

NAME: _____**ID:** _____**INSTRUCTIONS:**

- THE EXAM IS CLOSED BOOK/CLOSED NOTES.
- THE DURATION IS 2.0 HOURS.
- CALCULATORS ARE NOT ALLOWED.
- CELL PHONES ARE NOT ALLOWED IN THE EXAMINATION ROOM.
- WRITE YOUR NAME AND ID NUMBER IN THE SPACE PROVIDED ABOVE.
- PROVIDE YOUR ANSWERS IN THE SPACE PROVIDED ON THE QUESTION SHEET.
- THE SCRATCH BOOKLET WILL NOT BE CONSIDERED IN GRADING.
- BE AS NEAT AND CLEAR AS POSSIBLE.

Problem	Total Points	Earned Points
1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
8	10	
9	10	
10	10	
	100	

1. Use a 1 to 8 de-multiplexer to build a 3-input decoder.
2. Use the decoder from problem 1 and OR gates to implement a 3-bit prime number detector circuit. Reminder: the number 1 is not prime.

5. Let A and B be two 8-bit positive binary numbers. Use an iterative circuit to design a magnitude comparator that outputs a 1 when A is larger or equal to B.

6. Show how to build a D flip-flop using a T flip-flop with enable and combinational logic.

7. Explain the concept of metastability in S-R flip-flop. Give an example.
8. Show how to build an edge-triggered S-R flip-flop using an edge-triggered D flip-flop and combinational logic. Assume that a combination of $S=1$ and $R=1$, does not change the state.

9. Design a synchronous state machine with two inputs x and y . The output z is to be '1' when the inputs x and y are the same a multiple of 3 times.

10. Design a synchronous state machine with one input signal x and one output signal y . The state machine is to detect a sequence of '1100 on input x and to output a '1 for one cycle on y when the sequence is detected.