



COLLEGE OF ENGINEERING, SCIENCE AND TECHNOLOGY

School of Electrical & Electronics Engineering

Trade Diploma in Electronics Engineering

EEE551 – Digital Electronics II

FINAL EXAMINATION

Trimester 2, 2015

Date: As per Exam Time Table

Time: As per Exam Time Table (3 hours)

Venue: As per Exam Timetable

Instructions to Students

1. You are allowed an extra ten (10) minutes of reading time during which you are NOT allowed to write.
2. Attempt ALL questions in this examination booklet
3. Write your answers in the answer booklet provided.
4. Write your Student ID number on each page used.
5. Begin each Section on a fresh page and use both sides of the answer sheet.
6. You may use calculators provided they are non-programmable.
7. Clearly number the questions in your answer paper in their correct sequence and write legibly. Show all working.
8. Attach any extra sheets used to your answer booklet securely with the string provided.

Final Examination**Question 1: Logic families [10 marks]**

- A) From the table given below, determine the noise margins when a 74LS device is driving a 74ALS input. [3 marks]

Typical TTL series characteristics.

	74	74S	74LS	74AS	74ALS	74F
Performance ratings						
Propagation delay (ns)	9	3	9.5	1.7	4	3
Power dissipation (mW)	10	20	2	8	1.2	6
Max. clock rate (MHz)	35	125	45	200	70	100
Fan-out (same series)	10	20	20	40	20	33
Voltage parameters						
$V_{OH}(\text{min})$ (V)	2.4	2.7	2.7	2.5	2.5	2.5
$V_{OL}(\text{max})$ (V)	0.4	0.5	0.5	0.5	0.5	0.5
$V_{IH}(\text{min})$ (V)	2.0	2.0	2.0	2.0	2.0	2.0
$V_{IL}(\text{max})$ (V)	0.8	0.8	0.8	0.8	0.8	0.8

- B) Define: [2 marks]
- Noise Margin & Noise Immunity
 - propagation delay
 - Fan-In
- C) For each SSI devices, each package contains a code identifying the package. Describe what each letter and digits refers to, for code N74LS00. [1 mark]
- D) Compare the electrical characteristic of TTL and CMOS. [2 marks]
- E) Name 3 important parameters for evaluating and comparing logic families. [2 marks]

Question 2: Multiplexers/decoders [15 marks]

- A) Consider a 3-input and 3 output system depicted as follows: [3.5 marks]
Implement the system using 74154 decoder.

x3	x2	x1	y1	y2
0	0	0	1	d
0	0	1	d	0
0	1	0	0	1
0	1	1	0	1
1	0	0	1	1
1	0	1	1	1
1	1	0	0	1
1	1	1	d	0

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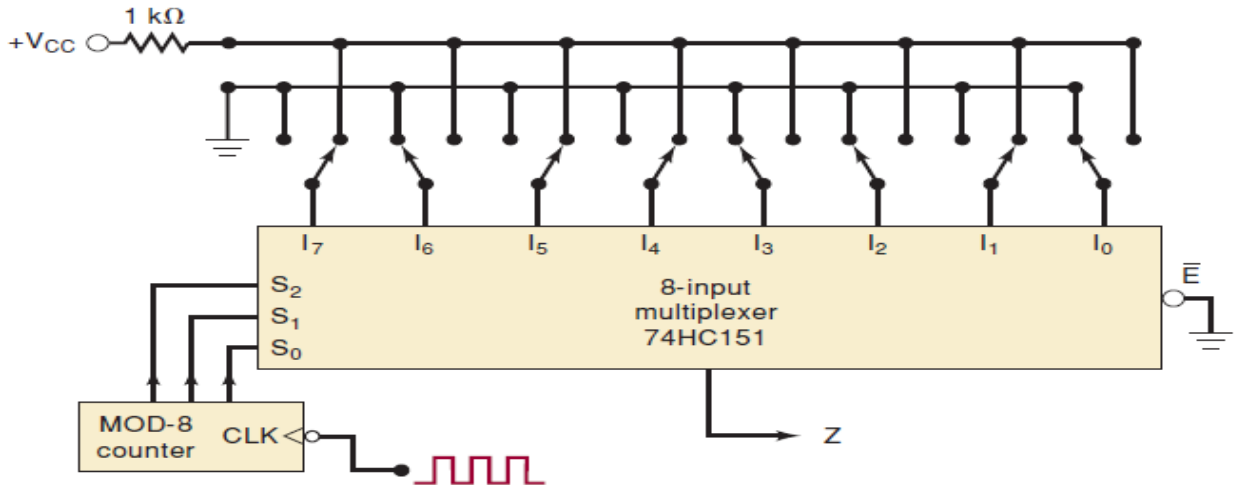
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B) Consider the 3-input(x3 x2 x1) system given by :

$$y = \Sigma(0,1,3,5,7) + d\Sigma(2,6)$$

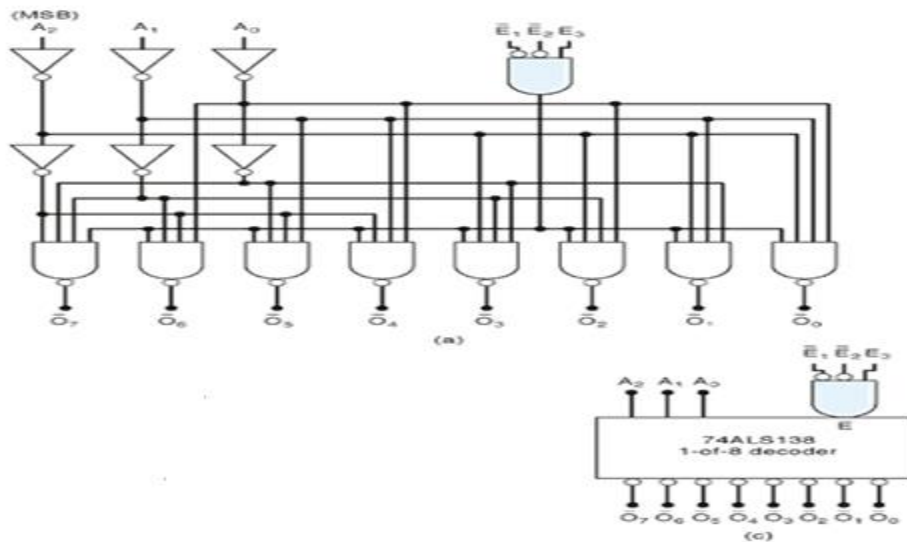
Draw a 74LS151, 8-input multiplexer based circuit that realizes the system. [3.5 marks]

C) Figure below shows how a multiplexer can be used to generate logic waveforms with any desirable pattern. The pattern is programmed using eight SPDT switches, and the waveform is repetitively produced by pulsing the MOD-8 counter. Draw the waveform at Z for the given switch positions with respect to the clock cycle. [3 marks]



D) Refer to the figure below and determine the levels at each decoder output for the following sets of input conditions. [2.5 marks]

- i) All inputs low except $E_3 = \text{high}$
- ii) All inputs high except $E_1' = E_2' = \text{low}$

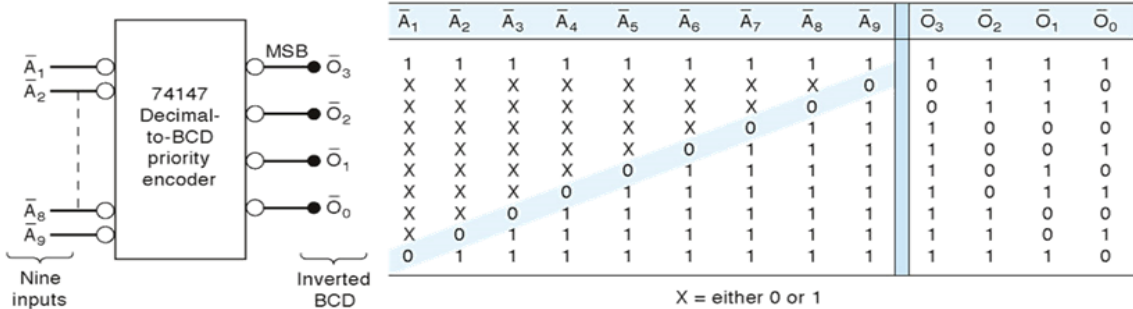


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E) Refer to the priority encoder below and determine the output levels for the 74147 encoder when $A_8' = A_5' = 0$ and all other inputs are high. [2.5 marks]

74147 decimal-to-BCD priority encoder.



Question 3: Combinational logic circuits [15 marks]

A) A 4-input, single output combinational system is given by: [5 marks]

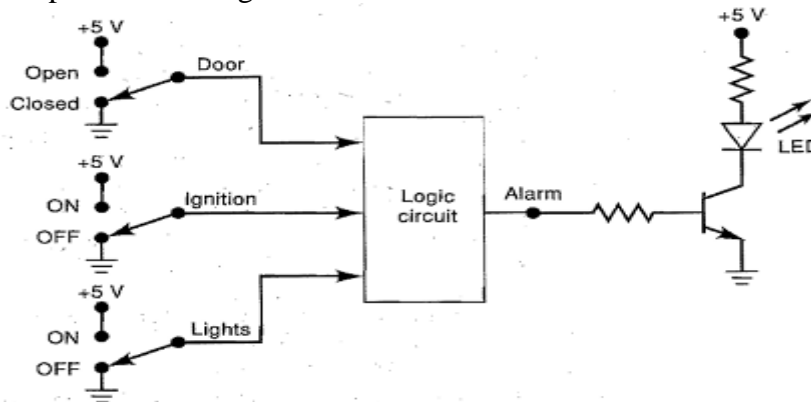
$$Y = f(X_4, X_3, X_2, X_1) = X_4' X_3 X_1 + X_3 X_2 X_1' + X_4' X_2 + X_4 X_1$$

- i) Draw the Karnaugh map representation for this system.
- ii) Draw the Truth Table representation for the system.

B) Figure below shows a diagram for an automobile alarm circuit used to detect certain undesirable conditions. The three switches are used to indicate the status of the door by the driver seat, the ignition, and the headlights, respectively. Design the logic circuit with these three switches as inputs so that the alarm will be activated whenever either of the following conditions exists:

- The headlights are on while the ignition is off.
- The door is open while the ignition is on.

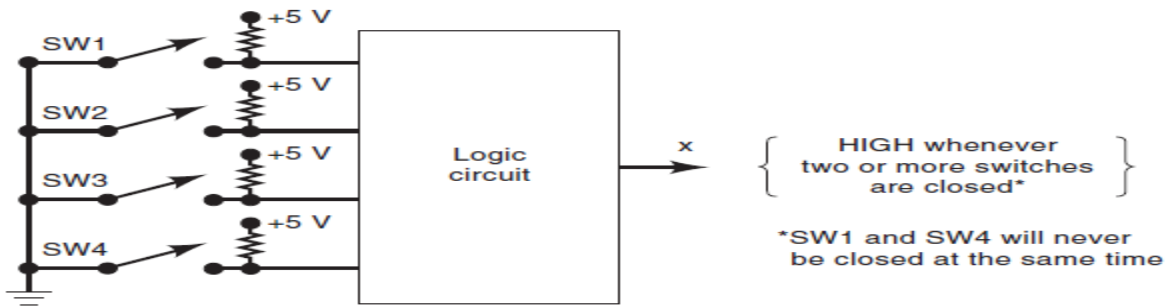
[5 marks]



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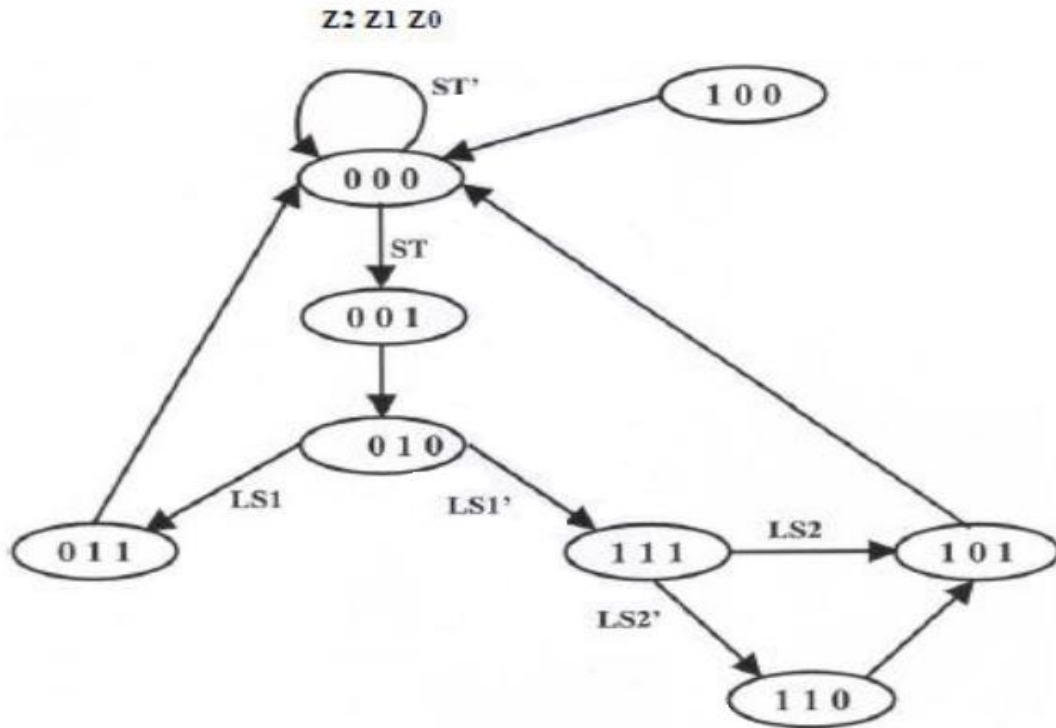
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- C) Figure below shows four switches that are part of the control circuitry in a copy machine. The switches are at various points along the path of the copy paper as the paper passes through the machine. Each switch is normally open, and as the paper passes over a switch, the switch closes. It is impossible for switches SW1 and SW4 to be closed at the same time. Design the logic equation to produce a HIGH output whenever *two or more* switches are closed at the same time. [5 marks]



Question 4: Sequential logic circuit [15 marks]

- A) Describe two types of sequential circuit. [2 marks]
 B) The state diagram of a synchronous sequential controller is depicted in Figure below. The system has 3 inputs, ST, LS1, and LS2. Design the system using JK flip-flop based circuit. (Note: Do not implement the circuit). [13 marks]

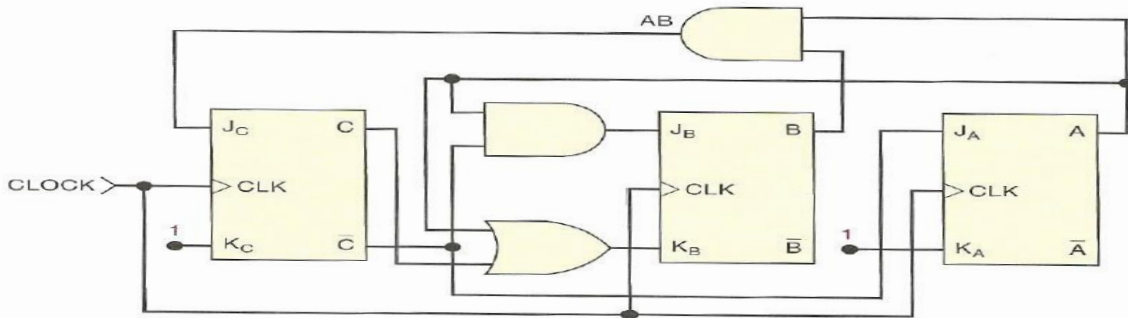


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Question 5: Counters [12.5 marks]

Analyze the synchronous counter in the Figure below and draw its state diagram.



Question 6: Arithmetic circuits [12.5 marks]

A) Design a full adder circuit using. Show truth table, k-map, equation and circuit. [6 marks]

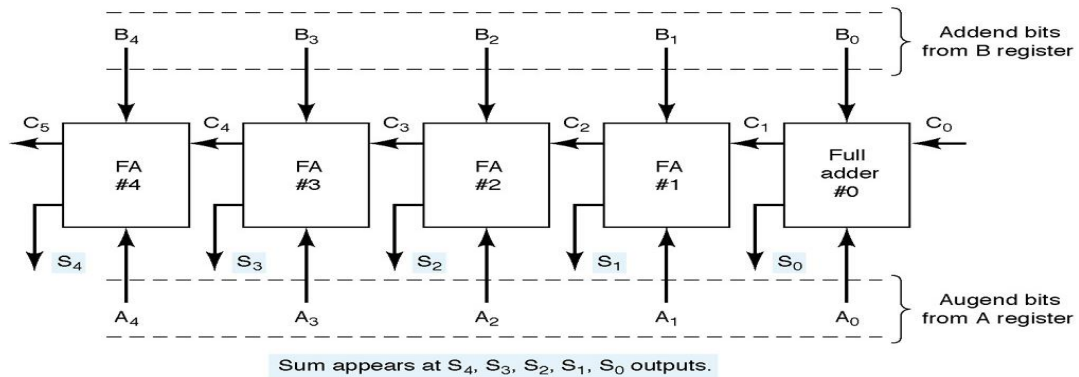
B) Assume the following input levels in the Figure below, $A_4 A_3 A_2 A_1 A_0 = 01001$;

$B_4 B_3 B_2 B_1 B_0 = 00111$ and $C_0 = 0$.

[6.5 marks]

i) What are the logic levels at the output of FA #2

ii) What is the logic level at the C_5 output



Question 7: memory devices/display devices [10 marks]

A) A certain memory has a capacity of $2K * 8$.

[2 marks]

i) What is the number of bits per word?

ii) How many words does it store?

iii) How many memory cells does it contain?

B) Compare main memory of computer with auxiliary memory.

[2 marks]

C) Define Byte.

[1 marks]

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D) Indicate which of the following refers to LCD displays and which refers to LED displays.

- i) Emit light
- ii) Reflect ambient light
- iii) Are best for low-power application
- iv) Require an ac voltage
- v) Use a 7-segment arrangement to produce digits
- vi) Require current-limiting resistors

[5 marks]

Question 8: DAC/ADC and PLD [10 marks]

- A) What is digitizing a signal. [1 mark]
- B) Explain Quantization error. [1 mark]
- C) A five-bit DAC has a current output. For a digital input of 10110, an output current of 20mA is produced. What will be I_{out} for a digital input of 11001. [2 marks]
- D) Define Resolution(step size). [1 mark]
- E) What is the minimum sample frequency needed to reconstruct an analog signal. [1 mark]
- F) What occurs if the signal is sampled at less than the minimum frequency determined in E above. [1 mark]
- G) What are the three major categories of digital system and describe each. [3 marks]

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Appendix

Excitation Table for FFs

q	Q	S	R	J	K	D	T
0	0	0	d	0	d	0	0
0	1	1	0	1	d	1	1
1	0	0	1	d	1	0	1
1	1	d	0	d	0	1	0