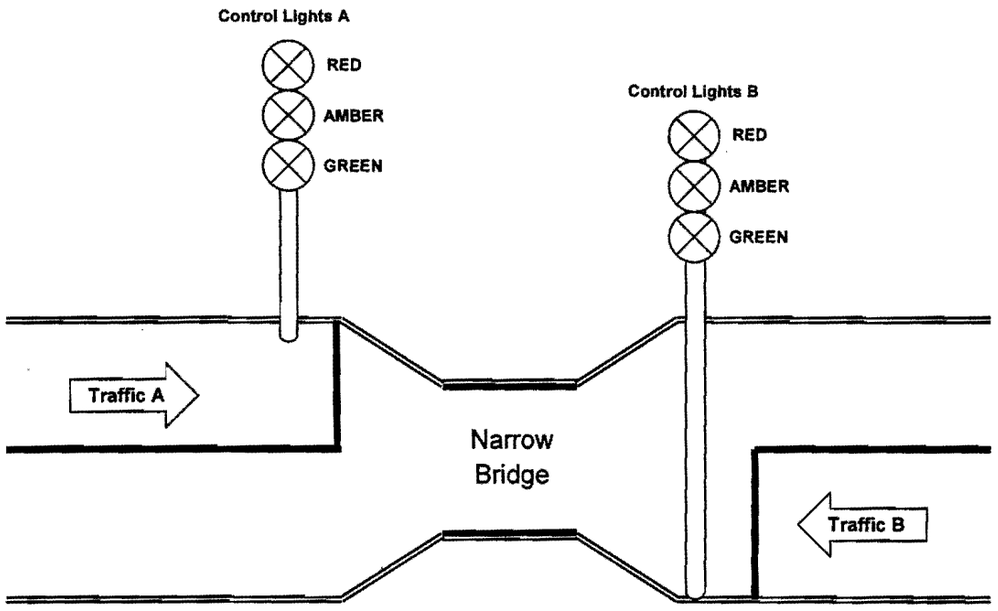

Figure Q4. Traffic control lights diagram for Question 4

The traffic control lights are required to operate so that traffic flows as follows: Traffic B is allowed 9 seconds to pass through, while traffic A is allowed 12 seconds. Traffic A is allowed to pass through the bridge when the GREEN light in Control Lights A is ON, otherwise the Traffic A is stopped. Similarly traffic B can only pass through the bridge when the GREEN lamp in traffic control B is on. When a traffic control light turns from GREEN to RED, for 2 seconds, it turns ON the AMBER light and then switch on the RED lamp. Assume that, initially (before the control regime comes into effect), all traffic is stopped for 4 seconds.

Design a traffic controller that ensures an orderly flow of traffic in Road 1, Lane A, and Lane B, to satisfy the requirements of the traffic control regime. **Use ONLY *ROM* and a *Shift Register* to implement your design.** Show all working and explain how your circuit works. Explain how your design satisfies the behavioural requirements of a traffic controller.

[25]

Question 5

(i) With the aid of a diagram (or diagrams), explain how a Master-Slave D flip-flop works. Explain the rationale for having this type of circuit edge-triggered rather than level-triggered.

[5]

(ii) Design a timing circuit that provides an output signal that stays on for exactly eight clock cycles. A start signal sends the output to the 1 state, and after eight clock signals returns to the 0 state.

[14]

(iii) Discuss the instruction execution cycle in a microprocessor. [6]

END OF PAPER