



MACHAKOS UNIVERSITY

University Examinations 2019/2020 Academic year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF EDUCATION (SCIENCE)

SPH 441: MICROPROCESSOR APPLICATIONS AND SYSTEMS

DATE: 10/12/2019

TIME: 8.30-10.30 AM

INSTRUCTIONS TO CANDIDATES

Answer Question **ONE** in **section A** and Any Other **TWO** Questions in **section B**.

SECTION A (COMPULSORY)

QUESTION ONE (30 MARKS)

- a)
 - i. By use of an example, distinguish between a sensor and an actuator (2 marks)
 - ii. Depending upon function, infrared sensors are grouped as thermal and quantum. What are the differences between these two types? (2 marks)
 - iii. Briefly explain the need for an analogue-to digital converter (ADC) in microprocessor-based systems (2 marks)
- b) Give the measurable physical quantities in the following energy types: (2 marks)
 - i. Mechanical
 - ii. Thermal
 - iii. Electrical
 - iv. Magnetic
- c)
 - i. Distinguish between Combinational and Sequential circuits (4 marks)
 - ii. Define the term gate as used in basic digital circuits (1 mark)
- d) Make truth table for a 3-input (4 marks)

- i. AND gate
 - ii. OR gate
 - iii. NAND gate
 - iv. NOR gate
- e) State any two examples of digital systems (2 marks)
- f) Convert $(0.6875)_{10}$ into octal (3 marks)
- g) i. List two types of Analogue to Digital converters (2 marks)
- ii. Outline two types of Digital to Analogue converters (2 marks)
- h) i. Differentiate between low-level and high-level programming languages (2 marks)
- ii. State one merit and one demerit of machine code compared to a high-level language (2 marks)

QUESTION TWO (20 MARKS)

- a) Rotary encoders are divided into two, namely incremental and absolute. Discuss, with the aid of diagrams, these encoders in terms of their:
- i. Differences (5 marks)
 - ii. Applications (5 marks)
- b) Light Dependent Resistor, LDR, are used in street lamps, camera light meters, alarm clock, burglar alarm circuits, light intensity meters, and counting packages moving on a conveyor belt. Explain how LDR are used in:
- i. Street lamps, (2 marks)
 - ii. Camera (2 marks)
 - iii. Light meters (2 marks)
 - iv. Burglar alarm circuits (2 marks)
 - v. Counting packages moving on a conveyor belt (2 marks)

QUESTION THREE (20 MARKS)

- a) Given the logical equation
- $$Y = (A + BC) (B + \bar{C}A)$$
- i. Design a circuit using gates to realize this function (3 marks)
 - ii. Find out whether it is possible to design the circuit with only one type of gates (NAND or NOR). If yes, design the circuits. (3 marks)

- iii. Find out whether it is possible to simplify this equation. If yes, simplify it. (2 marks)
 - iv. Now design the circuit using the simplified expression obtained in part (iii) (3 marks)
 - v. Compare the circuits obtained in parts (i), (ii) and (iii) from the point of view of number of gates, number of inputs for the gates, types of gates, and propagation delay. (6 marks)
- b) Convert an **S-R FLIP-FLOP to a J-K FLIP FLOP** (3 marks)

QUESTION FOUR (20 MARKS)

- a) Draw a block diagram of a typical 8-bit microcomputer and discuss the functions of the following components: (12 marks)
- b) The buses
 - i. Central processing unit
 - ii. The memory
- c) Differentiate between a random-access memory (RAM) and a read only memory (ROM) (6 marks)
- d) Use a diagram to explain the WRITE operation of a random-access memory (2 marks)

QUESTION FIVE (20 MARKS)

- a) Convert the following binary numbers into decimal without the use of a calculator: (6 marks)
 - i. 1101
 - ii. 111000
- b) Explain using a diagram the application of binary no. system in the Gray and BCD coding (6 marks)
- c) Convert the following hexadecimal numbers to (i) binary (ii) decimal and (iii) octal: (6 marks)
 - i. 32_{16}
 - ii. $2A_{16}$
- d) State two applications of number systems in programming (2 marks)