



MACHAKOS UNIVERSITY

University Examinations 2020/2021 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR FIRST SEMESTER EXAMINATION FOR
BACHELOR OF SCIENCE (APPLIED PHYSICS AND TECHNOLOGY)

SPH 307: DIGITAL ELECTRONICS

DATE: 11/8/2021

TIME: 2.00-4.00 PM

INSTRUCTIONS:

- The paper consists of **two** sections
- Section **A** is **compulsory** (30 marks)
- Answer any **two** questions from section **B** (each 20 marks)

SECTION A (COMPULSORY)

QUESTION ONE (30 MARKS)

- a) Define the term radix as used in number systems. (1 mark)
- b) State the difference between Latch and a Flip flop (2 marks)
- c) Express $6A32.5F_{16}$ as the sum of product of its weighted basis (2 marks)
- d) Using Boolean algebra techniques simplify this expression (2 marks)
- $$A.B.C + A.B.\bar{C} + A.\bar{B}.C + A.\bar{B}.\bar{C} + \bar{A}.B.C + \bar{A}.B.\bar{C} + \bar{A}.\bar{B}.C + \bar{A}.\bar{B}.\bar{C}$$
- e) Find the gray code of binary number 110110100011 (1 mark)
- f) Find the excess-3 equivalent of $(237)_{10}$ (2 marks)
- g) Convert the decimal number 9673 to BCD. (2 marks)
- h) Give the hexadecimal equivalent of 0100 0011 0110_{BCD} (2 marks)
- i) State one difference between sequential and combinational circuits (1 mark)
- j) Show the logic arrangement for implementing a four-input AND gate using two-input AND gates only. (2 marks)

- k) Consider an arbitrary number system with the independent digits as 0, 1 and X. State the radix of this number system and list the first 9 numbers in this number system. (2 marks)
- l) Implement the expression $X = \overline{A\overline{B}C} + (D + E)$ using suitable logic gates (2 marks)
- m) Convert (+25) and (-36) into binary format and hence determine the solution of 25-36 using two's complement (3 marks)
- n) Define the term sample rate and state the Nyquist sampling theorem (2 marks)
- o) With suitable examples, distinguish between primary and secondary storage methods as used in computer technology (2 marks)
- p) State the main difference between Moore and Mealy Finite state machines (2 marks)

SECTION B (ANSWER ANY TWO QUESTIONS)

QUESTION TWO (20 MARKS)

- a)
 - i. State one difference between a register and a counter circuits (1 mark)
 - ii. Design an asynchronous 3 bit up counter circuit and draw its timing diagram with a truth table for each clock to show how it counts digits 0 to 7 (6 marks)
- b) Decode the following message which was encoded using ASCII code. Take the ASCII code of A to be (41)₁₆ and P to be (50)₁₆ (5 marks)
 - i. 01000100 01001001 01000111 01001001 01010100 01000001 01001100
 - ii. 00100000 01000101 01001100 01000101 01000011 01010100
 - iii. 01010010 01001111 01001110 01001001 01000011 01010011
- c)
 - i Derive the truth table of an octal to binary encoder (2 marks)
 - ii Write the Boolean function of the binary encoder in c (i) (2 marks)
 - iii Implement the octal binary encoder in c (i) using OR gates only (4 marks)

QUESTION THREE (20 MARKS)

- a)
 - i Derive the truth table for a 2 to 4 decoder (2 marks)
 - ii Derive the Boolean expression for the decoder in a (i) (2 marks)
 - iii Implement the decoder using NOT and AND gates only (3 marks)
- b) Define a register and describe the working of SISO, SIPO and PIPO shift register (7 marks)
- c) Minimize the following functions using K-map simplification techniques (6 marks)
 - i. $\overline{A}\overline{B}C + \overline{A}B\overline{C} + \overline{A}BC + A\overline{B}\overline{C}$
 - ii. $f(w,x,y,z) = (0,1,2,4,5,6,8,9,12,13,14)$

QUESTION FOUR (20 MARKS)

- a) With the aid of a truth table implement a circuit that can be used as a full adder (6 marks)
- b) Suppose the cash room at a store has access restricted to certain employees, each of who has a key, which produces a logic 1 at particular inputs to an unlocking circuit. Only the store manager (M) can enter alone. The assistant manager (A) and the cashier (C) also have access, but only when accompanied by each other, or by the store manager. Write a truth table and the Boolean expression then design a minimized combinational logic circuit using AND and OR gate only that will allow access by producing a logic 1 when the above conditions are met. (6 marks)
- c) By use of logic diagrams and truth tables describe the four types of flip flops and show how the JK flip flop makes the indeterminate state of SR flip flop useful (8 marks)

QUESTION FIVE (20 MARKS)

- a) Describe the following features of a computer storage device (6 marks)
 - i. Volatility
 - ii. Addressability
 - iii. Accessibility
- b) By use of diagrams discuss the working principles of weighted resistor and R-2R methods of digital to analogue conversion (6 marks)
- c) Figures 1 (a) and (b) are circuit diagrams of switching systems.
 - i. For each circuit, determine the truth table and the logic expression (4 marks)
 - ii. Implement the expressions in c (i) using NAND gates only (4 marks)

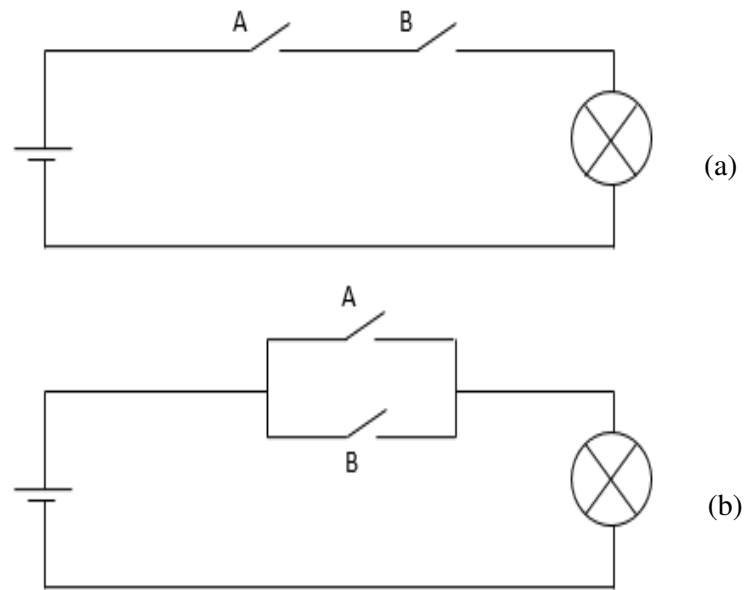


Fig: 1