

2521/105, 2602/106

2601/106, 2603/106

**ELECTRICAL MEASUREMENTS AND
ANALOGUE ELECTRONICS I**

Oct./Nov. 2022

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

**DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING
(POWER OPTION)
(TELECOMMUNICATION OPTION)
(INSTRUMENTATION OPTION)
MODULE I**

ELECTRICAL MEASUREMENTS AND ANALOGUE ELECTRONICS I

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination.

Answer booklet;

Mathematical table/Non-programmable electronic calculator.

The paper consists of EIGHT questions in TWO sections; A and B.

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

All questions carry equal marks.

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

Candidates should answer all questions in English.

This paper consists of 8 printed pages.

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

SECTION A: ELECTRICAL MEASUREMENTS

Answer **THREE** questions from this section.

1. (a) Define each of the following with respect to measurements:
- (i) unit;
 - (ii) standard.
- (2 marks)
- (b) Derive the dimensions of resistivity in the Length-Time-Mass-Current (LMTI) system. (6 marks)
- (c) With aid of a labelled diagram, describe the measurement of three phase power to a star connected load by two-wattmeter method. (6 marks)
- (d) Figure 1 shows test results of a crankshaft position measurement by a sensor. Determine the:
- (i) peak-to-peak voltage;
 - (ii) rotational speed of the craftshaft in revolutions per minute (rpm).
- (6 marks)

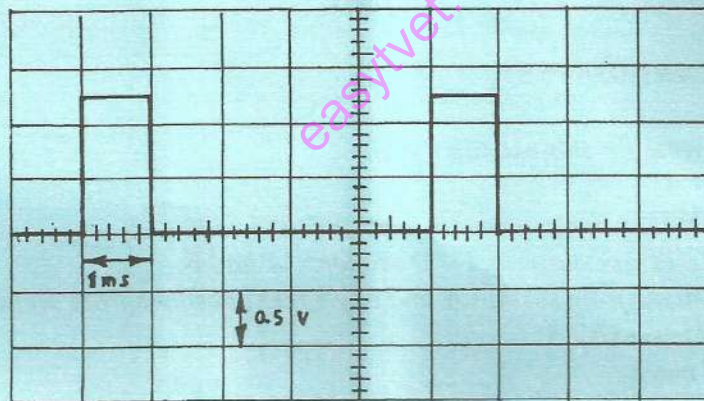


Fig. 1

2. (a) (i) State **two** materials used in soldering.
- (ii) Distinguish between silver and braze soldering.
- (4 marks)

- (b) (i) Describe corrective maintenance.
(ii) State two demerits of the maintenance in b(i).
(5 marks)

(c) Figure 2 shows a set up used to measure resistance, R . The ammeter and voltmeter internal resistance are 0.01Ω and 2000Ω respectively. The readings are 2 A and 180 V respectively. The measured resistance, $R_m = 90 \Omega$. Determine the:

- (i) current through voltmeter, I_V ;
(ii) current through resistor R ;
(iii) voltage across resistor R ;
(iv) percentage error in the measurement.

(7 marks)

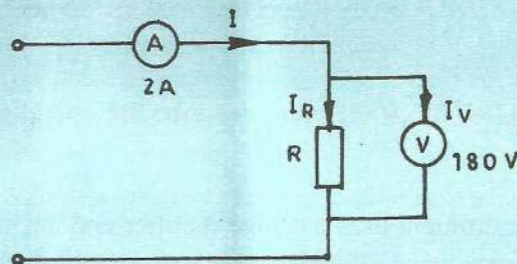


Fig. 2

(d) Figure 3 shows Maxwell's inductance-capacitance bridge. At balance, $R_2 = 300 \Omega$, $R_3 = 700 \Omega$, $R_4 = 1500 \Omega$, $C = 0.8 \text{ pF}$. Determine the:

- (i) resistance R_1 ;
(ii) inductance L .

(4 marks)

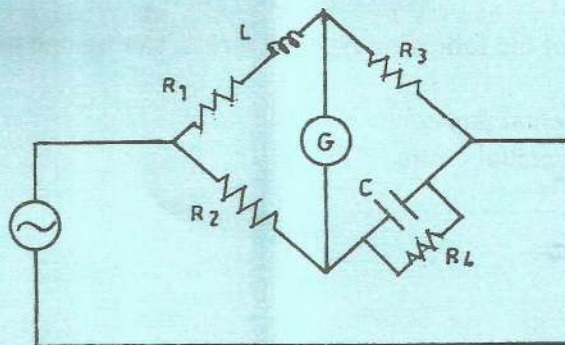


Fig. 3

3. (a) Define each of the following with respect to reliability:
- (i) availability;
 - (ii) redundancy.
- (2 marks)
- (b) With aid of a labelled diagram, describe reliability bathtub curve. (10 marks)
- (c) Ten electronic devices are tested for 500 hours. During the test, 2 failures occurred. Determine the:
- (i) Mean Time to Failure (MTTF);
 - (ii) Mean Time Between Failure (MTBF);
 - (iii) Failure rate;
 - (iv) Probability that a particular device will be operated at time equal to MTBF.
- (8 marks)
4. (a) With aid of a labelled block diagram, describe the operation of a digital frequency meter. (8 marks)
- (b) A rectifier type instrument uses a bridge rectifier and has its scale calibrated in terms of r.m.s values of a sine wave. It indicates a voltage of 2.22 V when measuring a triangular waveshape. Determine the:
- (i) average value of voltage;
 - (ii) peak value of voltage;
 - (iii) r.m.s value of voltage;
 - (iv) error in the reading.
- (8 marks)
- (c) State **four** merits of electrostatic instruments used in voltage and current measurements. (4 marks)
5. (a) Describe each of the following types of errors, stating one method of minimising each.
- (i) instrumental errors;
 - (ii) environmental errors.
- (6 marks)

- (b) Table 1 shows four oscillation period measurements of a pendulum and their corresponding time.

Table 1

Period measurement No.	Time (s)
1	2.05
2	2.03
3	1.93
4	2.01

Determine the:

- (i) mean period of the pendulum;
- (ii) average absolute error;
- (iii) relative error.

(7 marks)

- (c) With aid of a labelled diagram, explain the operation of a flux meter.

(7 marks)

SECTION B: ANALOGUE ELECTRONICS I

Answer TWO questions from this section.

6. (a) Describe each of the following vacuum tube valves:

- (i) diode;
- (ii) triode.

(4 marks)

- (b) With aid of a characteristic curve, explain the voltage current (V-I) characteristics of a zener diode.

(6 marks)

(c) Figure 4 shows a transistor circuit. Determine the:

- (i) base current, I_B ;
- (ii) collector current, I_C ;
- (iii) collector voltage, V_C ;
- (iv) emitter voltage, V_E .

(10 marks)

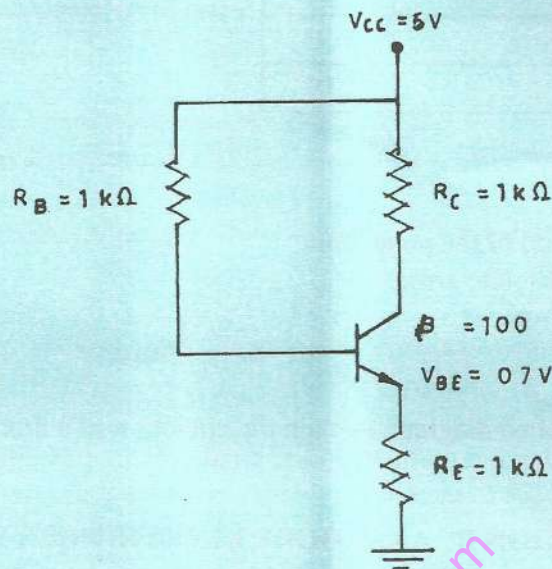


Fig.4

7. (a) Define each of the following with respect to Field effect transistors (FETs).

- (i) channel;
- (ii) gate.

(2 marks)

(b) Explain the depletion mode of operation in metal oxide field effect transistor (MOSFET).

(3 marks)

(c) With aid of a labelled diagram, explain the operation of an n-channel enhancement type MOSFET.

(7 marks)

(d) Figure 5 shows a junction field effect transistor (JFET) circuit. Determine the:

- (i) source voltage, V_S ;
- (ii) drain voltage, V_D ;
- (iii) drain-to-source voltage, V_{DS} ;
- (iv) gate-to-source voltage, V_{GS} .

(8 marks)

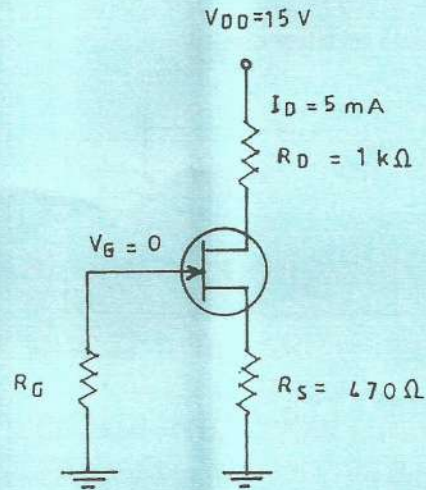


Fig.5

8. (a) Draw a labelled block diagram of a regulated power supply. (4 marks)

(b) Figure 6 shows a voltage regulator circuit.

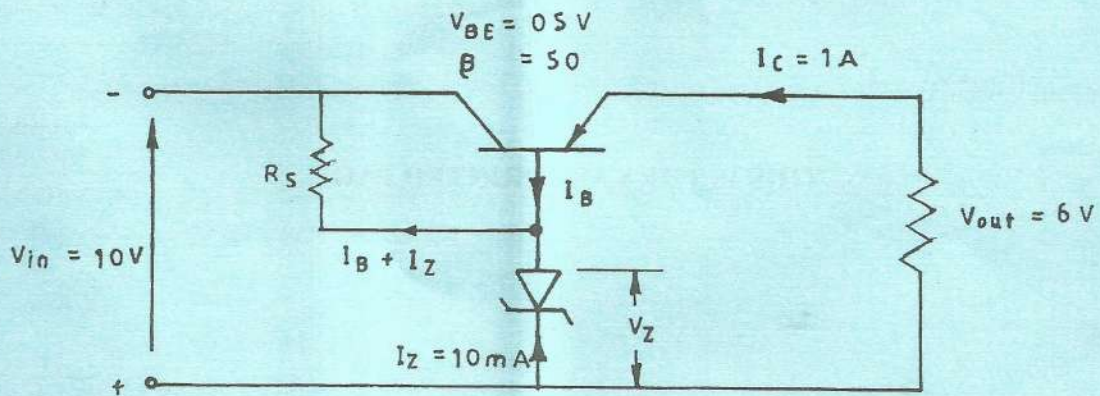


Fig. 6

Determine the:

- (i) base current, I_B ;
- (ii) zener voltage, V_Z ;
- (iii) voltage across, R_S ;
- (iv) value of resistor, R_S .

(8 marks)

- (c) Figure 7 show a half-wave rectifier circuit:

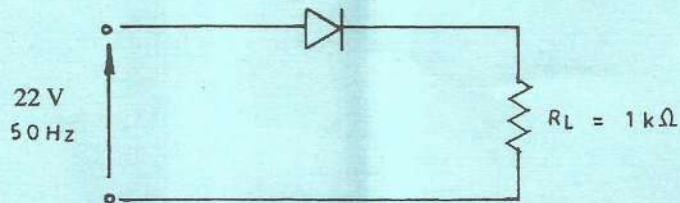


Fig.7

Determine the:

- (i) maximum d.c voltage across the load;
- (ii) maximum d.c current through the load;
- (iii) r.m.s current through the load.

(6 marks)

- (d) State **two** types of full-wave rectifiers.

(2 marks)

THIS IS THE LAST PRINTED PAGE.