Name:_____ Index No.: _____

2521/102
2601/103
2602/103
2603/103
ENGINEERING MATHEMATICS I
June/July 2015
Time: 3 hours

Candidate's Signature:_____

Date:_____

THE KENYA NATIONAL EXAMINATIONS COUNCIL

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



ENGINEERING MATHEMATICS I

**3 hours**

## INSTRUCTIONS TO CANDIDATES

*Write your name and index number in the spaces provided above.*
*Sign and write the date of the examination in the spaces provided above.*
*You should have Mathematical tables / Scientific calculator for this examination.*
*This paper consists of **EIGHT** questions.*
*Answer any **FIVE** questions in the spaces provided in this question paper.*
*All questions carry equal marks.*
*Maximum marks to each part of a question are as shown.*
*Do **NOT** remove any pages from this booklet.*
***Candidates should answer the questions in English.***

**For Examiner's Use Only**

| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | TOTAL SCORE |
|---|---|---|---|---|---|---|---|---|---|
| Candidate's Score | | | | | | | | | |

**This paper consists of 20 printed pages.**

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



**Turn over**

Name:_____ Index No:_____/_____

2521/105, 2602/106
2601/106, 2603/106
ELECTRICAL MEASUREMENTS,
AND ANALOGUE ELECTRONICS
June/July 2015
Time: 3 hours

Candidate's Signature: _____

Date:_____

# THE KENYA NATIONAL EXAMINATIONS COUNCIL

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

ELECTRICAL MEASUREMENTS AND ANALOGUE ELECTRONICS



**3 hours**

**INSTRUCTIONS TO CANDIDATES**

*Write your name and index number in the spaces provided above.*
*Sign and write the date of the examination in the spaces provided above.*
*You should have Drawing instruments and Scientific calculator/mathematical table for this examination.*
*This paper consists of **TWO** sections; **A** and **B**.*
*Answer any **THREE** questions from section **A** and **TWO** questions from section **B** in the spaces provided in this question paper.*
***All** questions carry equal marks.*
*Maximum marks for each part of a question are as shown.*
*Do **NOT** remove any pages from this booklet.*
***Candidates should answer the questions in English.***

**For Examiner's Use Only**

| Section | Question | Maximum Score | Candidate's Score |
|---|---|---|---|
| A | | 20 | |
| | | 20 | |
| | | 20 | |
| B | | 20 | |
| | | 20 | |
| | **Total Score** | **100** | |

**This paper consists of 24 printed pages.**

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

(1) June/July 2015

## SECTION A

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

1. (a) Explain the following types of errors which may occur during measurement:

(i) gross errors;
(ii) environmental errors;
(iii) random errors.

(6 marks)

(b) (i) State any **two** factors that determine the choice of a suitable method of measuring resistance.

(ii) An unknown resistor in series with a milliammeter is measured using the ammeter-voltmeter method. The voltmeter used has a sensitivity of 1000 Ω/υ and reads 100 V on its 150 V scale when connected across the resistor. If the milliammeter reads 5 mA, determine the:

(I) apparent value of the resistor;

(II) actual value of the resistor;

(III) percentage error. (8 marks)

(c) With the aid of a labelled diagram describe how a ballistic galvanometer is calibrated using Hibbert Magnetic standard. (6 marks)

2. (a) (i) Define the following terms with respect to soldering:

(I) solder;

(II) flux.

(ii) Outline the procedure followed during soldering process. (6 marks)



(b) (i) Distinguish between an integrated circuit (IC) and a printed circuit board (PCB).

(ii) Describe the following methods of fault location in electronic systems:

(I) functional area test;

(II) half-split.

(6 marks)

(c) (i) Explain the following types of maintenance in an electrical workshop.

(I) corrective;

(II) planned.

(ii) Outline the steps involved in carrying out a planned maintenance programme. (8 marks)

3. (a) (i) Explain the term "unit" in relation to measurements.

(ii) Differentiate between electrostatic system of units (ESU) and electromagnetic system of units (EMU). (6 marks)

(b) Explain the following standards of measurements:

(i) international;

(ii) secondary. (6 marks)



(c) (i) Define the following in relation to errors and for each give its mathematical expression:

(I) absolute;

(II) relative.

(ii) A standard measuring instrument measures the value of a resistance as 10.25 Ω. If the actual value of the resistance is 10.22 Ω, determine the

(I) absolute error of measurement;

(II) percentage error. (8 marks)

4. (a) Define the following terms as applied in equipment reliability:

(i) Derating;

(ii) Mean Time to Repair (MTTR) (4 marks)

(b) (i) Explain the following with respect to equipment maintainability:

(I) availability;

(II) life cycle costs.

2015 (3)

(ii) On the same axis of "users costs" Vs "availability" draw the graphs of :

(I) equipment price;
(II) costs of failure;
(III) total cost of I and II and determine optimum availability.

(9 marks)

(c) (i) State any **two** categories of equipment manuals used to aid repair work.

(ii) Outline the main function of each of the following tools and measuring instruments when used in electronic laboratory.

(i) signal generator;
(ii) solder sucker;
(iii) long nose pliers;
(iv) screw driver;
(v) multimeter.

(7 marks)

5. (a) Distinguish between shunts and multipliers as applied in range extension of measuring instruments. (4 marks)

(b) With the aid of a labelled diagram describe the operation of a rectifier instrument when used for measurement of current. (6 marks)

(c) Figure 1 shows an a.c bridge used in the measurement of self inductance. At balance derive the expression for:

(i) industance, $L_1$;
(ii) Q factor for the circuit.

(10 marks)

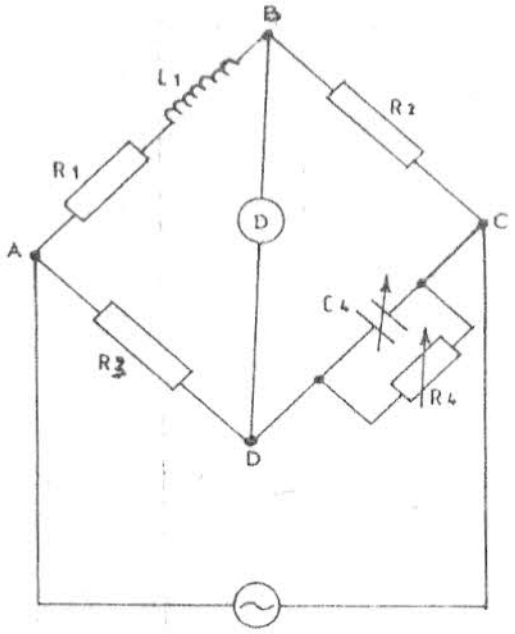



Fig.1

## SECTION B

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

6. (a) State any **two** charges found in an atom of an element. (2 marks)

(b) (i) Define "work function" in relation to electron emission.

(ii) Explain:

(I) how "space charge" is formed in a vacuum diode.

(II) the process of thermionic emission and give **one** application. (6 marks)

(c) With the aid of labelled energy band diagrams, explain the variation of the forbidden energy gap in the following materials.

(i) conductors;
(ii) insulators;
(iii) semi-conductors. (12 marks)

7. (a) (i) State the **two** basic modes of operation of MOSFET.

(ii) Draw labelled N-channel symbol for each mode in a(i). (3 marks)

(b) With aid of labelled diagrams explain the principle of operation of an N-Channel Junction Field Effect Transistor (JFET) when biased from two sources. (5 marks)

(c) (i) Figure 2 shows a fixed bias configuration of a JFET amplifier circuit having $I_{DSS}$ of 8 mA and Vp = -4 V. Determine:

(I) $V_D$

(II) $V_{GS}$

(III) $I_D$

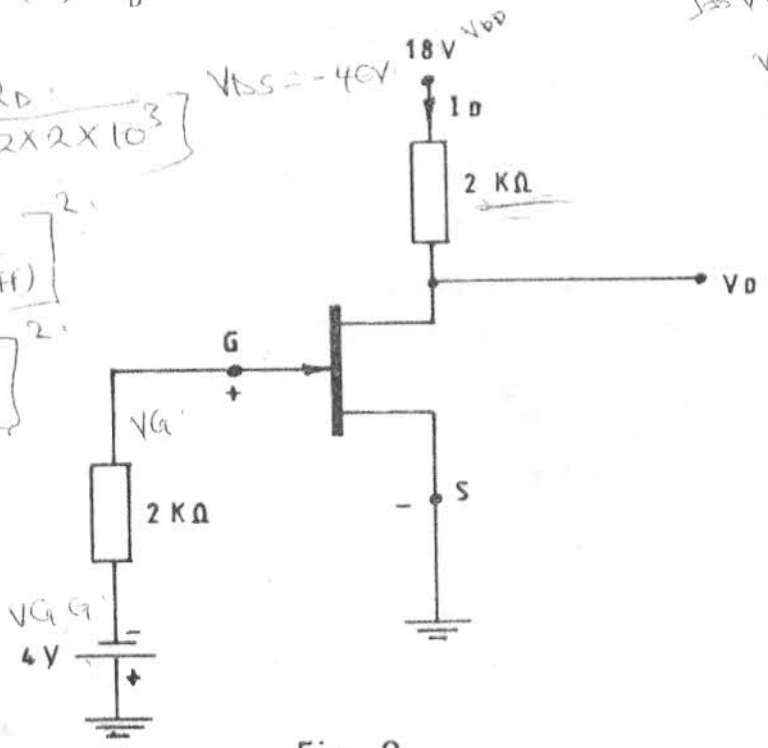
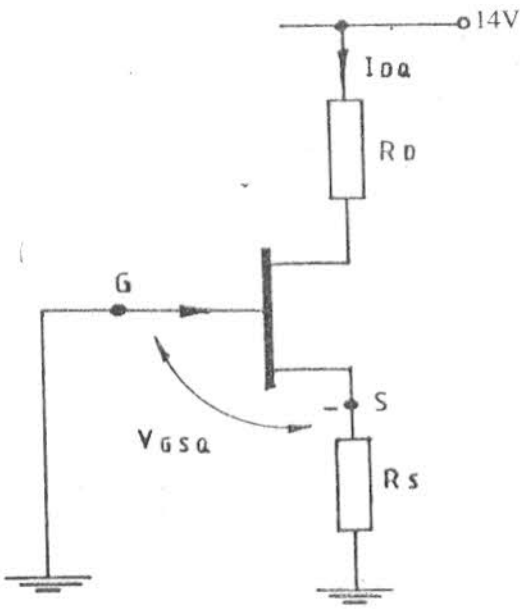



Fig. 2

(ii) Figure 3 shows a common source self biased JFET amplifier with $I_{DSS}$ = 8 mA, Vp = -6 V. The Q-point occurs at $I_{DQ}$ = 4 mA. Assuming $R_D = 3R_S$, determine the value of resistor $R_S$ and $R_D$.

(12 marks)



8. (a) (i) State the **three** Bipolar Junction Transistor configuration.

(ii) A NPN transistor has $I_E$ = 10 mA and dc current gain ($\alpha$) of 0.967, determine

(I) $I_C$;
(II) $I_B$;
(III) $\beta$.

(9 marks)

(b) Figure 4 shows a potential divider biased circuit. Assuming base-emitter voltage of 0.5 V and $I_C \simeq I_E$, determine the:

(i) collector current;
(ii) collector-to-emitter voltage.

(8 marks)

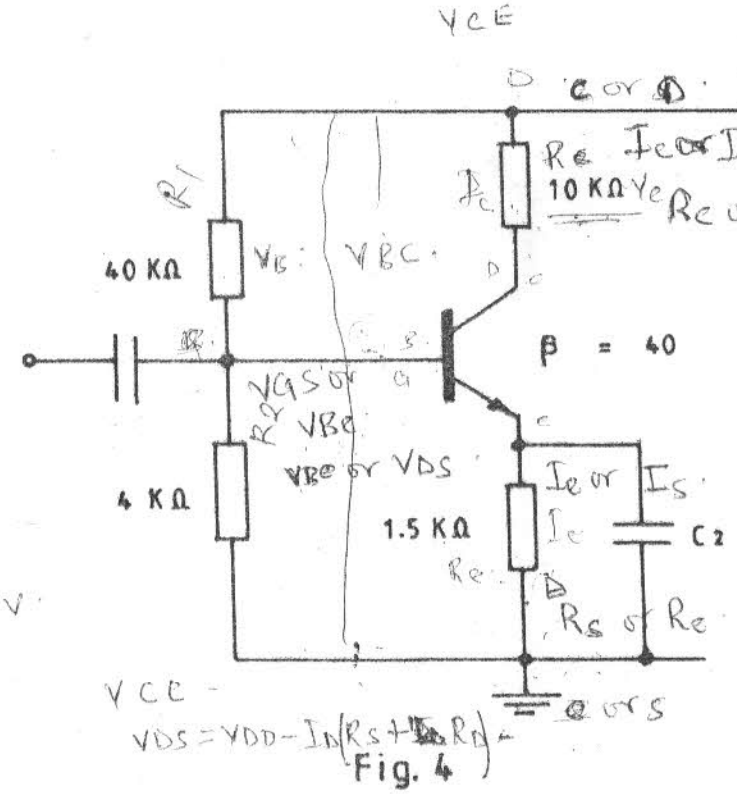



Fig. 4

(c) Draw the dc load line and mark the Q-point of the circuit in b(ii).

(3 marks)