EEEN202 Test 2 **12th June 2021**

9:30am – 11:00am in MCLT101

Open Book: Written and printed notes are allowed.

Calculators also permitted.

Total: 50 Marks **Total time: 90 minutes**

Student Name	
Student Number	

Instructions:

Please read all instructions carefully.

Answer questions on these sheets. Use the back of the sheets if you need more space.

The test is in two parts, part A and part B. You are to answer only one of the two questions in part A and all of the questions in Part B.

Part A, Digital electronics and Logic

Answer either Question 1 or Question 2

Question 1 (16 marks total)

On an industrial assembly line the output of four sensors (S3, S2, S1 and S0) are used to monitor the presence of an object. The sensors all have a binary output and will produce a HI signal when the object is detected. A fault condition on the production line is indicated when more than one of the sensors detect the object at the same time. However, the system is designed so that S3 and S0 will never be HI at the same time and similarly S2 and S1 will never be HI at the same time. You must now design a logic circuit that will put the output Z in a HI state when a fault condition is detected on the line.

(a) Complete the truth table below, showing the relationship between the sensor outputs and the output of the logic circuit. (4 marks)

S3	S2	S1	S0	Z
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	

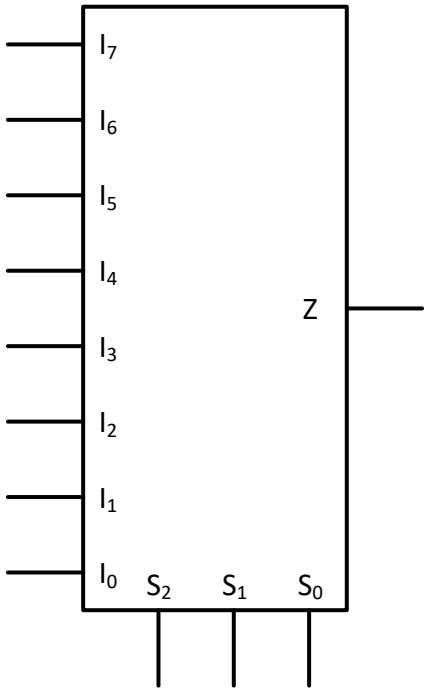
(b) Use your truth table to construct the K-map and simplify. Complete the K-map below and clearly show your simplification and the resultant logic equation. (4 marks)

	/S1./S0	**/S1.S0**	**S1.S0**	**S1./S0**
/S3./S2				
/S3.S2				
S3.S2				
S3./S2				

(c) You must now implement this logic, but it is given that you have only 2-input logic gates available and need to implement your circuit using as few logic gates as possible. Sketch your suggested logic circuit. (4 marks)

(d) You must now implement the same logic, but use an 8:1 MUX. Clearly show what inputs will be connected to each of the select inputs as well as the data inputs on the MUX below.

(4 marks)



Question 2 (16 marks total)

You have to design a synchronous 3-bit (CBA) up/down counter that can count up through the states (001) → (010) → (100) → (101) and recycles. The counter should contain a direction input which forces it to count down on a LO control signal. It should also contain a stop/go control that will freeze the counter when this signal is HI. If any unused states are encountered, the counter should go to (001).

(a) Sketch the state transition diagram for this counter. (4marks)

(b) Neglect the stop/go control signal described above and complete the excitation table below for this counter using D flip-flops.

(4 marks)

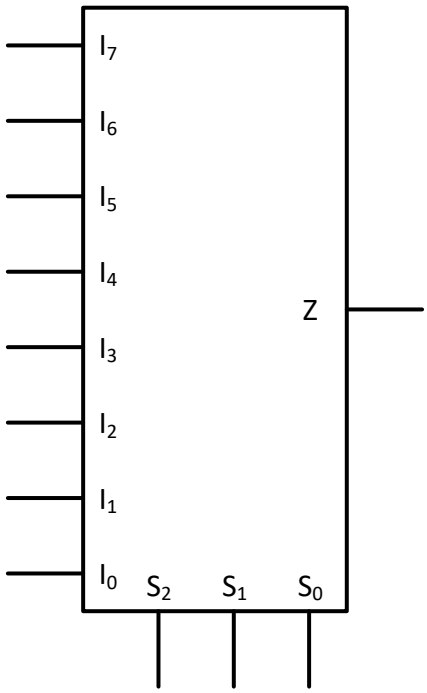
Present					**Next**				**Required**		
D	**C**	**B**	**A**		**C**	**B**	**A**		**D_C**	**D_B**	**D_A**
0	**0**	**0**	**0**								
0	**0**	**0**	**1**								
0	**0**	**1**	**0**								
0	**0**	**1**	**1**								
0	**1**	**0**	**0**								
0	**1**	**0**	**1**								
0	**1**	**1**	**0**								
0	**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**								

(c) Use a K-map and determine the logic required for D_A. Complete the K-map below and clearly show your simplification and the resultant logic equation. (4 marks)

	/B./A	**/B.A**	**B.A**	**B./A**
/D./C				
/D.C				
D.C				
D./C				

(d) Show how D_A can be implemented using an 8 :1 MUX. Clearly show what inputs will be connected to each of the select inputs as well as the data inputs on the MUX below.

(4 marks)



Part B, Microprocessors, ADCs, DACs and memory

Answer all questions.

Question 3 (12 marks total) Microprocessors

(a) Briefly describe the function of the Arithmetic Logic Unit (ALU). (2 marks)

(b) With regard to the 8051 series microprocessor, explain the difference between the RET and RETI instructions. (2 marks)

(c) Briefly describe the difference between a microprocessor and a microcontroller. (2 marks)

(d) Describe the differences between the Polling and Interrupt driven approaches and the advantages/ disadvantages. (6 marks)

Question 4 (12 marks total) ADC and DAC

(a) Sketch a diagram of a feedback type Analogue to Digital Converter and describe the function of each of the key parts. (6 marks)

(b) Briefly explain the key principle behind the Successive Approximation Convertor in how it goes about generating the guess values. (2 marks)

(c) A 12-bit ADC has an input voltage range of 0 to +5V

i. What is the resolution? (2 marks)

ii. What would be the decimal and binary output values for an input voltage of 3.72V (2 marks)

Question 5 (10 marks total) Memory

(a) A typical computer system will use a combination of SRAM and DRAM. Briefly describe the differences between these two types of memory and the typical purpose they are used for. (4 marks)

(b) The diagram below shows the timing and operation of various signals during a memory read cycle. Describe the signals and the steps that the microprocessor and the memory each undergo. (6 marks)