MACHAKOS UNIVERSITY

University Examinations for 2022/2023

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

FIRST YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE (COMPUTER SCIENCE)

SCO 106: ELECTRONICS

DATE: **TIME:**

INSTRUCTIONS:

Answer question one and any other two questions

QUESTION ONE (COMPULSARY) (30 MARKS)

a) Outline the two main classification of electronic components, giving examples in each case **(**4 marks)

b) A resistor with an electrical resistance value of 10 Ω is connected to another with a resistance value of 20 Ω. The two resistors are connected in parallel. What is the total resistance across the network (2 marks)

c) With the aid of circuit diagrams, differentiate between forward biased and reverse biased connection of general purpose p-n junction diode (4 marks)

d) Convert the following numbers:

i. 300_{10} into the binary number system (2 marks)

ii. 100111_2 into the decimal number system (2 marks)

iii. 4320_{10} into the octal number system (2 marks)

iv. 1010111100_2 to the hexadecimal system (4 marks)

e) With the aid of a circuit diagram and a truth table, explain the operation of a NOT-gate (5 marks)

f) Outline three applications of electronic component (3 marks)

g) Differentiate between a word and a byte (2 marks)

QUESTION TWO (20 MARKS)

a) From the Boolean expression $F = A\bar{B} + \bar{A}B$, realize a logical circuit of an XOR-gate (3 marks)

b) Minimize the Boolean expression, $F = AB\bar{C} + A\bar{B}\bar{C} + B\bar{C}$ and implement using basic logic gates the minimized expression (6 marks)

c) Compare asynchronous and synchronous counters using logical block diagram (4 marks)

d) Design a 3-bit synchronous up-counter using J-K flip flops (7 marks)

QUESTION THREE (20 MARKS)

a) Implement and show the truth table of a multiplication operation equivalence using a network of a resistor, light emitting diode, a transistor and power source (5 marks)

b) Describe the operation of a half adder circuit with two variables A and B, showing the possible outputs on a truth table (6 marks)

c) Given two binary numbers 10111 and 110001, perform binary addition (2 marks)

d) Define combinational logic circuit as used in digital electronics (1 mark)

e) Design a digital logic circuit that takes 1-bit A and 1-bit B, returning a sum bit S and a carry out bit C as outputs. The design should include:
   i) Truth table
   ii) Logic functions
   iii) Circuit symbols (6 marks)

QUESTION FOUR (20 MARKS)

a) Construct an OR-gate using two NPN bipolar junction transistors, showing its truth table (5 marks)

b) Differentiate between combinational and sequential logic circuits (4 marks)

c) Minimize the following Boolean function using Karnaugh map method
F (A, B, C, D) = Σm(0, 1, 3, 5, 7, 8, 9, 11, 13, 15) (6 marks)

d) With the aid of diagrams, explain the difference between forward bias diode and reverse bias diode (4 marks)

e) With reference to sequential circuits, define flip flop (1 mark)

QUESTION FIVE (20 MARKS)

a) With reference to memories, differentiate between ROM and RAM (2 marks)

b) Using Boolean algebra properties, minimize the Boolean expression $F = \overline{A\bar{B}(A + C)} + \bar{A}\mathrm{B}\overline{(A + B + \bar{C})}$ and implement the minimized expression using basic logic gates (6 marks)

c) With the help of a logic circuit explain the operation of S-R flip flop (6 marks)

d) Design and implement a 2-to-4 decoder with basic logic gates, showing the truth table (6 marks)