

ECE275 Midterm 2 2025

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Student Name:

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1 Instructions

- There are three problems. All problems are required.
- Maximum number of marks is 50. This exam amounts 10% toward the final grade.
- Time allowed is 50 minutes.
- In order to minimize distraction to your fellow students, you may not leave during the last 10 minutes of the examination.
- The examination is closed-book. One 8×11 in two-sided cheatsheet is allowed.
- Non-programmable calculators are permitted.
- Please use a pen or heavy pencil to ensure legibility. Colored pens/pencils are recommended for K-map grouping.
- Please show your work; where appropriate, marks will be awarded for proper and well-reasoned explanations.

Problem 1. Give two Moore state transition tables for a sequential circuit to control a phone answering machine. The circuit should have three inputs (R , A , and S) and one output (Z). $R = 1$ for one clock cycle at the end of each phone ring. $A = 1$ when the phone is answered. S selects whether the machine should answer the phone after two rings ($S = 0$) or four rings ($S = 1$). To cause the tape recorder to answer the phone, the circuit should set the output $Z = 1$ after the end of the second ($S = 0$) or fourth ($S = 1$) ring, and hold $Z = 1$ until the recorder circuit answers the phone (i.e., when A goes to 1). If a person answers the phone at any point, A will become 1, and the circuit should reset. Assume that S is not changed while the phone is counting rings. (15 marks).

(Hint: You can draw two Moore state transition tables, one for $S = 0$ and one for $S = 1$. Fill in the following tables)

Table for $S = 0$

Unanswered Ring count	Present State	Next State				Output (Z)
		$RAS = 000$	010	100	110	
0	P_0	P_0	P_0	P_1	P_0	0
1	P_1					
2	P_2					

Table for $S = 1$

Unanswered Ring count	Present State	Next State				Output (Z)
		$RAS = 001$	011	101	111	
0	P_0	P_0	P_0	P_1	P_0	0
1	P_1					
2	P_2					
3	P_3					
4	P_4					

Problem 2. Determine the propagation delay and contamination delay of the circuit in Figure 2.83. Use the gate delays given in Table 2.8. (5 marks).

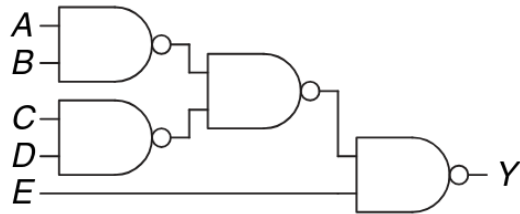
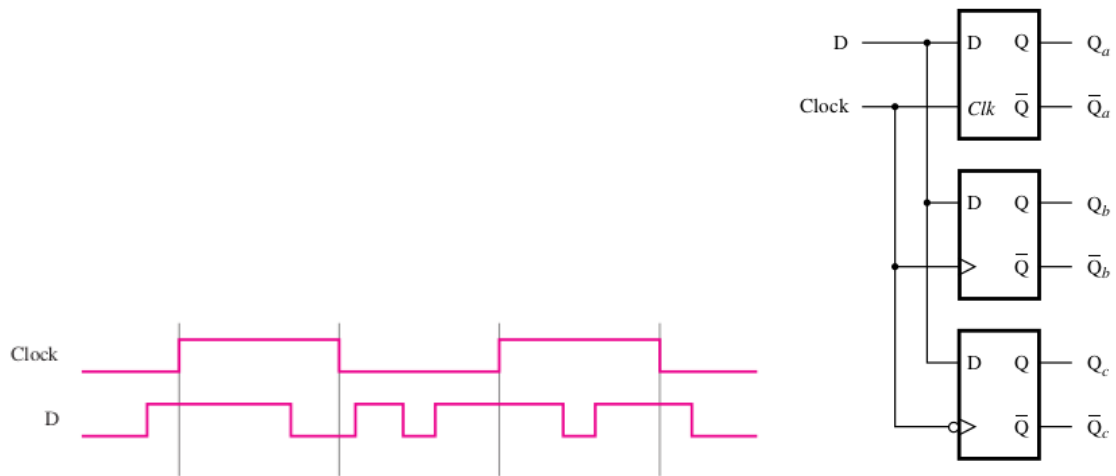


Figure 2.83 Circuit schematic

Table 2.8 Gate delays for Exercises 2.43–2.47

Gate	t_{pd} (ps)	t_{cd} (ps)
NOT	15	10
2-input NAND	20	15
3-input NAND	30	25
2-input NOR	30	25
3-input NOR	45	35
2-input AND	30	25
3-input AND	40	30
2-input OR	40	30
3-input OR	55	45
2-input XOR	60	40

Problem 3. Consider the timing diagram in Figure 1. Assuming that the D and Clock inputs shown are applied to the circuit in Figure 1, Draw waveforms for the Q_a , Q_b , and Q_c signals. (10 marks)



Problem 4. Find the expression for J_0 and K_0 assuming that J_0 and K_0 are inputs to the J-K flip flop that capture the state of the least significant bit Q_0 of the following state encoded table. The state encoding table given with state encoding denoted as $Q_2Q_1Q_0$. (20 marks).

Present State $Q_2Q_1Q_0$	Next State		Output	
	$X = 0$ $Q_2^+Q_1^+Q_0^+$	$X = 1$ $Q_2^+Q_1^+Q_0^+$	$X = 0$ Z	$X = 1$ Z
000	100	101	1	0
001	100	101	0	1
010	000	000	1	0
011	000	000	0	1
100	111	110	1	0
101	110	110	0	1
110	011	010	1	0
111	011	011	0	1