

2521/203 2602/202
2601/202 2603/202
DIGITAL AND ANALOGUE
ELECTRONICS II
June/July 2023
Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING
(POWER OPTION)
(TELECOMMUNICATION OPTION)
(INSTRUMENTATION OPTION)

MODULE II

DIGITAL AND ANALOGUE ELECTRONICS II

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

Answer booklet;

Mathematical tables/non-programmable scientific calculator;

Drawing instruments.

This paper consists of EIGHT questions in TWO sections, A and B.

Answer FIVE questions choosing any TWO questions from section A, and any THREE questions from section B in the answer booklet provided.

All questions carry equal marks.

Maximum marks for each part of a question are as indicated.

Candidates should answer the questions in English.

This paper consists of 5 printed pages and one insert.

Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

SECTION A: ANALOGUE ELECTRONICS II

Answer any TWO questions from this section.

1.
 - (a) List any **two** applications of light emitting diodes (LEDs). (2 marks)
 - (b) With the aid of a labelled diagram, describe the construction of a TRIAC. (6 marks)
 - (c) Draw the output waveforms of the three classes of amplifiers with respect to their mode of operation. (6 marks)
 - (d) An amplifier has an open circuit voltage gain of 1000, an output resistance of $15\ \Omega$ and input resistance of $7\ \text{k}\Omega$. It is supplied from a signal source of $10\ \text{mV}$ with internal resistance of $3\ \text{k}\Omega$. The amplifier feeds a load of $35\ \Omega$. Determine the:
 - (i) magnitude of the input voltage;
 - (ii) magnitude of the output voltage.(6 marks)
2.
 - (a) State **three** methods of turning ON a silicon controlled rectifier (SCR). (3 marks)
 - (b) With the aid of labelled diagram, describe the operation of a SCR. (6 marks)
 - (c) With the aid of an equivalent circuit diagram, explain the principle of operation of a Unijunction Transistor (UJT). (6 marks)
 - (d) With the aid of a labelled diagram, describe the operation of a diode clipping circuit. (5 marks)
3.
 - (a) State **three** merits of sinusoidal oscillators. (3 marks)
 - (b) With the aid of a labelled diagram, describe the construction of Colpitt's oscillator. (6 marks)
 - (c) With the aid of a labelled diagram, describe the operation of a light amplification by stimulated emission of radiation (LASER). (6 marks)

- (d) **Figure 1** shows a summing amplifier circuit, with three inputs having varied gains. The input voltage V_1 , V_2 and V_3 are 0.5 V , 0.2 V and 0.1 V respectively.

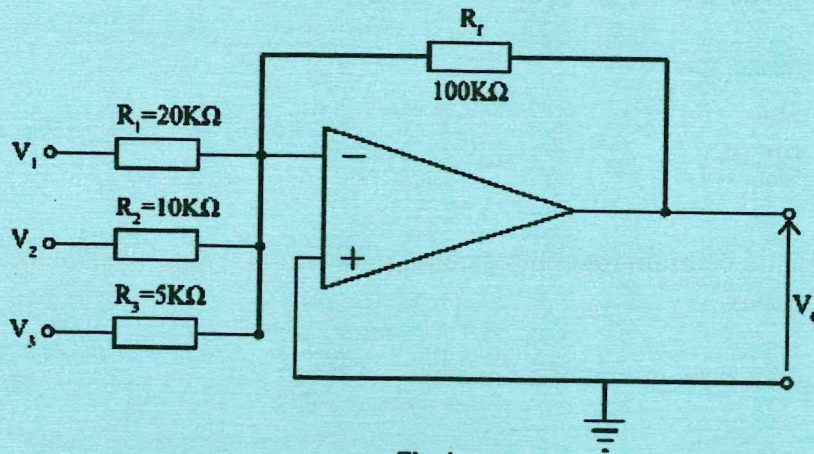


Fig. 1

Determine the:

- (i) gain under input voltage V_1 ;
- (ii) gain under input voltage V_2 ;
- (iii) output voltage.

(5 marks)

SECTION B: DIGITAL ELECTRONICS

Answer any **THREE** questions from this section.

4. (a) State **three** advantages of digital over analogue systems: (3 marks)
- (b) Perform each of the following conversions:
 - (i) 45.35_{10} into binary;
 - (ii) $FEB.9A7_{16}$ into octal;
 - (iii) 645.725_8 into decimal.

(11 marks)
- (c) (i) Add $10010110_2 + 01110011_2$ in Binary Coded Decimal (BCD).
 (ii) Convert 1001101101_2 to gray code. (6 marks)
5. (a) Prove each of the following Boolean identities: (8 marks)
 - (i) $A(A + B) = A$.
 - (ii) $\overline{A} \overline{B} \overline{C} + \overline{A} B \overline{C} + A \overline{B} \overline{C} + ABC = \overline{C}$.

- (b) Given the Boolean expression;

$$Z = \overline{\overline{A \cdot B + \overline{AC} + (A + B) \cdot C}}$$

Draw the:

- (i) truth table;
 (ii) logic circuit.

(8 marks)

- (c) Draw a schematic diagram for complementary metal oxide semi-conductor (SMOS) using NAND gates. (4 marks)

6. (a) **Figure 2** shows a logic circuit of a flip-flop.

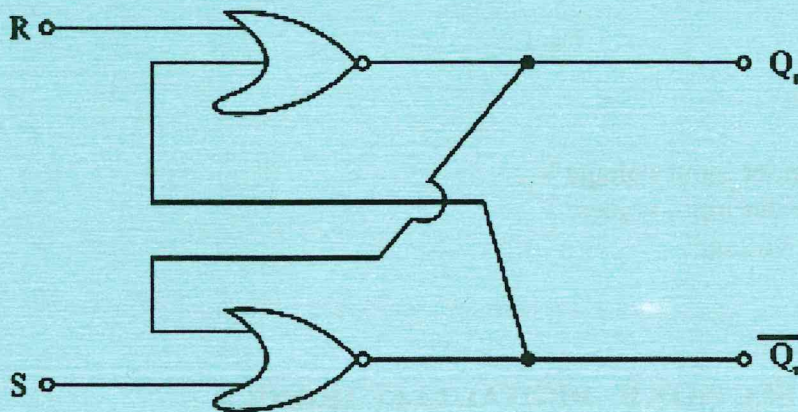


Fig. 2

- (i) identify the flip-flop;
 (ii) draw the truth table of the flip-flop in a (i).

(5 marks)

- (b) State **three** applications of shift registers used in digital circuits. (3 marks)

- (c) With the aid of a logic circuit diagram, describe a 4-bit serial in serial out shift register (SISO). (8 marks)

- (d) A digital to analog converter (DAC) has a digital input of 1001. Determine the output voltage. (4 marks)

7. (a) (i) Draw a truth table of a full-adder.
 (ii) Obtain the Boolean expression for the sum and carry out of a(i). (8 marks)

- (b) With the aid of a labelled diagram, describe Ramp type analogue to digital converter (ADC). (6 marks)

- (c) With the aid of a labelled diagram, describe the construction of a ring counter. (6 marks)

8. (a) State **three** factors to be considered when choosing a microcomputer system. (3 marks)
- (b) A system is made up of $64K \times 16$ RAM chips. Determine the:
- word size;
 - address size;
 - capacity in bytes.
- (5 marks)
- (c) Figure 3 shows a block diagram of a micro-computer system.

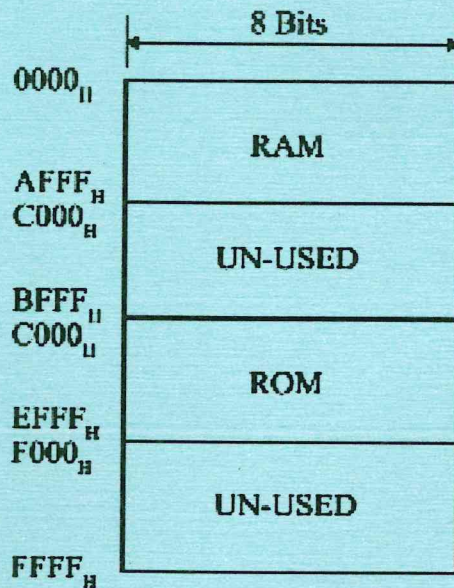


Fig. 3

Determine the total capacity in kilobytes for each of the following memory chips:

- RAM;
 - ROM;
 - UN-USED.
- (8 marks)
- (d) Describe the operation of magnetic bubble memory device. (4 marks)

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