STAMFORD COLLEGE

SCHOOL OF ENGINEERING

FOUNDATION STUDIES IN ENGINEERING
(ELECTRICAL AND ELECTRONIC)

KE008: Introduction to Electronics

Date : 23 March 2007 (Friday)
Time : 10.00 am – 12.00 am **Duration: 2 hours + 10 minutes reading time**

Instructions to Candidates

1. SIX questions set.
2. Answer any FOUR questions.
3. All questions carry equal marks.
4. Maximum marks attainable: 100

Please ensure that this examination paper contains SIX questions on THREE printed pages before you start the examination.

Books, papers and other written materials are not allowed to be brought into the examination hall. A candidate who violates the examination rules of Stamford College or commits a malpractice will be disqualified from the examination.

Write your Examination Index Number on each page of your answer booklet.

Answer any FOUR questions

Question 1

(a) There are three AND-gates and one INVERTER-gate in Figure Q1.

(i) Derive the Boolean Expression for the output signal, OUT, in Figure Q1.

(5 marks)

(ii) Construct a functional truth-table for the circuit shown in Figure Q1.

(16 marks)

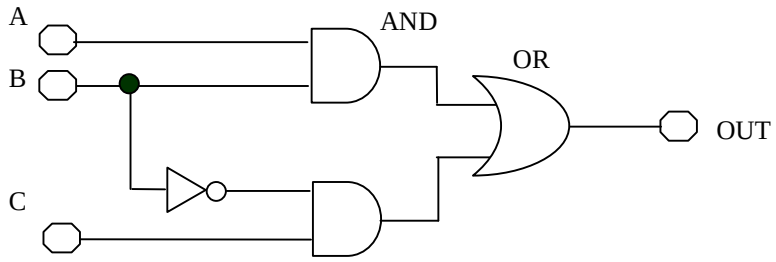

Figure Q1

(b) Build a functional truth-table for a two inputs AND-gate.

(4 marks)
(Total = 25 marks)

Question 2

(a) Using Karnaugh-Map method, simplify the expression:

$$f(A,B,C) = \overline{A}\overline{B}\overline{C} + \overline{A}\overline{B}C + AB\overline{C} + ABC + A\overline{B}C$$

(10 marks)

(b) Realize the simplified expression in part(a) using basic gates.

(5 marks)

(c) Using Boolean Algebra to simplify the expression:
$(A+B)(A+C)$ (5 marks)

(d) Construct a truth-table to identify the Boolean equation $(A+B)(A+C)$ is equal to $A+BC$.

(5 marks)

(Total = 25 marks)

Question 3

(a) Design a binary half adder.

(i) Realize the functions of a binary half adder using a truth-table.

(16 marks)

(ii) Draw a logic gate diagram for the half adder in part(a)(i)

(4 marks)

(b) What is a multiplexer? Explain its main function.

(5 marks)

(Total = 25 marks)

Question 4

(a) Distinguish between P-type and N-type semiconductors.

(6 marks)

(b) Explain the operation of a half-wave rectifier with the aid of a circuit diagram and its relevant output waveforms.

(15 marks)

(c) Phosphorus is added to silicon to give an impurity concentration of 2×10^{18} atoms/cm^3. Determine the number of majority and minority carriers.
(Given the intrinsic silicon concentration as $n_i = 1.45 \times 10^{10}$ atoms/cm^3)

(4 marks)

(Total = 25 marks)

Question 5

(a) Draw the symbol for a general operational amplifier and label all its terminals.

(5 marks)

(b) The voltage gain of an inverting amplifier is 10 with an input resistor of 12 kΩ. The amplifier is designed using an operational amplifier. Do the following:

(i) Find out the value for the feedback resistor.

(5 marks)

(ii) Sketch the circuit diagram with its component values.

(5 marks)

(c) Sketch a diagram for a summing amplifier with three inputs using an operational amplifier and explain its operation.

(10 marks)

(Total = 25 marks)

Question 6

(a) Explain the working operation of a JK flip-flop with its functional truth-table.

(10 marks)

(b) The system block diagram of a 4-to-1 multiplexer is shown in Figure Q6(b).

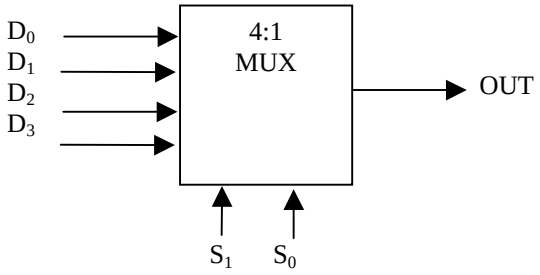

Figure Q6(b)

(i) Derive the expression for the output of a 4-to-1 multiplexer.

(4 marks)

(ii) Explain the operation of a 4-to-1 multiplexer by using the expression.

(4 marks)

(c) Realize a 4-to-1 multiplexer using basic gates.

(7 marks)
(Total = 25 marks)

End of Exam