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.

(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

(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 biasing 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)

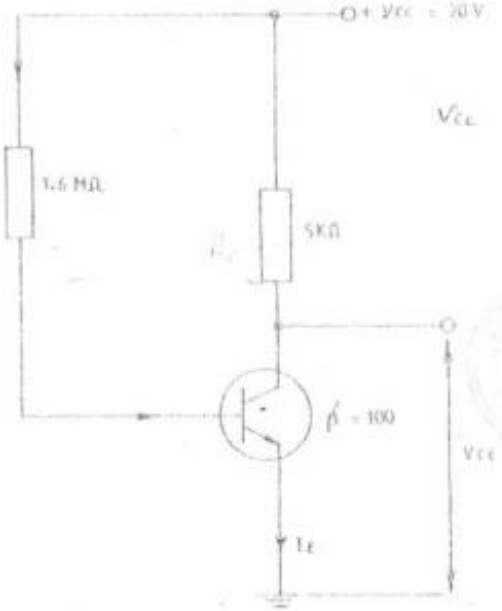

Fig. 1

(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)

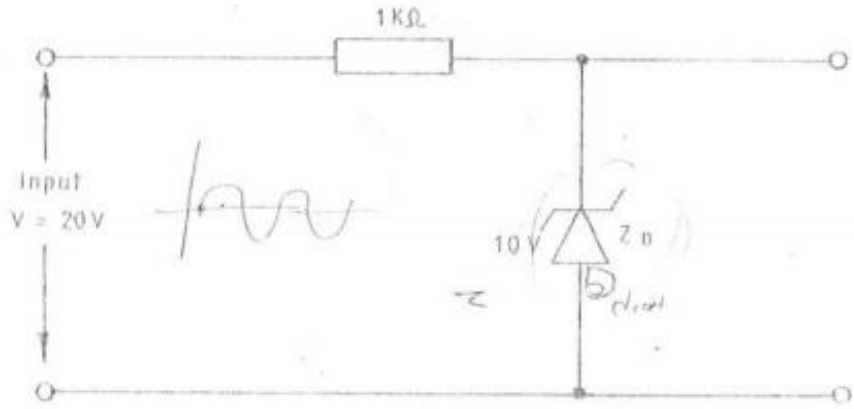

Fig. 2

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