

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)

2521/105 2602/106

2601/106 2603/106

June/July 2016

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

5. (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 $1.2\ \mu\text{A}$ 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. (12 marks)
- NB: neglect V_{BE}

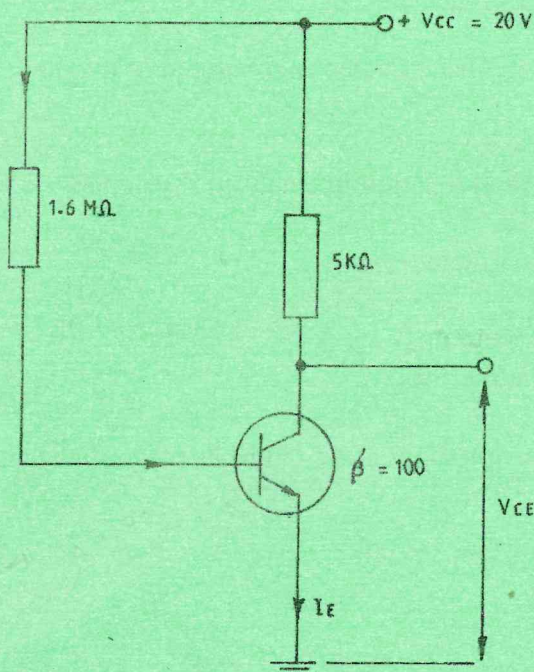


Fig. 1

2521/105 2602/106

2601/106 2603/106

June/July 2016

- (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)

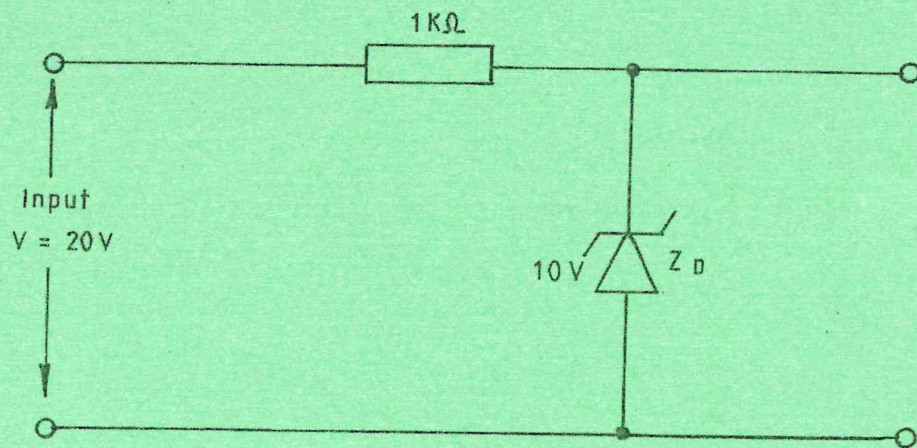


Fig. 2

THIS IS THE LAST PRINTED PAGE.