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DIGITAL AND ANALOGUE ELECTRONICS

Oct./Nov. 2012

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

**DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING
(POWER)
MODULE II**

DIGITAL AND ANALOGUE ELECTRONICS

3 hours

INSTRUCTIONS TO CANDIDATES*Write your name and index number in the spaces provided above.**Sign and write the date of the examination in the spaces provided above.**You should have the following for this examination:**Answer booklet;**Scientific calculator (non-programmable).**This paper contains TWO sections; A and B.**Answer any TWO questions in section A and any THREE questions in section B.**All questions carry equal marks.**Maximum marks for each part of a question are as shown.***For Examiner's Use Only**

Section	Question	Maximum Score	Candidate's Score
A	1	20	
	2	20	
	3	20	
	4	20	
B	5	20	
	6	20	
	7	20	
	8	20	
Total Score			

This paper consists of 16 printed pages.

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

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SECTION A:

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

1. (a) With the aid of diagrams differentiate between damped oscillations and undamped oscillations. (4 marks)

(b)

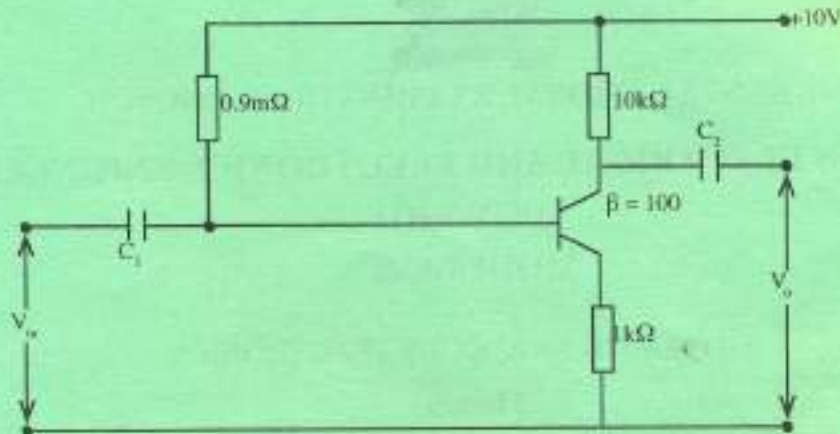


Figure 1

Figure 1 shows a series feedback connection. Neglecting V_{BE} and taking $r_e' = \frac{25mV}{I_E}$. Determine:

- (i) Voltage gain without feedback (A_v).
- (ii) Feedback factor.
- (iii) Voltage gain with feedback (A_{v+})

(11 marks)

- (c) With the aid of a block diagram, differentiate between voltage series and voltage shunt feedback connection. (5 marks)

2. (a) Define the following terms as used in operational amplifiers:

- (i) slew rate;
- (ii) common mode rejection ratio.

(4 marks)

- (b) With the aid of a circuit diagram, derive the expression for the output voltage of a summer amplifier with three inputs. (6 marks)

- (c) Draw the voltage current (VI) characteristics curve for a TRIAC and explain its shape. (10 marks)

3. (a) With the aid of a circuit diagram, explain the operation of a Bistable multivibrator. (8 marks)
- (b) Explain the principle of operation of a photo diode. (6 marks)
- (c)

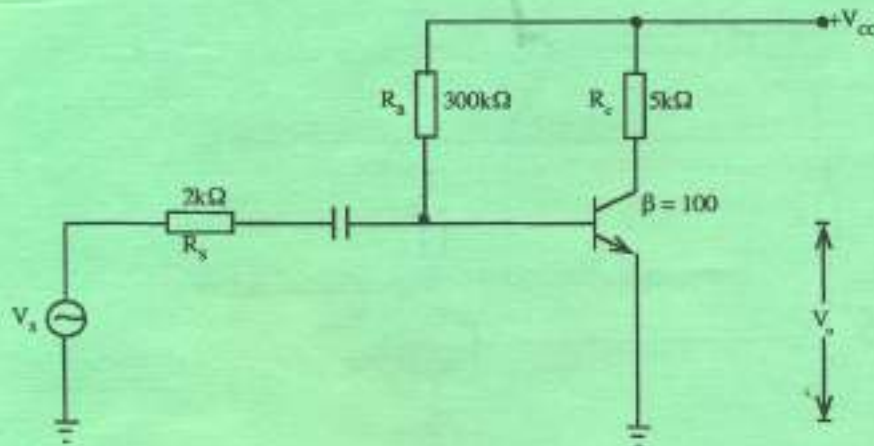


Figure 2

Figure 2 shows a common Emitter transistor amplifier. If the h parameters are $h_{ie} = 1k\Omega$, $h_{fe} = 100$, $h_{re} = 5 \times 10^{-4}$ and $h_{oe} = 2 \times 10^{-5}$ Determine.

- Input impedance (r_{in})
- Output impedance (r_o)
- Current gain (A_i)

(6 marks)

SECTION B

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

4. (a) (i) State **two** uses of digital codes in digital and / mechanical systems. (2 marks)
- (ii) Using one's complement, work out.
 $100011_2 - 111010_2$ (4 marks)
- (iii) Convert 10011100111 into Gray code. (2 marks)

- (b) Draw the symbols and write the truth tables for the following TWO input logic gates.

- I. NAND
- II. XOR
- III. XNOR

(6 marks)

- (c) Figure 3 shows a logic circuit.

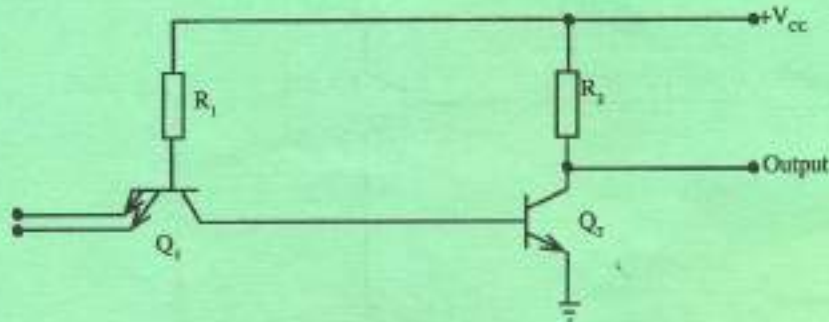


Figure 3.

- (i) Describe its operation.
- (ii) Draw its truth table.

(6 marks)

5. (a) Implement the following logic expression using NAND gates only.

$$Q = A\bar{C} + \bar{B}C + AB$$

(4 marks)

- (b) A logic circuit has output 1's for the following Boolean expression and 0's for the remaining inputs.

$$F(A, B, C, D) = \sum (1, 2, 3, 4, 6, 7, 9, 10, 12)$$

- (i) Draw a Karnaugh map representation for the inputs.
- (ii) Write down the simplified Boolean expression from the K-map. (8 marks)
- (c) (i) With the aid of a logic diagram and truth table, explain the operation of a half adder circuit. (4 marks)
- (ii) The following inputs are applied to a 74LS283 4-input full adder.

$$A_4 A_3 A_2 A_1 = 0101, B_4 B_3 B_2 B_1 = 1001, C_{in} = 1$$

Determine the sum output and the output carry.

(4 marks)

6. (a) (i) State Demorgan's theorems. (2 marks)

(ii) Simplify the following Boolean expression.

$$Q = \overline{AB}(A+C) + \overline{AB}(A+\overline{B}\overline{C})$$

(4 marks)

(b) An alarm system is needed to maintain three boilers in an industrial plant. Three sensors monitor water level (A), Temperature (B) and Pressure (C). The system provide a high signal that can be connected to a buzzer, if the water level is low and the temperature is too high, or if the water level is low and the pressure is too high, or if the water level is low and the temperature and pressure is too high, if the water level is normal and the temperature or pressure is too high.

(i) Draw a truth table to represent the system conditions.

(ii) Write down the Boolean expression for the alarm system.

(iii) Design a logic circuit to implement the system.

(8 marks)

(c) (i) State two applications of decoders.

(ii) Draw a logic diagram and truth table of a four – input multiplexer. (6 marks)

7. (a) Differentiate between synchronous and asynchronous counter. (2 marks)

(b) Figure 4 shows a five-bit asynchronous counter with a clock input frequency of 10MHz.

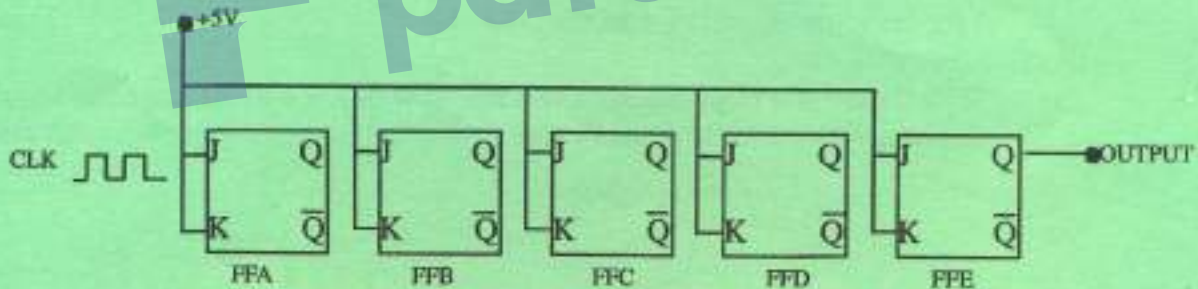


Figure 4

Determine the:

(i) MOD number of the counter

(ii) Counting range.

(iii) Count after 144 pulses.

(6 marks)

- (c) (i) Explain the following terms as used in flipflops.
I. Set up time.
II. Edge triggered. (4 marks)
- (ii) With the aid of logic diagram and truth table, explain the terms NO CHANGE, SET, RESET and INVALID as used in a NAND gate Latch. (8 marks)
8. (a) (i) With the aid of a circuit diagram, explain the operation of a R/2R Digital to Analogue Converter (DAC). (4 marks)
- (ii) An 8-bit DAC produces a 10v for the binary digit 10110110_2 . Determine the:
I. Resolution.
II. Stepsize.
III. Maximum scale output voltage. (6 marks)
- (b) Define the following terms as used in memories.
(i) Read only memory.
(ii) Memory word.
(iii) Access time. (3 marks)
- (c) (i) A DRAM has 16 non-multiplexed address pins and 4 data input/output pins. Determine the organization of the DRAM. (2 marks)
- (ii) With the aid of a block diagram, describe how 64K x 4 ROM can be arranged to give 256K x 8 ROM memory size. (5 marks)