Electronic Circuits 2
5255

GENERAL CERTIFICATE OF EDUCATION BOARD

Technical and Vocational Education Examination

JUNE 2025 KAWLO **INTERMEDIATE LEVEL**

Specialty Name and Acronym	**ELECTRONICS – ELN**
Subject Title	**Electronic Circuits**
Subject Code No.	**5255**
Paper No.	**2**

Duration: Three Hours

Section A has **FOUR** Questions. **Answer Question ONE and Any Other Two.**

Section B has **TWO** Questions. **Answer One Question.**

Show all the steps in your calculations giving your answer at each stage and indicating the units and symbols used.

All sketches must be neat and clear.

You are allowed to use non programmable calculators and mathematical sets

You are reminded of the necessity for good English and orderly presentation in your answers.

SECTION A: ANALOGUE ELECTRONICS

Answer question one and any two questions

1. CIRCUIT ANALYSIS

The circuit parameters of the circuit in figure 1 are E1 = 20V, E2 = 40V, E3 = 10V, R1 = 4Ω, and R2 = R3 = 8Ω.

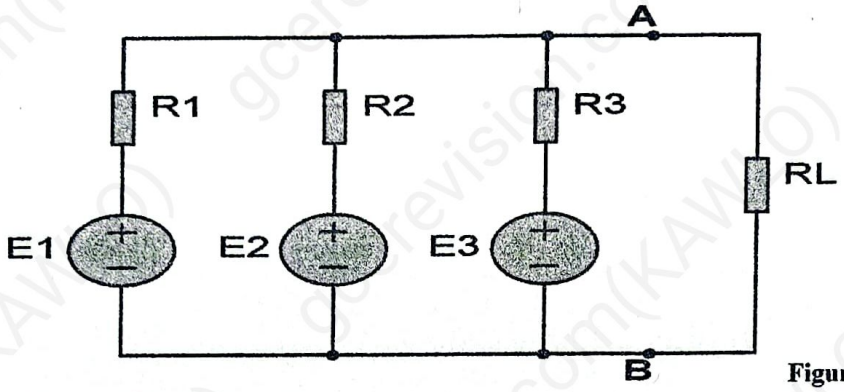

Figure 1

1.1 State milman's theorem. **(3 marks)**

1.2 Calculate the value of the Thevenin's equivalent voltage seen to the left of A – B terminals. **(7 marks)**

1.3 Calculate the value of the Thevenin's equivalent resistance seen to the left of A – B terminals. **(6 marks)**

1.4 Deduce the value of RL required for maximum power to be transferred to the load. **(3 marks)**

1.5 Calculate the maximum load power. **(6 marks)**

(Total = 25 marks)

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2. DIODE CIRCUIT

Figure 2 shows a diode circuit. The values of the circuit elements are E = 15V; R1=100Ω; R2 = 50Ω; R3 = 22Ω; the barrier potential of the diodes is 0.6V.

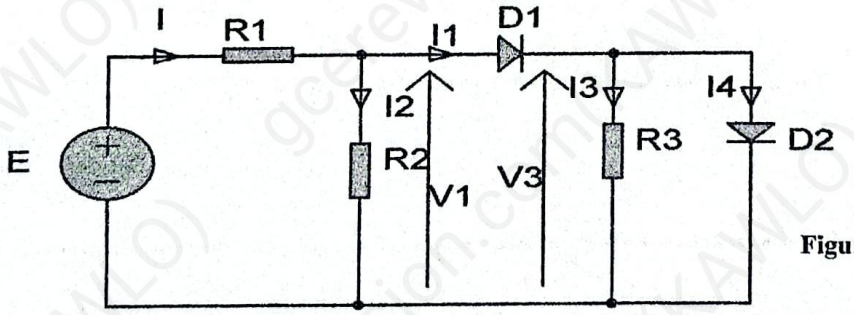

Figure 2

2.1 Draw the equivalent model of the diode when it is forward biased. **(4 marks)**

2.2 If the two diodes are conducting, find:

2.2.1 the voltage V3, **(2 marks)**

2.2.2 the voltage V1, **(2 marks)**

2.2.3 the values of the currents I3 amd I2. **(5 marks)**

2.2.4 the values of the currents I, I1 and I4. **(6 marks)**

2.3 If E = - 10V,

2.3.1 What is the state of the diodes? **(2 marks)**

2.3.2 Calculate the values of the currents I2 and I. **(4 marks)**

(Total = 25 marks)

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3. FIELD EFFECT TRANSISTOR

Consider figure 3 below. The quiescent point lies mid – way the load line; I_{DSS} = 15mA; $V_{GS(OFF)}$ = - 8V; RG = 1MΩ.

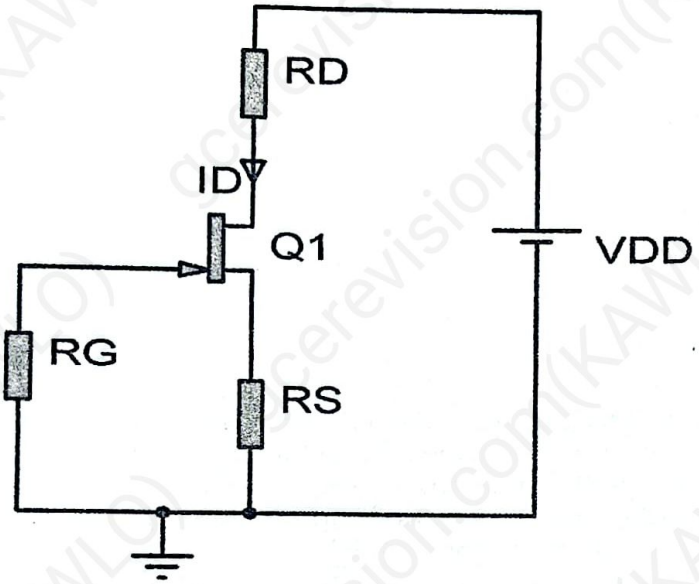

Figure 3

3.1 Identify the type of transistor biasing used in figure 3. **(2 marks)**

3.2 Name two other types of biasing circuits. **(2 marks)**

3.3 Determine the quiescent gate – source voltage V_{GSQ}. **(3 marks)**

3.4 Determine the quiescent drain current I_{DQ}. **(2 marks)**

3.5 Write the expression for Rs and calculate its value. **(3 marks)**

3.6 Write the expression for RD and calculate its value. **(3 marks)**

3.7 Calculate the power P_T dissipated by the transistor. **(4 marks)**

3.8 Identify, with justification, the operating mode of the transistor. **(4 marks)**

3.9 Give two applications of junction field effect transistor **(2 marks)**

(Total = 25 marks)

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4. OPERATIONAL AMPLIFIER

The operational amplifier used in figure 4 is ideal. The circuit parameters are R1 = 56KΩ, RF = 560KΩ; R3 = 120KΩ; R4 = 12KΩ.

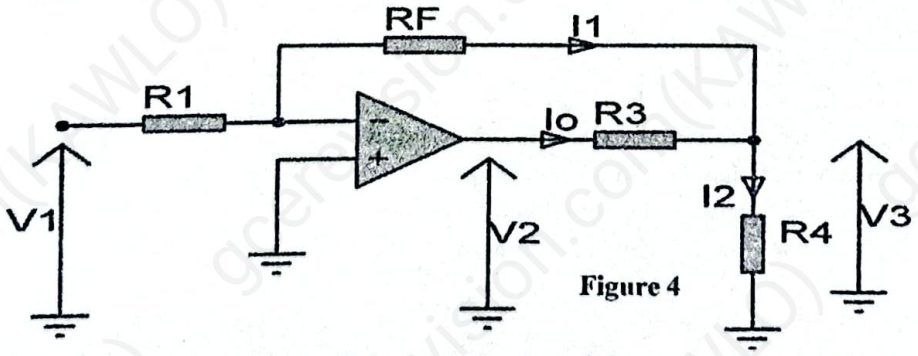

Figure 4

4.1 Identify the operating mode of the operational amplifier used in figure 4. Explain your answer. **(3 marks)**

4.2 Write the expression of the voltage at the inverting input e⁻ of the OPAM in terms of V1 and V3. **(4 marks)**

4.3 Deduce the voltage gain $A_V = \frac{v_3}{V_1}$ of the operational amplifier circuit. **(3 marks)**

4.4 Deduce the name of the circuit implemented in figure 4. **(2 marks)**

4.5 If V1 = 4V, find:

4.5.1 The current I1 **(3 marks)**

4.5.2 The voltage V3. **(3 marks)**

4.5.3 The current I_2. **(3 marks)**

4.5.4 The current Io **(3 marks)**

(Total = 25 marks)

SECTION B: DIGITAL ELECTRONICS

Answer one question in this section

5. Combinational logic

5.1 Perform the following conversions

a. $10010101.10_2 = (\text{----------})_{10}$ **(2 marks)**

b. $374_8 = (\text{----------})_{16}$ **(2 marks)**

c. $3AB.1_{16} = (\text{----------})_2$ **(2 marks)**

5.2 Add the following BCD numbers:

a. 00011000 + 00010001 **(2 marks)**

b. 01100100 + 00110011 **(2 marks)**

5.3 In a certain chemical-processing plant, a liquid chemical is used in a manufacturing process. The chemical is stored in three different tanks. A level sensor in each tank produces a HIGH voltage when the level of chemical in the tank drops below a specified point. The sensors are labeled X, Y and Z. The output F of the chemical processing plant goes HIGH when at least two of the level sensors produces a high voltage. A high voltage represents a logic 1.

a. Construct the truth table of the system. **(4 marks)**

b. Give the sum – of – product expression of the output F. **(2 marks)**

c. Use karnaugh map to simplify F. **(4 marks)**

d. Draw the logic circuit of the simplified output using two inputs NAND gates. **(5 marks)**

Total = 25 marks)

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6. Sequential logic

6.1 When is a JK flip flop said to be operating in the toggle mode? **(3 marks)**

6.2 Why are some flip flops described as asynchronous? **(2 marks)**

6.3 Consider the circuit of figure 6 below.

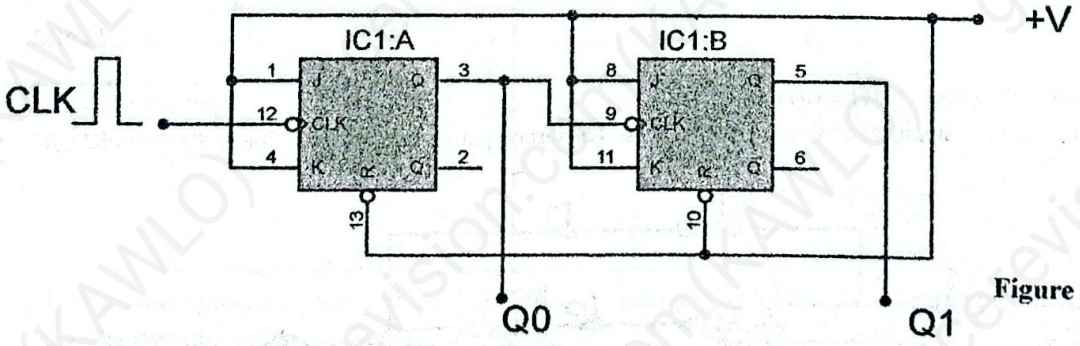

Figure 6

6.3.1 Identify the type of counter implemented in figure 6. **(2 marks)**

6.3.2 Identify the operating mode of the flip flops used in this system. **(2 marks)**

6.3.3 What is the state of the asynchronous inputs of this counter? **(2 marks)**

6.3.4 Draw the timing diagram of the counter. **(4 marks)**

6.3.5 Construct the truth table of the counter. **(6 marks)**

6.3.6 Deduce the MOD number of the counter. **(2 marks)**

6.3.7 If the frequency of the clock signal is 32KHz, find:

6.3.7.1 the frequency at Q0 output, **(4 marks)**

6.3.7.2 the frequency at Q1 output, **(3 marks)**

(Total = 25 marks)
