2521/105 2602/106
2601/106 2603/106
ELECTRICAL MEASUREMENT
AND ANALOGUE ELECTRONICS
June/July 2016
Time: 3 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

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

MODULE I

ELECTRICAL MEASUREMENT AND ANALOGUE ELECTRONICS

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Drawing instruments;
Non-programmable electronic calculator;
Mathematical tables.
This paper consists EIGHT questions into 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 a question are as shown.
Candidates should answer the questions in English.

This paper consists of 5 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 any **THREE** questions in this section.*

1. (a) Define the following system of units as applied in measurements:

   (i) absolute unit;
   (ii) derived unit. (2 marks)

   (b) Derive the dimensions of the following quantities using the electrostatic system of units:

   (i) charge (Q);
   (ii) current (I). (8 marks)

   (c) State **four** advantages of the MKS system of units in electrical measurements. (4 marks)

   (d) Using the LMTI system of units, derive the dimensional equations for:

   (i) EMF;
   (ii) magnetic flux density. (6 marks)

2. (a) Explain the following types of measurement errors:

   (i) environmental errors;
   (ii) instrumental errors;
   (iii) gross errors;
   (iv) residue errors. (8 marks)

   (b) State **three** detectors and their operational frequencies as commonly used for a.c. bridges. (6 marks)

   (c) Explain how the following factors affect precision measurement of medium resistance with wheatstone bridge:

   (i) temperature effects;
   (ii) contact resistance;
   (iii) thermo-electric effects. (6 marks)

3. (a) State **three** causes of faults on a printed circuit board. (3 marks)

   (b) List **five** tools used in the repair and maintenance of electronic equipment. (5 marks)

   (c) Explain **three** points a service engineer should consider when fault finding on electronic equipment. (6 marks)

   (d) Outline **three** operational objectives and **three** cost objectives of good maintenance. (6 marks)

4. (a) Describe the term 'reliability' as applied in electrical measurements. (4 marks)

(b) Explain the importance of the following in relation to reliability:

(i) mean time between failures;
(ii) mean time to failure;
(iii) availability. (6 marks)

(c) Table 1 shows the performance of ten pressure monitors, observed while operating for a period of 1200 hours. Every failed unit is replaced immediately. Determine the:

(i) MTBF;
(ii) failure rate (10 marks)

Table 1

Unit Number	Time of Failure (hours)	Failure
1	650	1
2	420	1
3	130 and 725	2
4	585	1
5	630 and 950	2
6	390	1
7	No failure	0
8	880	1
9	No failure	0
10	220 and 675	2

(a) State three reasons for the inaccuracies encountered in magnetic measurements. (3 marks)

(b) Outline six methods of fault location in electronic systems. (6 marks)

(c) Explain the following wattmeter errors:

(i) eddy current errors;
(ii) stray magnetic field errors. (6 marks)

(d) Draw a labelled construction diagram of Hibberts magnetic standard used in magnetic measurements. (5 marks)

SECTION B: ANALOGUE ELECTRONICS

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

6. (a) Explain how the following extrinsic semi-conductors are formed.

(i) N- type;

(ii) P-type. (4 marks)

(b) (i) State **three** applications of semi-conductor diodes (6 marks)

(ii) With aid of voltage-current characteristics, describe the avalanche breakdown in a P-N junction diode. (10 marks)

(c) A silicon diode has a forward voltage drop of 1.5V and a forward d.c. current of 150 mA. It has a reverse current of 1.2 μA and a reverse voltage of 12 V. Determine for the diode the:

(i) forward resistance;

(ii) reverse resistance. (6 marks)

7. (a) Draw equivalent two source biaising circuits using the transistor symbol for the following:

(i) PNP transistor;

(II) NPN transistor. (4 marks)

(b) Figure 1 shows an amplifier circuit.

(i) Determine the d.c. operating point.

(ii) Sketch the d.c. loadline.

NB: neglect V_{BE} (12 marks)

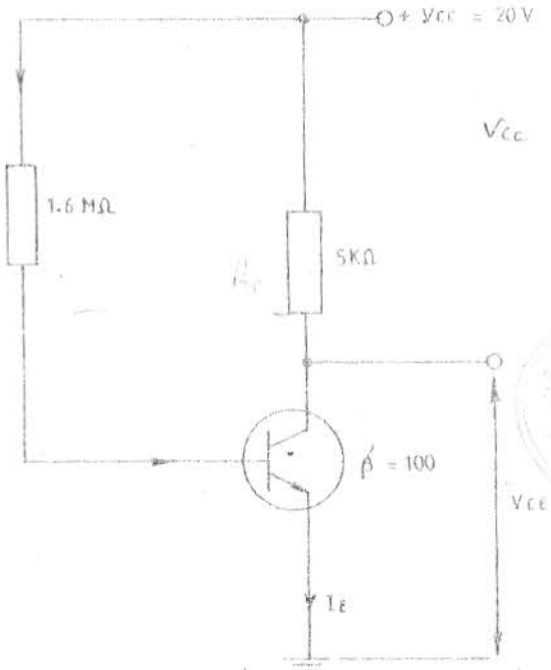

Fig. 1

(c) State **two** advantages and **two** disadvantages of field effect transistors over bipolar junction transistors. (4 marks)

8. (a) State **three** advantages of bridge rectifier over bi-phase rectifier. (3 marks)

(b) (i) With aid of circuit diagram and voltage waveforms, describe the operation of a single phase half wave rectifier feeding a purely resistive load.

(ii) Derive the expression for the output d.c. current for the rectifier in b(i). (11 marks)

(c) Figure 2 shows a zener diode stabilizer. Determine the output voltage with no load current. (6 marks)

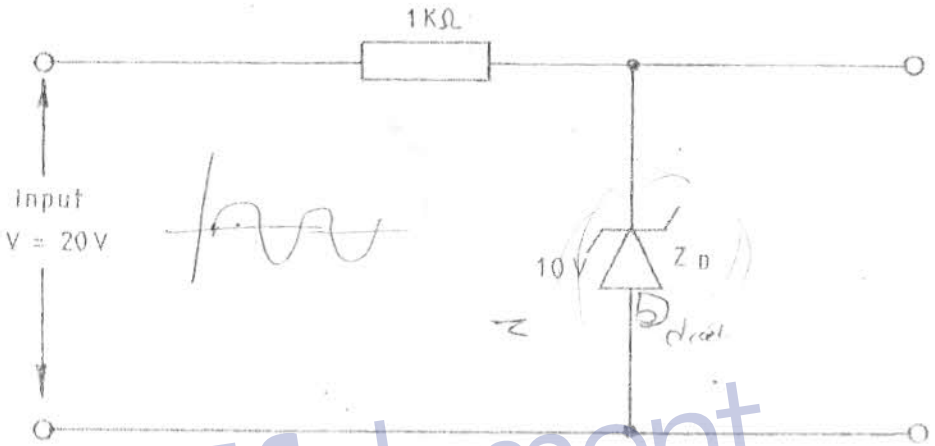

Fig. 2

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