THE UNITED REPUBLIC OF TANZANIA
MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA

STUDENTS' ITEM RESPONSE ANALYSIS REPORT ON THE FORM TWO NATIONAL ASSESSMENT (FTNA) 2021

ELECTRONICS AND COMMUNICATION ENGINEERING

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081 ELECTRONICS AND COMMUNICATION ENGINEERING

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FOREWORD

The National Examinations Council of Tanzania (NECTA) is pleased to issue a Students' Items Response Analysis (SIRA) report in order to provide feedback on students' performance at the Form Two National Assessment (FTNA) 2021 for Electronics and Communication Engineering subject. The report is intended to inform future students, teachers, examiners and other key education stakeholders on the general performance, specific areas of weakness and suggestions for improvement.

The report is mainly based on responses obtained from students' scripts and statistical data. The examiners have analysed students' responses to each question and identified factors which affected students' performance. These include students' inability to understand the requirements of the questions, failure in using correct formulae to solve problems, and lack of knowledge and skills in various topics. Each factor has been clarified using extracts from students' scripts as illustrations.

The National Examinations Council of Tanzania believes that the feedback which is provided in this report will be useful to education stakeholders and that, the suggestions offered will enable them to take appropriate measures to promote students' performance in future.

The Council is grateful to all stakeholders who participated in the preparation of this report in various capacities, including data collection and analysis as well as in writing of the report.

Dr. Charles E. Msonde
EXECUTIVE SECRETARY

LIST OF SYMBOLS AND ABBREVIATIONS

A.C	Alternating Current
BJT	Bipolar Junction Transistor
SIRA	Students' Items Response Analysis
FTNA	Form Two National Assessment
D.C	Direct Current
P.D	Potential Difference
mA	Milliampere
emf	Electromotive force
Hz	Hertz
KJ	Kilojoule
NECTA	National Examinations Council of Tanzania
SI Unit	International System of Units
V	Volt
W	Watt
Ω	Ohm
μ	Micro
%	Percentage

1.0 INTRODUCTION

This report represents the analysis of items response of the students who sat for the subject of Electronics and Communication Engineering in the year 2021. It presents a detailed analysis of the students' response in each question. The Electronics and Communication Engineering paper consisted of three sections, namely Section A, B and C with a total of 10 questions.

Section A consisted of two objective questions from various topics. The students were required to answer all questions from this section. A total of 15 marks were allotted to this section.

Question 1 was a multiple choice question with 10 items. The items were set from the topics *Safety Management and Rules, Drawing Techniques, Semiconductors, Introduction to Electricity, Electronic Components, Semiconductor Devices and Electronics Workshop Practice I*. Each item carried 1 mark making a total of 10 marks.

Question 2 was a matching item with five items from the topic of *Electronic Components*. Each item weighed 1 mark. A total of 5 marks were allotted to this question.

Section B consisted of 7 short answer questions from various topics; including *Electronics Engineering, Occupational Information, Safety Management and Rules, Drawing Techniques, Electronic Workshop Laboratories Practice, Electronic Drawing, Introduction on Electricity, Introduction to Measurement and Instrumentation, Electronic Component, Semiconductors, Semiconductor Devices* and *Electronics Workshop Practice II.* This section comprised of 70 marks. The students were required to answer all questions from this section.

Section C consisted of 1 structured question from the topic of Introduction to Electricity. A total of 15 marks were allotted to this section.

A total of 235 students sat for the Electronics and Communication Engineering paper. Among them, 170 (72.3%) students passed while 65 (27.7%) failed. Therefore, the overall performance on the Form Two National assessment (FTNA) for the year 2021 was good since 170 (72.3%) scored above 30%. The analysis of the students' performance in each question is categorized into three graded ranges as follows: The performance is considered to be good if students scored from 65% and

above of the total marks allotted in the intended question. The performance is considered average if students scored from 30 % to 64% of the total marks allotted to the intended paper. The performance is considered poor if students scored below 30% of the total marks. The performance grade range is summarised in Table 1.

Table 1: Categories of the Grade Ranges of the Student's Performance

Range in %	0 – 29	30 – 64	65 – 100
Remark on performance	Weak	Average	Good

2.0 ANALYSIS OF STUDENTS' RESPONSE TO EACH QUESTION

A detailed analysis and general evaluation of the students' responses to each question is presented in this section to indicate students' strength and challenges faced in responding to each question.

2.1 SECTION A: OBJECTIVE QUESTIONS

2.1.1 Question 1: Multiple Choice Items

The question comprised of 10 multiple choice items, numbered (i) – (x) constructed from various topics. The students were required to choose the correct answer from the given alternatives by writing the most correct answer in the box provided. This question had a total of 10 marks and each item weighed 1 mark

The question was attempted by 235 (100%) students of which 10 (4.3%) scored from 0 to 2 marks, 151 (64.3%) scored from 3 to 6 marks and 74 (31.5%) scored from 7 to 10 marks. The general performance of the students in this question was good. The overall students' performance in this question is summarised in Figure 1.

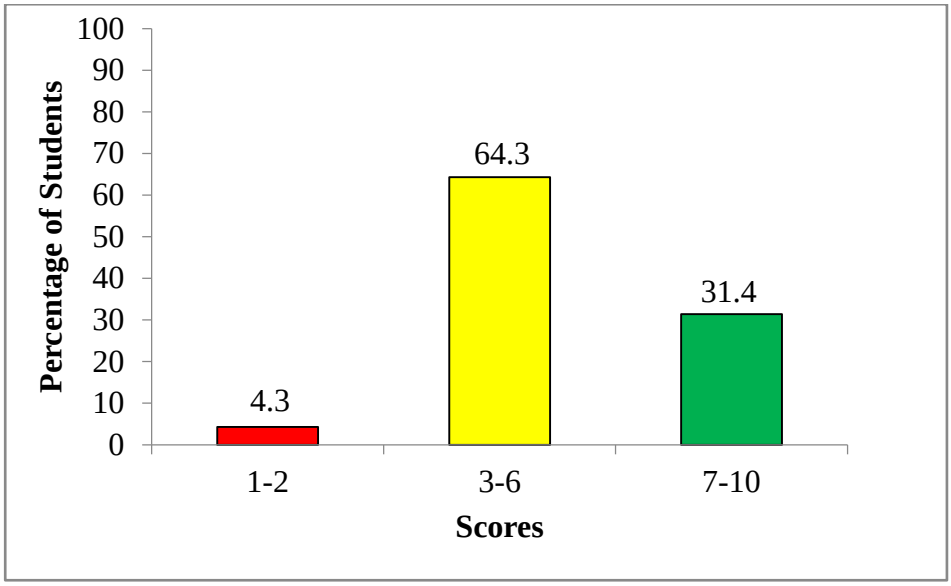


Figure 1: *Students' Performance in Question 1.*

The analysis of the students' response to this question shows that most of the students managed to choose the correct answer in items (i), (ii), (iii), (vi) and (vii) which were set from the topics *Safety Management and Rules, Drawing techniques, Semiconductors, Semiconductor Devices* and *Introduction on Electricity* respectively.

Item (i) required students to identify the type of fire extinguisher that can be used to put off the fire resulting from electricity mishandling. Most of them opted for alternative D, *carbon dioxide* which was the correct answer. This response shows that students had sufficient knowledge of the type of fire extinguisher that can be used to put off the fire caused by electricity mishandling. However, there were students who wrongly selected alternative B, *dry powder* because it is in the dry form which cannot conduct electricity but it cannot combat the fire caused by electricity mishandling.

Some students selected alternative A, *water* which was a wrong answer. Students who chose this alternative thought that since most of the fires are put off by the water they thought even fire caused by electricity can be put off by using water. There was no student who opted for alternative C, *foam* since it is not commonly used in everyday life to put off fire.

Item (ii) required students to suggest the appropriate drawing instrument which will be used to set and measure angles. Most of the students opted

alternative D, *protector* which was the correct answer. Majority of the students provided the correct response, indicating that they had adequate knowledge on drawing instruments used to set and measure angles. Some of the students selected alternative B, *compass* because it is also used to set angles but they forget that it cannot measure the angles. Few students selected alternative C, *divider* an instrument which is used to draw or set an angle but it is specifically used to set equal distance of parts of drawing.
There was no student selected alternative A, *ruler* because it is obvious that a ruler is used to draw lines and measure distance instead of setting and measuring angles.

In item (iii) students were required to study a drawing and state which part will appear at the outermost shell of the structure of atom from the given alternatives. Most students selected alternative B, *electron* which was the correct answer. The students who chose this option had sufficient knowledge of atomic structure. Some students who chose alternative A, *proton* mixed up things as proton appears at the outermost shell. No student opted for alternative C, *nucleus* and alternative D, *Neutron* because they were able to realised that these two parts are positioned inside the structure and not outside.

Item (vi) required students to identify the majority and minority charge carrier of NPN and PNP transistors. The correct answer was B, *electrons and holes*. Most students chose the correct answer because they had adequate knowledge of charge carrier of the NPN and PNP transistor and their arrangement. Some of the students who selected alternative C, *silicon and germanium* failed to distinguish between the semiconductor materials and charge carrier of transistors. Students who opted alternative A, *holes and electron* had knowledge of charge carrier but they overlooked the arrangement because the question asked them to identify majority and minority charge carrier NPN and PNP transistors respectively. Few students who opted for alternative D, *acceptor ions and donor ions* had knowledge of charge carrier but they confused with the arrangement of NPN and PNP respectively.

Item (vii) required students to state the relationship which determines the average power in a pure resistive circuit. The answer was alternative D, *product of r.m.s (effective) values of current and voltage.* Most of the students who selected correct answer had sufficient knowledge of average

power in pure resistive circuits of AC circuits. However, few students opted for alternatives A, *a product of peak values of current and r.m.s values,* B, *product of average value of current and voltage,* and alternative C, *product of peak values of current and voltage*. These students confused with rectifier circuits calculation which sometimes students calculate the average of direct current (dc) power.

On the other hand, items (iv), (v) and (viii) from the topics *Introduction to Electricity and Electronic components* respectively were averagely performed.

Item (iv) required students to calculate the energy supplied to a battery of 12V supplying a current of 5A for 2 min. The correct answer was alternative A, *7.2 KJ*. Students who opted the correct answer managed to use the correct formula to calculate energy, convert unit from hour to second and to change Joules to Kilojoules.
Some of the students selected alternative B, *0.72 KJ* which was a wrong answer because they used a wrong formula to change energy from Joules to energy in Kilo joules by dividing 10000 instead of 1000.
No one selected alternative C, *270 KJ* since it is not related to the correct answer. Those students who selected alternative D, *72 KJ* which was a wrong answer they used a wrong formula to change energy from Joules to Kilo joules as they divided by 100 instead of 1000.

Item (v) required students to state the reason for Gallium to be mostly preferred in LEDs fabrication. Most of the students opted for alternative C, *it emits more light*, which was the correct answer. The students recognised the properties of material used to fabricate LEDs and advantages of that material. Some of the students selected alternative A *It is durable,* which is a wrong answer because they confused materials used to fabricate LEDs with other semiconductor materials. LEDs are more durable but the students failed to know material which produce more light than others. Other students selected alternative D, *it has good radiation pattern,* as they confused with alternative C, *it emits more light* to its radiation pattern.

Item (viii) required the students to identify the colour code which represents the damaged capacitor. Most of the students opted alternative B, *brown, black, grey, black and red* instead of alternative A, *brown, black, yellow,*

black and red which is the correct answer. These students did not understand that the grey colour which is multiplier in B, is 0.01 instead of 10000. Few students opted for alternative C, *brown, black, blue, black and red.* The blue colour which is the multiplier of 100000 confused the students and led them to select wrong answer. No student opted for alternative D, *brown, black, violet, and red* because the black colour which has the tolerance of 20% was missing in the destructors, so it was easy for them to leave that destructor.

Also Items (ix) and (x) from the topics of *Introduction to Measurements* and *Electronic Workshop Practice II* respectively were poorly performed.

Item (ix) required students to set measuring instruments in order to measure voltage in a circuit by using a moving coil meter. The answer was alternative B. *a meter should be connected in parallel with load*. Few students who chose option B, which was the correct answer, had enough knowledge and skill in measuring voltage. No student selected option A *selector switch should be kept at the symbol* Ω because it was easy for students to realize that the symbol used was not suitable for voltage measurement. Some of the students selected alternative D, *a meter should be connected in series with load* which was a wrong answer. These students confused on how current and voltage are measured. Few students selected option C, *a selector switch should be kept at the minimum range*, which was an incorrect response because the distracter deviated from procedures of measurements.

Item (x) required students to recommend a necessary requirement for a good electronic workshop. Most of the students chose alternative *B, drawing office, aluminium windows and first aid box* instead of alternative A, *enough space, enough light and first aid box* which was a correct answer. The students thought that a workshop should have a drawing office with aluminium windows, which is not necessary for an electronic workshop. Enough space and enough light are very important for a good workshop. No student opted alternative C, *enough space, slippery floor and first aid box* because it is obvious that a slippery floor is not recommended in the workshop.

2.1.2 Question 2: Matching Items

The question comprised of five items, numbered (i) – (v) constructed from the topic of *Electronics Components*. Each item carried 1 mark, making a total of 5 marks. The students were given five electronic components on List A and required to match them with their corresponding schematic symbols in List B, which was comprised of eight schematic symbols.

The question was attempted by 235 (100%) students, and out of them 23 (9.8%) scored from 0 to 1 mark, 126 (53.6%) scored from 2 to 3 marks and 86 (36.6%) scored from 4 to 5 marks. The general performance of the students in this question was good. The overall students' performance in this question is summarised in Figure 2.

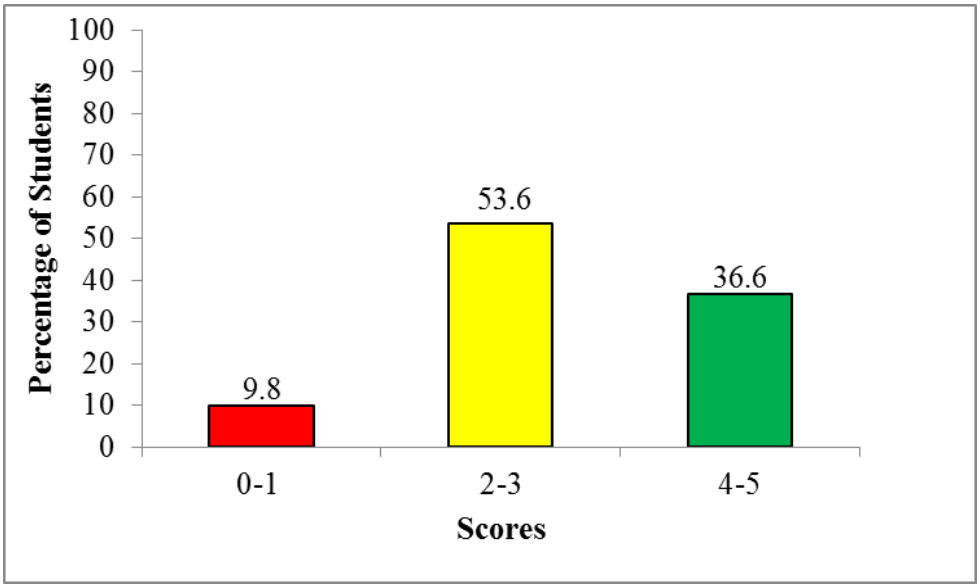


Figure 2: *Student's Performance in Question 2.*

The analysis of the students' responses to this question shows that most of the students managed to match the components with the circuit symbols correctly. Items on list A were (i) *fixed resistor*, (ii) *fixed capacitor*, (iii) *a ferrite core inductor*, (iv) *dust core transformer* and (v) *choke inductor* which were matched with eight circuit symbols on list B.

In item (i) students were required to match *fixed resistor* with its correct symbol given on list B. The correct response was alternative E. Most of the students matched correctly which shows that they were very familiar with the symbol since it is also used in other fields like engineering science.

Very few students matched incorrectly with variable resistor, which indicate that they had no basic knowledge of electronic symbols.

In item (ii) students were required to match *fixed capacitor* with its correct symbol. The correct response was option C. Most of the students associated the symbol correctly, which shows that they were familiar with it. Very few students confused and matched it incorrectly with other capacitor symbol like variable capacitor. Other students matched it with choke inductor.

In item (iii) students were required to match *a ferrite core inductor* with its correct symbol. The correct answer was option F. The students who matched correctly, had sufficient knowledge of the type of inductors. Other students who matched incorrectly confused and selected another types of symbol of air cored inductor. Few students selected the capacitor. These students show that they lack knowledge of the electronic components.

Item (iv) required students to match *dust core transformer* with its correct symbol. The correct response was option G. Most of the students who matched correctly had sufficient understanding of the response. However, some of the students chose the symbol of iron cored transformer, so they matched with incorrect symbol.

Item (v) required students to match *choke inductor* with its correct symbol. The answer was option B. Most of the students who matched correctly the symbol, had sufficient knowledge of inductor. Some of the students matched with a ferrite core inductor, while others matched with iron cored transformer which was wrong.

The general performance in this question was good because 90.2% of the students scored above average. This shows that, the majority of the students had adequate knowledge of the topic of electronic components, particularly in identifying electronic components circuit symbols. Most of the students managed to associate the names of the given electronic components with their corresponding circuit symbols. Only 9.8% of the students failed to associate the names of the given electronic components with their corresponding symbols. This signifies that, they did not have basic knowledge of the given components.

2.2 SECTION B: SHORT ANSWER QUESTIONS

2.2.1 Question 3: Electronics Engineering Occupational Information

The question consisted of two parts: (a) and (b). In part (a), students were required to state why communication system is an important tool in electronics engineering. In part (b) (i), students were required to use a block diagram to represent a typical communicational system model with three main components, and in (b) (ii) students were required to explain the significance of each block in the system drawn in part (b) (i).

The question was attempted by 231(98.3%) students, out of which 161 (68.5%) scored from 0 to 2 marks, 16 (6.8%) scored from 3 to 6 marks and 58 (24.7%) scored from 6.5 to 10 marks. The overall students' performance in this question is illustrated in Figure 3.

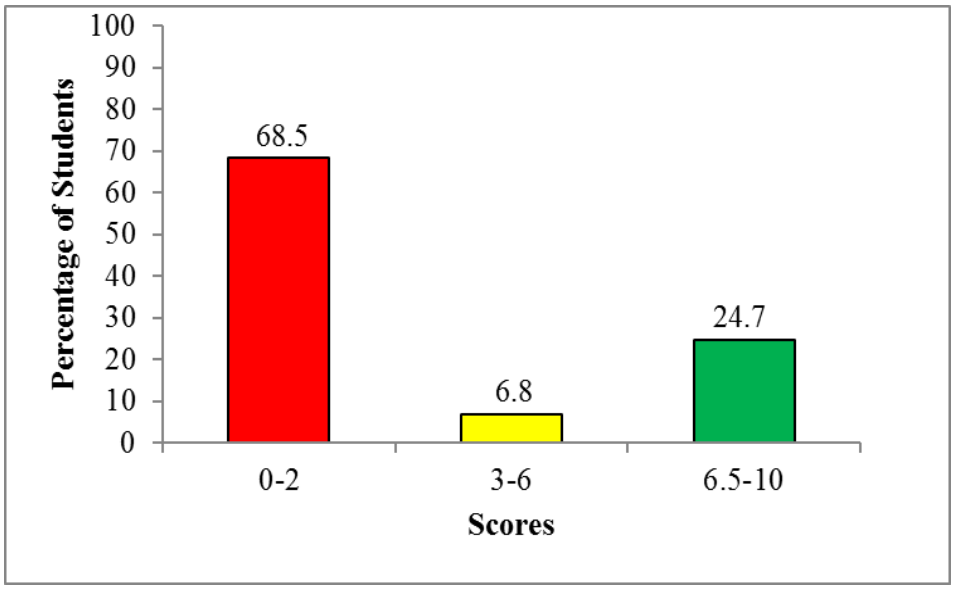
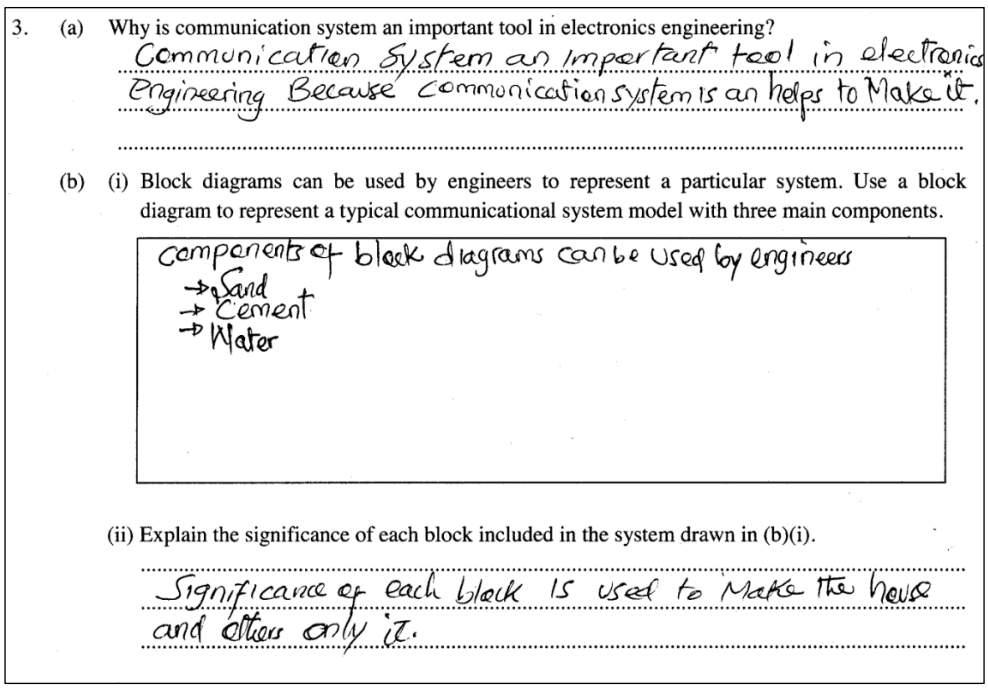


Figure 3: *Student's Performance in Question 3*

The general performance in this question was poor, since 161(68.5%) students scored below average. This reveals that the majority of the students had inadequate knowledge of the content of the subject matter. Some of the students failed to explain the importance of communication system in electronics engineering which was asked in part (a). For example, a response from one of the student read *it help electronics to have or buy good materials and have good workshops anywhere he want to have it*. This shows that the student had no sufficient knowledge of the topic of

communication system. In part (b), some of the students failed to draw a block diagram of a communication system; instead they mentioned the materials used to make building blocks of a house. Moreover, few of them drew a building block itself. In part (c), some of the students failed to explain the significance of communication system block diagrams. For example, some of them stated the application of building blocks used to build a house which was irrelevant to the task. Extract 3.1 shows the sample of a poor response from one of the students.


3. (a) Why is communication system an important tool in electronics engineering?

Communication System an important tool in electronics Engineering Because communication system is an helps to Make it.

(b) (i) Block diagrams can be used by engineers to represent a particular system. Use a block diagram to represent a typical communicational system model with three main components.

components of block diagrams can be used by engineers
→ Sand
→ Cement
→ Water

(ii) Explain the significance of each block included in the system drawn in (b)(i).

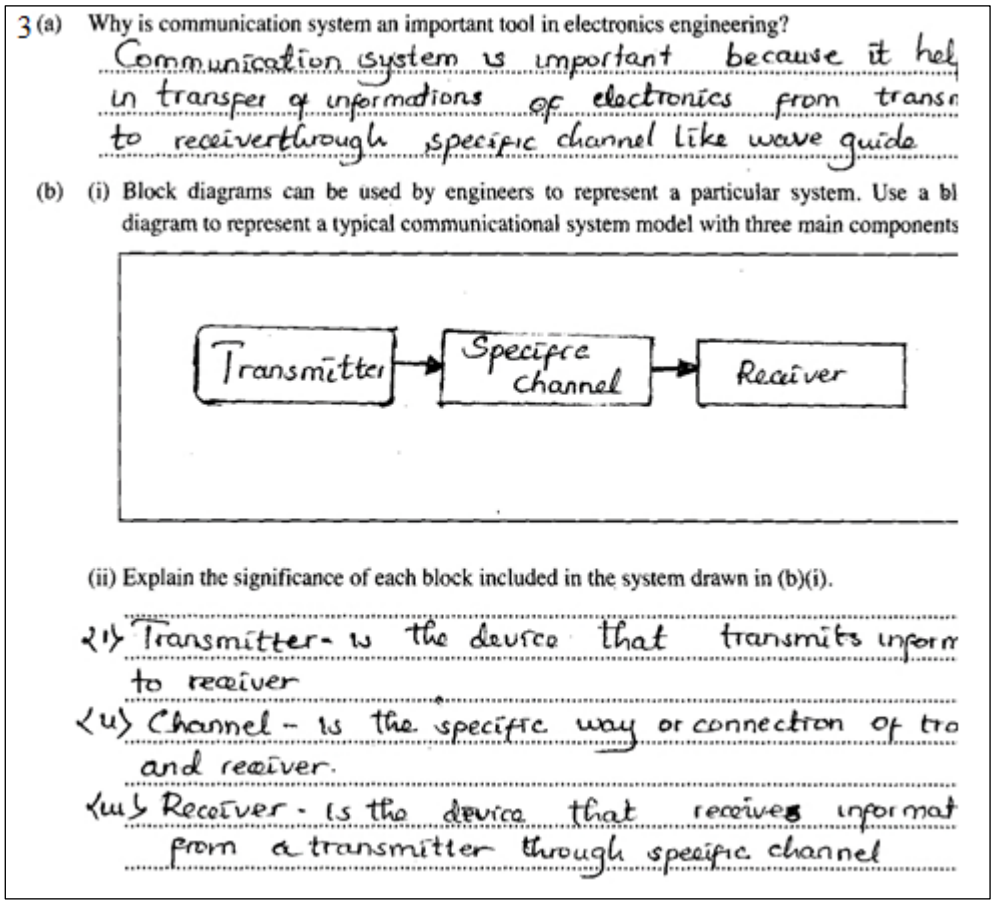
Significance of each block is used to Make the house and others only it.

Extract 3.1: A sample of an incorrect response to question 3.

Extract 3.1 is a sample of an incorrect response from one of the students who failed totally to provide the correct answers. The student mentioned the materials used to make building blocks.

However, there were many students who correctly responded to all three parts of the question. The students managed to explain the importance of communication system in part (a), drew a block diagram of a communication system as the question asked in part (b) (i) and also in part (b) (ii), the students correctly explained the significance of each block of the communication system drawn. This shows that, the students had enough

knowledge of the subject matter. Extract 3.2 illustrate a sample of a responses from one who provided correct answers.



Extract 3.2: A sample of a correct response to question 3.

Extract 3.2 is a sample of a correct response from a student who correctly explained the importance of communication system in electronics engineering, drew the block diagram of the communication system and explained the significance of each block in the drawn block diagram of communication system.

2.2.2 Question 4: Safety Management and Rules, Workshop/Laboratory Practice I

The question consisted of three parts, (a), (b) and (c). In part (a) students were required to explain why it is necessary to have knowledge of risk and hazard management in any working environment. In part (b) students were asked to rearrange the mixed procedures concerning artificial respiration

method as a treatment in case of electric shock. In part (c) students were required to give the importance of side cutter, wire stripper, screw driver and electrician knife in undertaking a task of installing a communication system.

The question was attempted by 235 (100%) students out of them 40 (17%) students scored from 0 to 2.5 marks, 97 (41.3%) scored from 3 to 6 marks and 98 (41.7%) students scored from 6.5 to 10 marks. Figure 4 summarises the overall performance of students in this question.

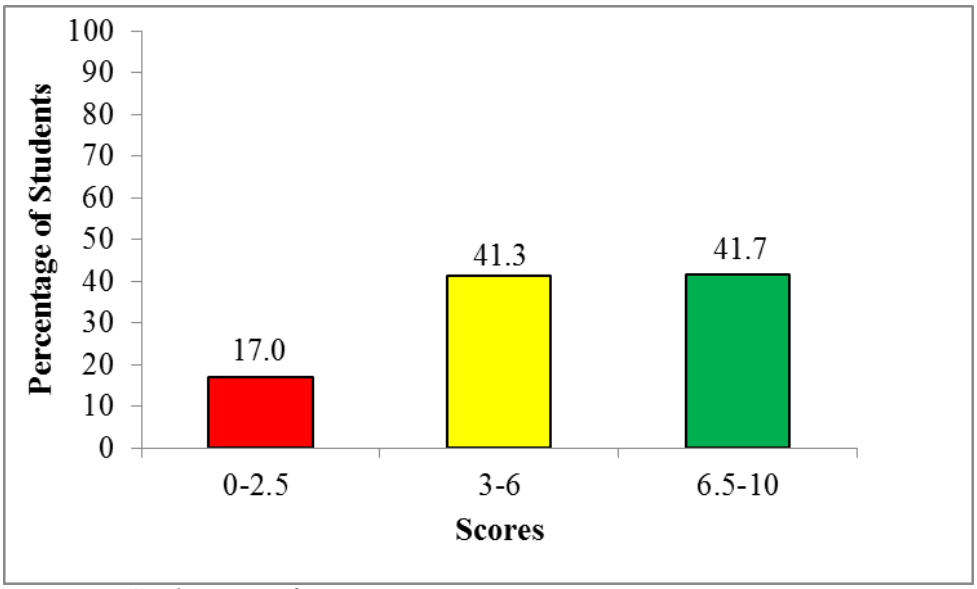
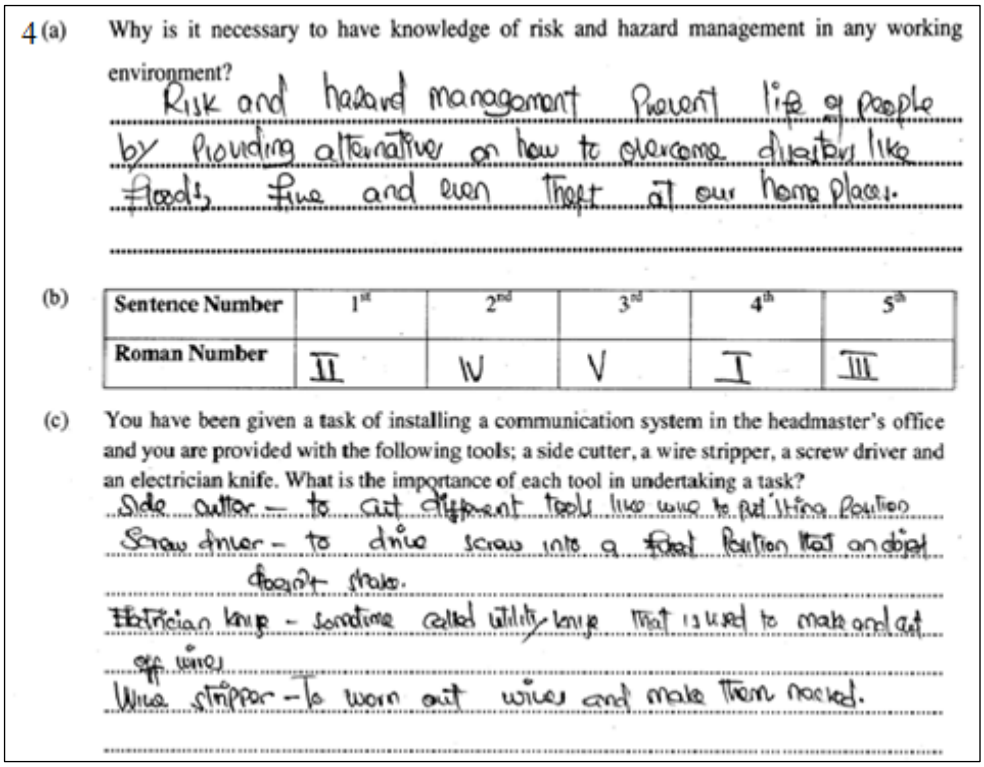


Figure 4: *Student's Performance in Question 4.*

The analysis reveals that the performance of students in this question was good since 83 per cent of the students scored from 3 to 10 marks. The majority managed to provide the correct responses to all parts as needed, which shows that they had adequate knowledge of the topic of *Safety Management and Rules as well as Electronics Workshop/Laboratory Practice I.*

These students stated correctly the necessity of having knowledge of risk and hazards management, correctly rearranged the mixed procedures of artificial respiration method as a treatment in case of electric shock and stated the importance of the given tools correctly, except one tool (Electrician knife). This justifies that the students had adequate knowledge. Extract 4.1 shows a sample of good response from a student who provided correct responses.



4 (a) Why is it necessary to have knowledge of risk and hazard management in any working environment?

Risk and hazard management Prevent life of people by Providing alternative on how to overcome disaster like floods, fire and even Theft at our home places.

(b)

Sentence Number	1st	2nd	3rd	4th	5th
Roman Number	II	IV	V	I	III

(c) You have been given a task of installing a communication system in the headmaster's office and you are provided with the following tools; a side cutter, a wire stripper, a screw driver and an electrician knife. What is the importance of each tool in undertaking a task?

Side cutter – to cut different tools like wire to put it into position

Screw driver – to drive screw into a fixed position that an object doesn't move.

Electrician knife – sometime called utility knife that is used to make and cut off wires

Wire stripper – to worn out wires and make them packed.

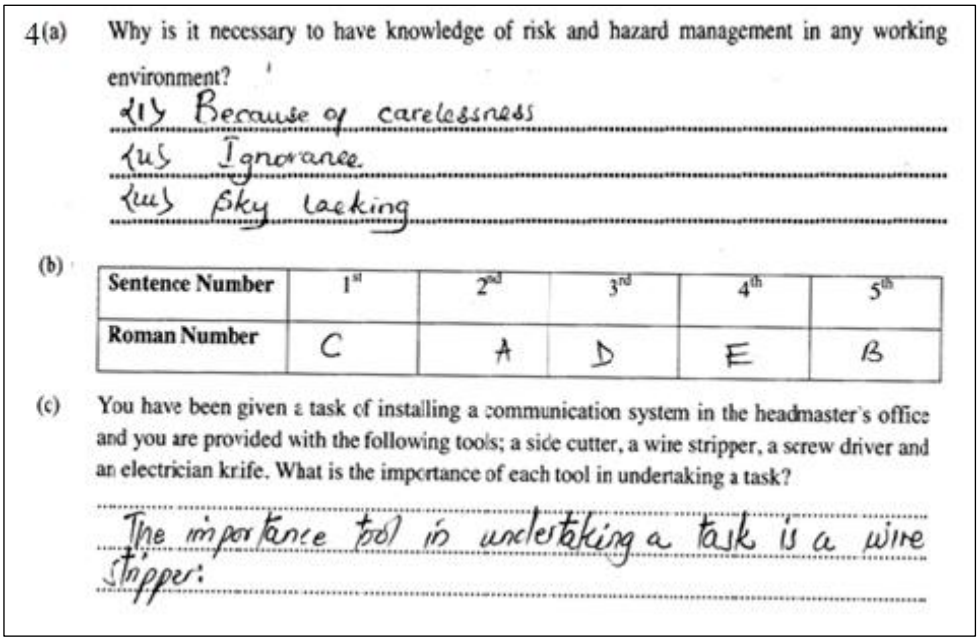
Extract 4.1: A sample of a correct response to question 4.

Extract 4.1 is a sample of correct responses provided by one of the students who stated correctly the necessity of having knowledge of risk and hazards management, correctly rearranged the mixed procedures of artificial respiration method as a treatment in case of electric shock and stated the importance of the given tools correctly, except for only one tool (Electrician knife).

However, some of the students failed to explain the necessity of risk and hazards management asked in part (a). For example, one student explained that *one can do the work without any interfere*. Another student just mentioned some points of the effects of someone who does not take care of the safety in the workshop.

In part (b), the student failed to correctly rearrange the mixed procedures of artificial respiration method as a treatment in case of electric shock; and wrote letters instead of the required roman numbers as asked in the question.

Similarly, in part (c) the student failed to explain the basic functions of the given working tools. This student provided a function of one of the tools as a general purpose tool for undertaking the given task. This signifies that the student did not understand the question. Extract 4.2 illustrates a sample of poor responses from a student who failed to provide correct responses to all parts of the question.



4(a) Why is it necessary to have knowledge of risk and hazard management in any working environment?

(i) Because of carelessness

(ii) Ignorance

(iii) Sky looking

(b)

Sentence Number	1st	2nd	3rd	4th	5th
Roman Number	C	A	D	E	B

(c) You have been given a task of installing a communication system in the headmaster's office and you are provided with the following tools; a side cutter, a wire stripper, a screw driver and an electrician knife. What is the importance of each tool in undertaking a task?

The importance tool in undertaking a task is a wire stripper:

Extract 4.2: A sample of an incorrect response to question 4.

Extract 4.2 shows a sample of an incorrect response from a student who failed to correctly explain the necessity to have knowledge of risk and hazard. Instead the student mentioned the effects of someone who does not take care of the safety in the workshop, and failed to rearrange the mixed procedures of artificial respiration method as a treatment in case of electric shock as well as to explain the basic functions of the given working tools.

2.2.3 Question 5: Introduction to Measurement and Instrumentation

The question had two parts (a) and (b). In part (a) students were required to study a given figure then:

(i) identify the function of each instrument indicated in the circuit.
(ii) calculate the power of R, if R has the resistance of 10 Ω and the voltage across it is 220 V;

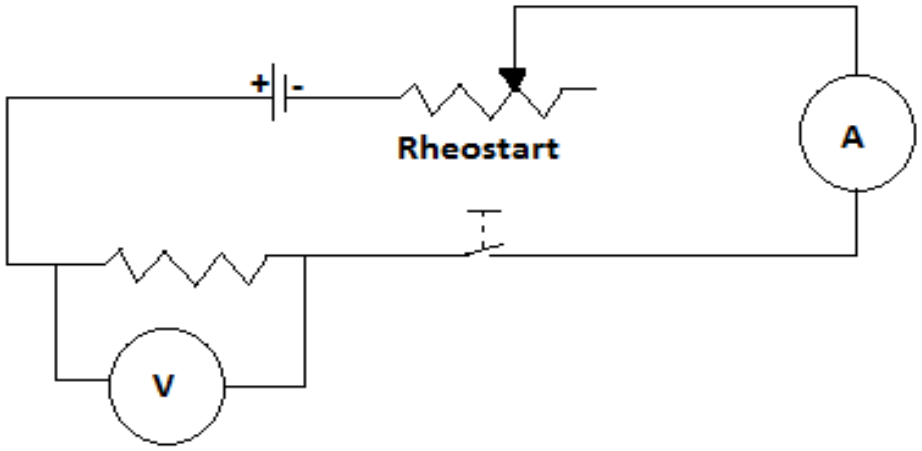


Figure 1

In part (b) the students were asked to determine the value of circuit current in Figure 2

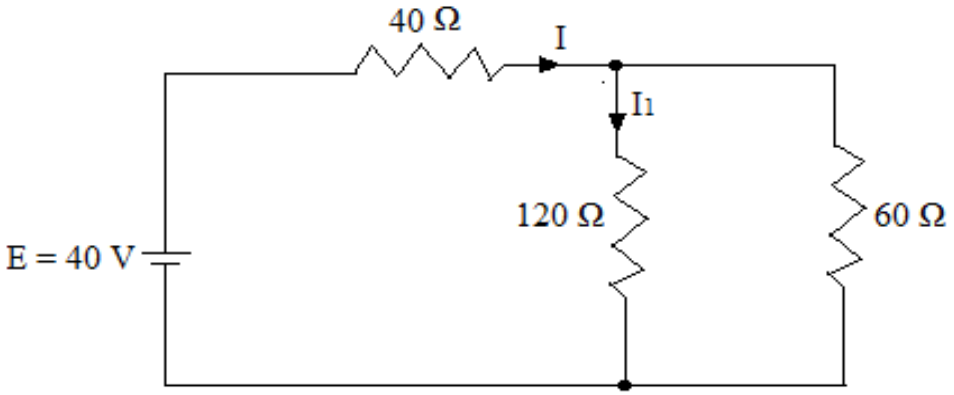


Figure 2

A total of 235 (100%) students attempted this question. The performance analysis of this question indicates that 46 (19.6%) students scored from 0 to 2.5 marks, 43 (18.3%) scored from 3 to 5.5 marks and 146 (62.1%) scored from 6 to10 marks. The overall performance in this question is summarised in Figure 5.

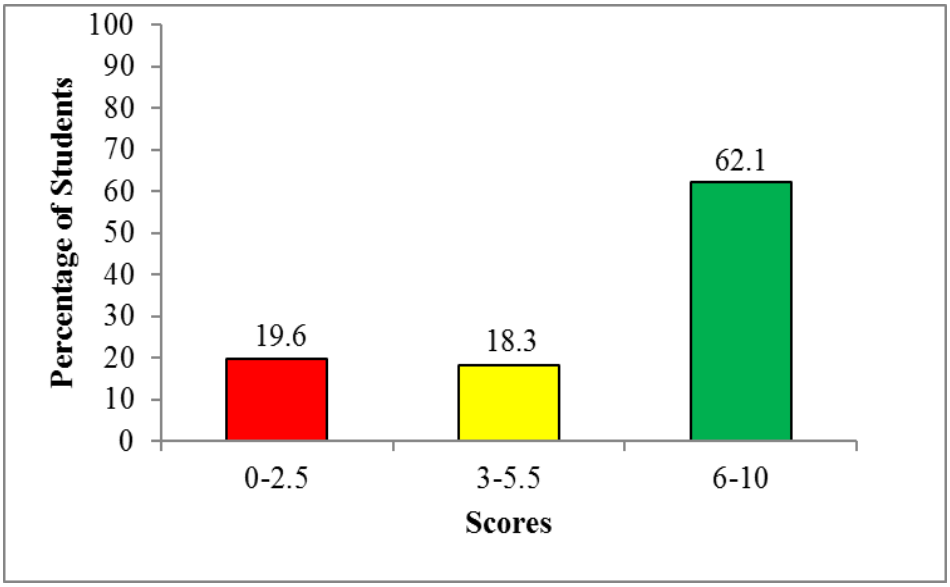


Figure 5: *Students' Performance in Question 5.*

The general performance of the students in this question was good because majority (80.4%) of the students scored above average. This performance indicates that many students had enough knowledge of the application of measuring instruments.

In part (a) (i), the students identified and explained the functions of measuring instruments correctly which was shown in the circuit. In part (a) (ii) the students managed to calculate the power dissipated in the resistor. Moreover, in part (b) the students correctly calculated the circuit current. Extract 5.1 indicates a good response from one of the students who did well.

5 a (i) Identify the function of each instrument indicated in the circuit.

Voltmeter - is an instrument used to measure the flow of voltage in a circuit.

Ammeter - Is an instrument used to measure the flow of current in a circuit.

(ii) If R has the resistance of 10 Ω and the voltage across it is 220 V; calculate the power of R.

Solution

R = 10Ω

V = 220V

P = ?

from P = I x V

but I = V/R = 220V/10Ω

I = 22 A

P = I x V

= 22A x 220V

= 4840 watt

∴ The power of R is 4840W

5 (b) Solution

from I = V/R

but $R_T = \frac{120 \times 60}{120+60} + 40 = \frac{7200}{180} = 40 + 40$

= 80Ω

I = 40V/80Ω

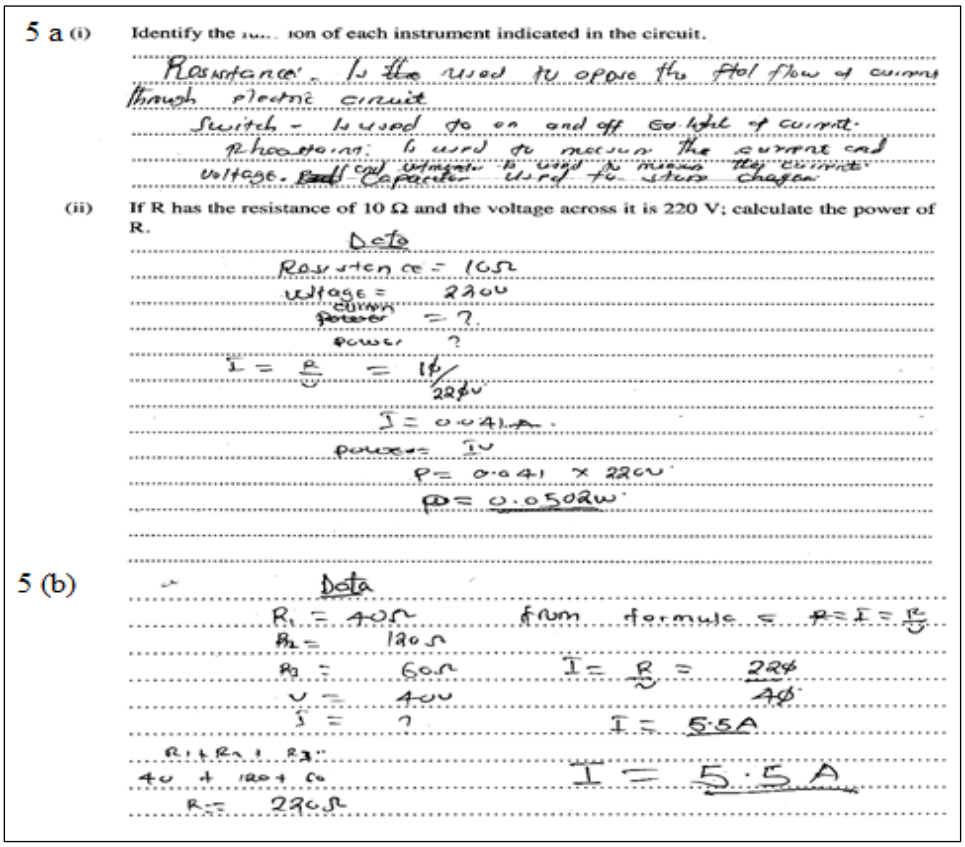
I = 0.5A

∴ Current is 0.5A

Extract 5.1: A sample of correct responses to question 5.

Extract 5.1 is a sample of good response from one of the students who was able to state the functions of measuring instruments shown in the circuit in Figure 1, calculate the power dissipated in the resistor and calculate the circuit current

However, some of the students failed to provide correct responses. For example, in part (a) (i) one of the students failed to state the functions of measuring instruments shown in the circuit, in instead, the student defined resistance and switch, which was not asked in the question. In part (a) (ii) the student failed to calculate the power dissipated in the resistor because of using an incorrect formula, the correct formula $I = \frac{R}{V}$ instead of the correct formula $I = \frac{V}{R}$. Moreover, in part (b) the student also failed to calculate circuit current because of using the same wrong formula as used in part (a) (ii). Extract 5.2 shows a sample of an incorrect response from one of the students.



Extract 5.2: A sample of an incorrect response to question 5.

Extract 5.2 is a sample of an incorrect response from one of the students who did not understand the demand of the question. Thus instead of stating the functions of measuring instruments which was shown in the circuit, the student stated the uses of resistor and switch which are not the measuring instruments. The student could not use the correct formula to calculate the power dissipated in the resistor and the circuit current.

2.2.4 Question 6: Semiconductor Devices

The question had three parts (a), (b) and (c), which required the student to:

(a) describe two ways of connection when biasing a semiconductor diode.

(b) draw a rectifier circuit and indicate the input and output signals.

(c) determine the maximum current that the diode can operate without damage, where, a zener diode is designed to operate at 500 mW with a breakdown voltage of 5.1 V.

The students who attempted this question were 225 (95.7%) and 10 (4.3%) did not attempt the question, 117 (49.8%) students scored from 0 to 2.5 marks, 74 (31.5%) scored from 3 to 6 marks and 44 (18.7%) scored from 6.5 to 10 marks. The general performance of students in this question is summarized in Figure 6.

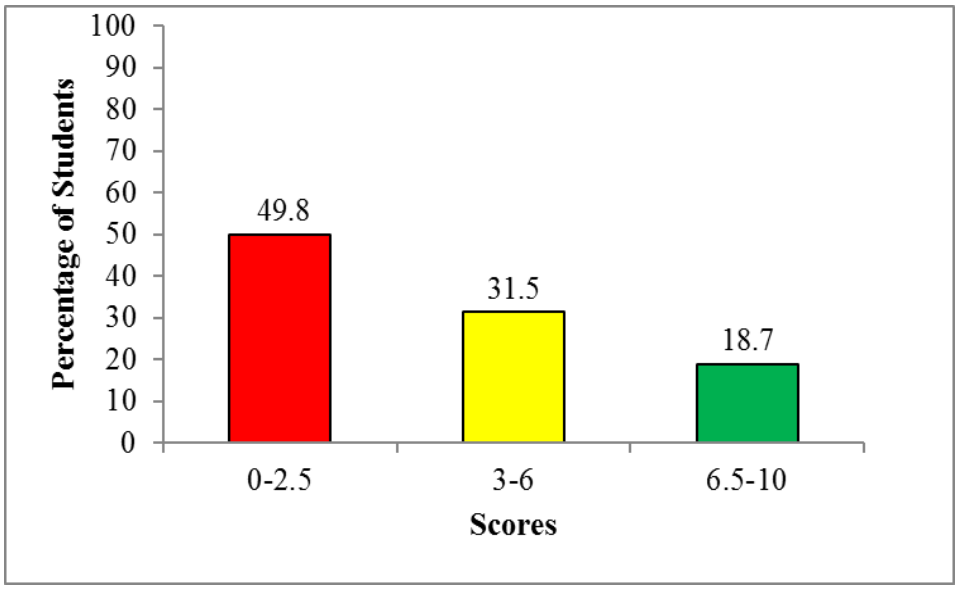


***Figure 6**: Students' Performance in Question 6.*

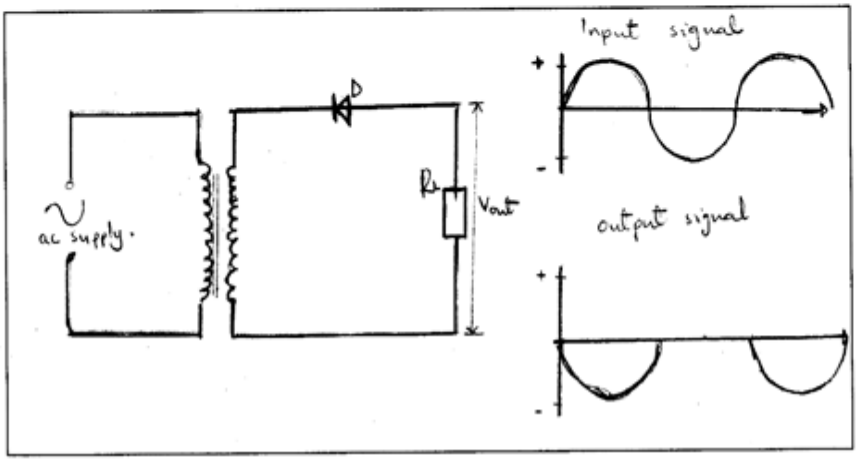
The analysis indicates that 50.2 percent of the students were able to describe two ways of connection when biasing the semiconductor diode in part (a). Moreover, the students were able to draw a half wave rectifier circuit indicating the input and output signal biasing on the given components as required in part (b). Furthermore, in part (c) the students determined correctly the maximum current on which the diode can operate without damage. However, some of the students in this group did not manage to provide all correct response in the given parts of the question; hence they could not score full marks. Extract 6.1 is a sample of good responses from one of the students.

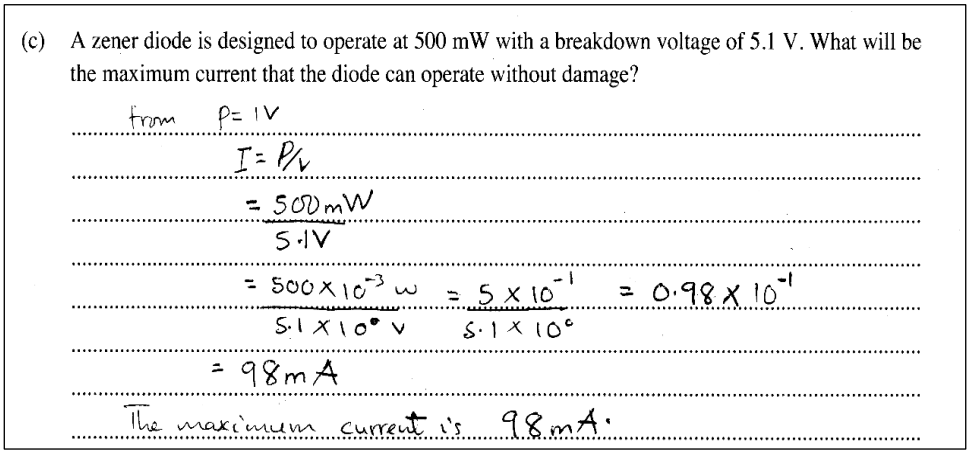
6(a) Describe two ways of connection when biasing a semiconductor diode.

Foward bias - when the P-region is connected to a positive terminal and the n-region is connected to the negative terminal of the battery.

Reverse biasing - when the p-region is connected to the negative terminal of the battery and the n-region is connected to a positive terminal of the battery.

(b) You have constructed a simple half-wave rectifier using a Diode (D) and a Load Resistor (R_L). After testing your circuit you realized that it produces the output waveform with only negative pulses. Draw a rectifier circuit you constructed and indicate the input and output signals.





Extract 6.1: A sample of correct responses to question 6.

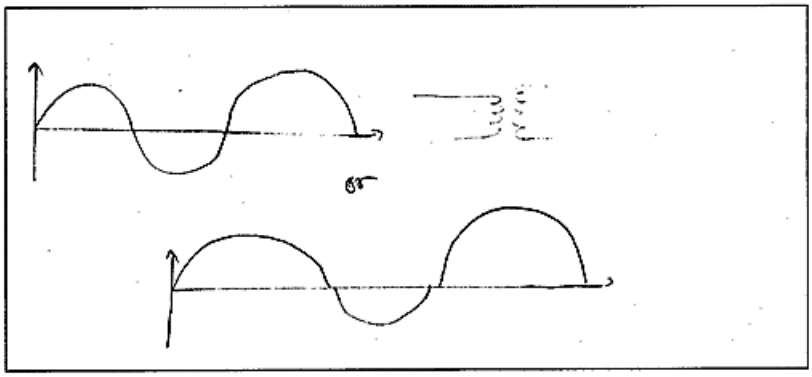
Extract 6.1is a sample of correct responses from one of the students who correctly described two ways of biasing semiconductor diode, drew half wave rectifier with input and output signal and calculated the maximum current.

On the other hand, some of the students failed to describe two ways of connection when biasing the semiconductor diode. They explained the effect of polarities between positive and negative terminals, which was an incorrect response. Further analysis shows that the students failed to draw a rectifier circuit indicating input and output signal obtained from the given components, instead some of them drew a positive half wave rectifier. However, in this group of students a few managed to draw a sine wave which was the input, but they failed to draw a negative output. In part (c) the students failed to determine the correct current in which the diode can tolerate without damage. The failure in this part was contributed by application of a wrong formula $I = \frac{V}{W}$. A sample of a poor response extracted from the students' script is shown in Extract 6.2.

6. (a) Describe two ways of connection when biasing a semiconductor diode.

Connecting with reverse biasing which produces low electric currents while Connecting with forward biasing improves conductivity of the electrons.

(b) You have constructed a simple half-wave rectifier using a Diode (D) and a Load Resistor (R_L). After testing your circuit you realized that it produces the output waveform with only negative pulses. Draw a rectifier circuit you constructed and indicate the input and output signals.



(c) A zener diode is designed to operate at 500 mW with a breakdown voltage of 5.1 V. What will be the maximum current that the diode can operate without damage?

Data given
Break down voltage = 5.1V
diode value = 500 mW
Maximum current = ?
$I = \frac{V}{R}$
$I = \frac{5.1V}{500mW}$
$I = 0.102A$ ∴ Maximum current is 0.102A

Extract 6.2: A sample of an incorrect response to question 6.

Extract 6.2 shows sample of an incorrect response from one of the students' who failed to describe two ways of connection when biasing the semiconductor diode. A student explained the effects of polarities between positive and negative parts. Also he/she failed to draw a rectifier inputs signals, and used wrong formula to determine the maximum current on which the diode can operate without damage.

2.2.5 Question 7: Drawing Techniques

The question had two parts: (a) and (b). Students were required to explain the uses of the tools (i) Drafting machine (ii) T – Square (iii) Paper tape (iv) Set square and (v) Light table. In part (b), students were asked to categorize each type of the given pencils 3H, 2H, H, HB, B – 2B used in sketching different drawing, according to their hardness and blackness.

This question was attempted by 222 (94.5%) students, and 13 (5.5%) did not attempt the question. The performance analysis indicates that 157 (66.8%) students scored from 0 to 2.5 marks, 68 (28.9%) scored from 3 to 6 marks and 10 (4.3%) scored from 6.5 to 8.5 marks. Figure 7 summarises the overall students' performance in the question.

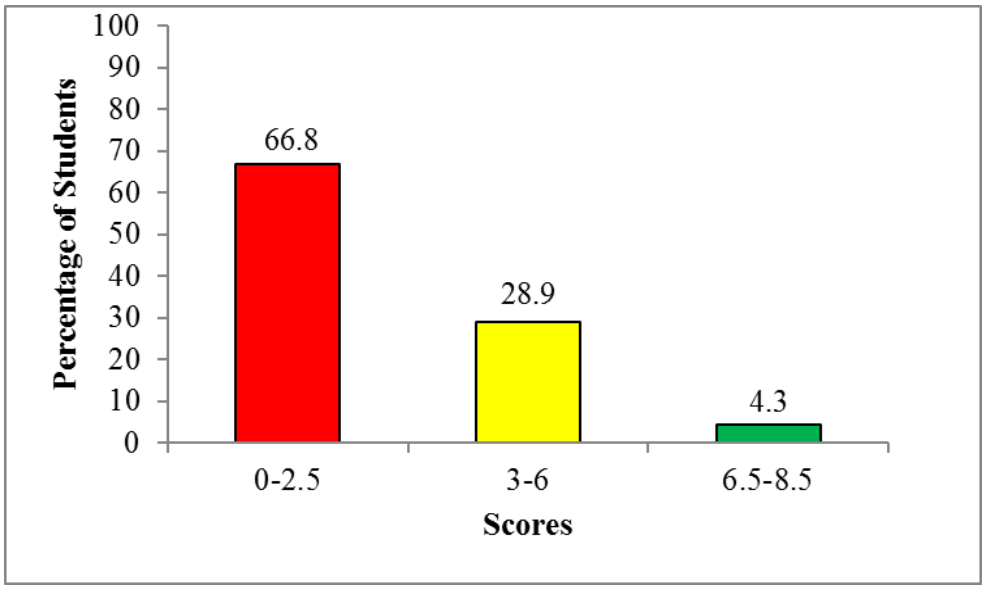
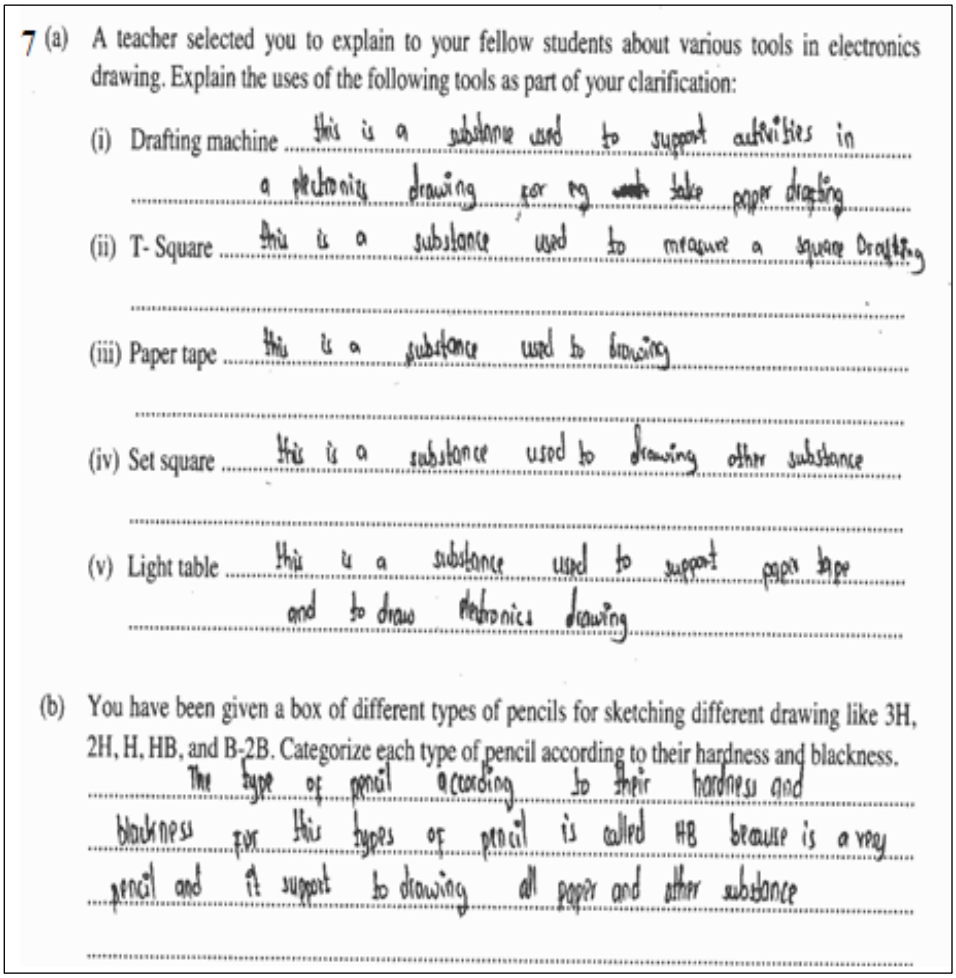


Figure 7: *Students' Performance in Question 7.*

The general performance of the students in this question was poor since 66.8% scored below average. The students provided incorrect response in part (a) which indicates that they had inadequate knowledge on drawing techniques. These students failed to explain uses of tools in electronics drawing in part (a). An example of incorrect response provided by one student was that a *paper tape as a substance used to drawing.* This student was attempting to give the meaning of the tools instead of their application. In part (b) the student failed to categorize types of pencils according to their hardness and blackness. For example, one student explained that *for this*

pencil is called HB. This student was attempting to explain one type of categories given from in the question. Extract 7.1 indicates a sample of poor response given by one of the students.


7 (a) A teacher selected you to explain to your fellow students about various tools in electronics drawing. Explain the uses of the following tools as part of your clarification:

(i) Drafting machine this is a substance used to support activities in a electronic drawing for eg make take paper drafting

(ii) T- Square this is a substance used to measure a square Drafting

(iii) Paper tape this is a substance used to drawing

(iv) Set square this is a substance used to drawing other substance

(v) Light table this is a substance used to support paper tape and to draw electronics drawing

(b) You have been given a box of different types of pencils for sketching different drawing like 3H, 2H, H, HB, and B-2B. Categorize each type of pencil according to their hardness and blackness.

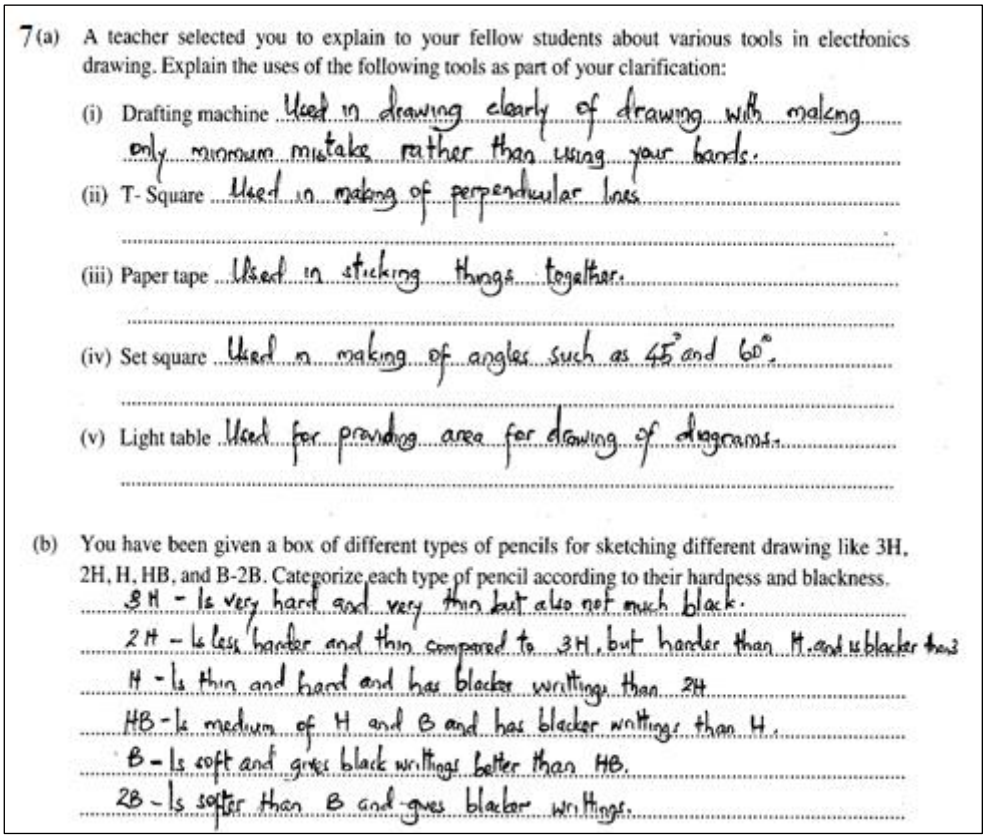
The type of pencil according to their hardness and blackness for this types of pencil is called HB because is a very pencil and it support to drawing all paper and other substance

Extract 7.1: A sample of an incorrect response to question 7.

Extract 7.1 is a sample of incorrect response from a student who failed to explain the uses of tools in electronics drawing instead student attempted to give their meaning. Also he/she, was unable to categorize types of pencils according to their hardness and blackness, instead he/she explained one name of pencil's hardness.

Despite of the poor performance, there were few students who managed to provide correct responses in both parts (a) and (b) of the question. These students clearly explained the uses of given electronics drawing tools in part (a), and in part (b) they managed to categorize the types of pencils

according to their hardness and blackness. This shows that these students had adequate knowledge of the topic of drawing techniques. Extract 7.2 shows a sample of good responses from one of the students.



7 (a) A teacher selected you to explain to your fellow students about various tools in electronics drawing. Explain the uses of the following tools as part of your clarification:

(i) Drafting machine Used in drawing clearly of drawing with making only minimum mistake rather than using your hands.

(ii) T- Square Used in making of perpendicular lines

(iii) Paper tape Used in sticking things together.

(iv) Set square Used in making of angles such as 45° and 60°.

(v) Light table Used for providing area for drawing of diagrams.

(b) You have been given a box of different types of pencils for sketching different drawing like 3H, 2H, H, HB, and B-2B. Categorize each type of pencil according to their hardness and blackness.

3H - Is very hard and very thin but also not much black.

2H - Is less harder and thin compared to 3H, but harder than H. and is blacker than H - Is thin and hard and has blacker writtings than 2H

HB - Is medium of H and B and has blacker writtings than H.

B - Is soft and gives black writtings better than HB.

2B - Is softer than B and gives blacker writtings.

Extract 7.2: A sample of correct response to question 6.

Extract 7.2 is a correct response from a student who properly explained the uses of given electronics drawing tools in part (a). In part (b), the student managed to categorize the types of pencils according to their hardness and blackness.

2.2.6 Question 8: Electronic Drawing

This question had three parts: (a), (b) and (c). Students were provided with a series circuit part one of the electronic system which comprises a 2kΩ resistor, a 12 V dc power supply a p-n junction diode and a defective connecting wire. From the given scenario, students were required to (a) organize the given materials and construct a series circuit which will perform the same function as the defective one, (b) test the working condition of the circuit drawn in part (a) calculate (i) circuit current and (ii)

voltage across the resistor and (c) comment on the outcome, if the 2 kΩ resistor is removed from the circuit drawn in part (a).

This question was attempted by 226 (96.2%) students out of 235 while 09 (3.8%) did not attempt it. Students performance analysis indicates that 38 (16.2%) students scored from 0 to 2.5 marks, 84 (35.7%) scored from 3 to 6 marks and 113 (48.1%) scored from 6.5 to 10 marks. Figure 8 summarises the overall students' performance in the question.

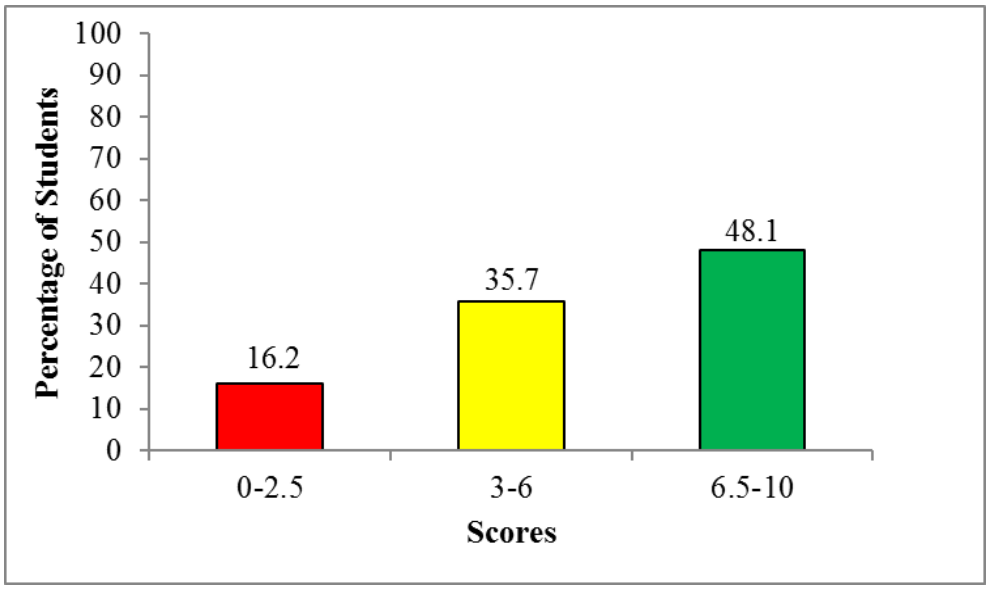
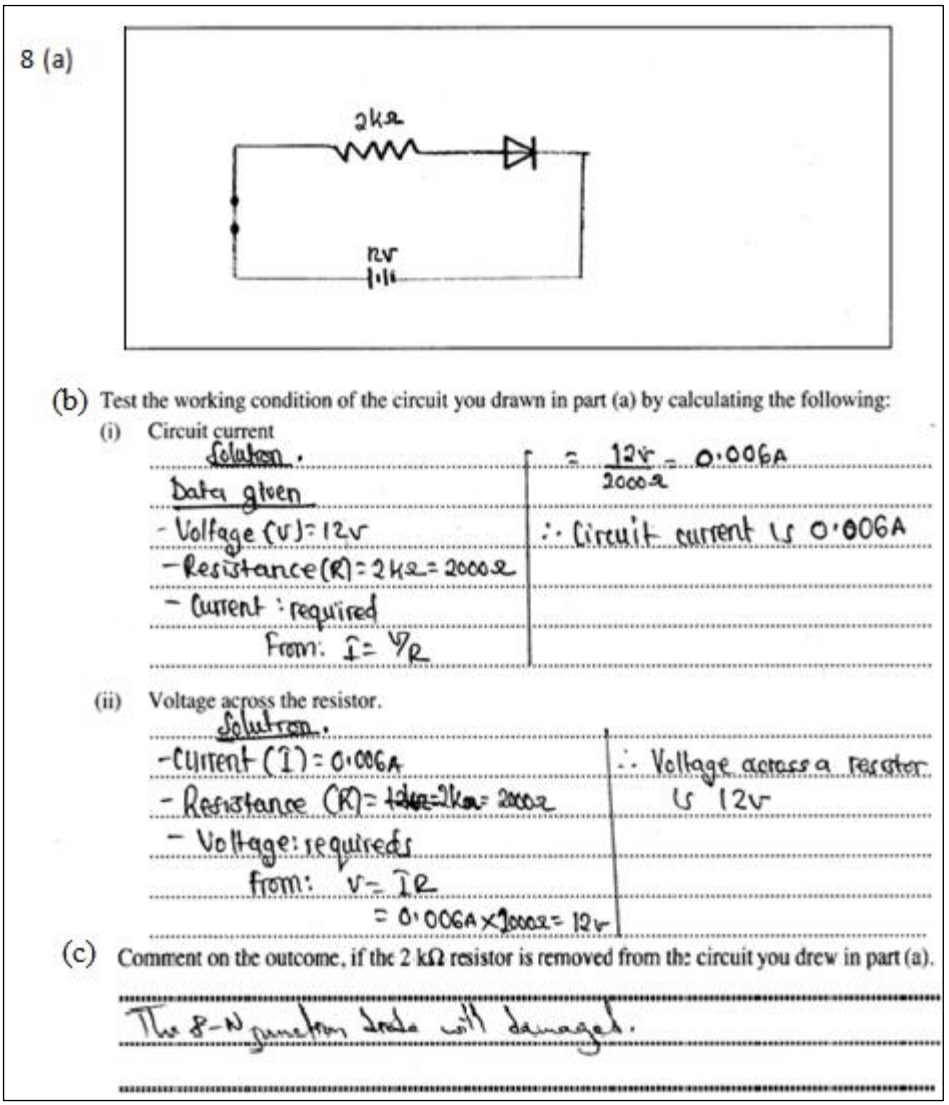


Figure 8: *Students' Performance in Question 8.*

The general performance of the students in this question was good since 83.8 percent scored from 3 to 10 marks. The students who had good performances managed to construct a series circuit which would perform the same function as the given scenario in part (a). In part (b) they correctly calculated the circuit current and voltage across the resistor and in part (c) they correctly commented on the effect of removing the resistor in the circuit drawn in part (a). Extract 8.1 shows a sample of good responses, from one of the students.

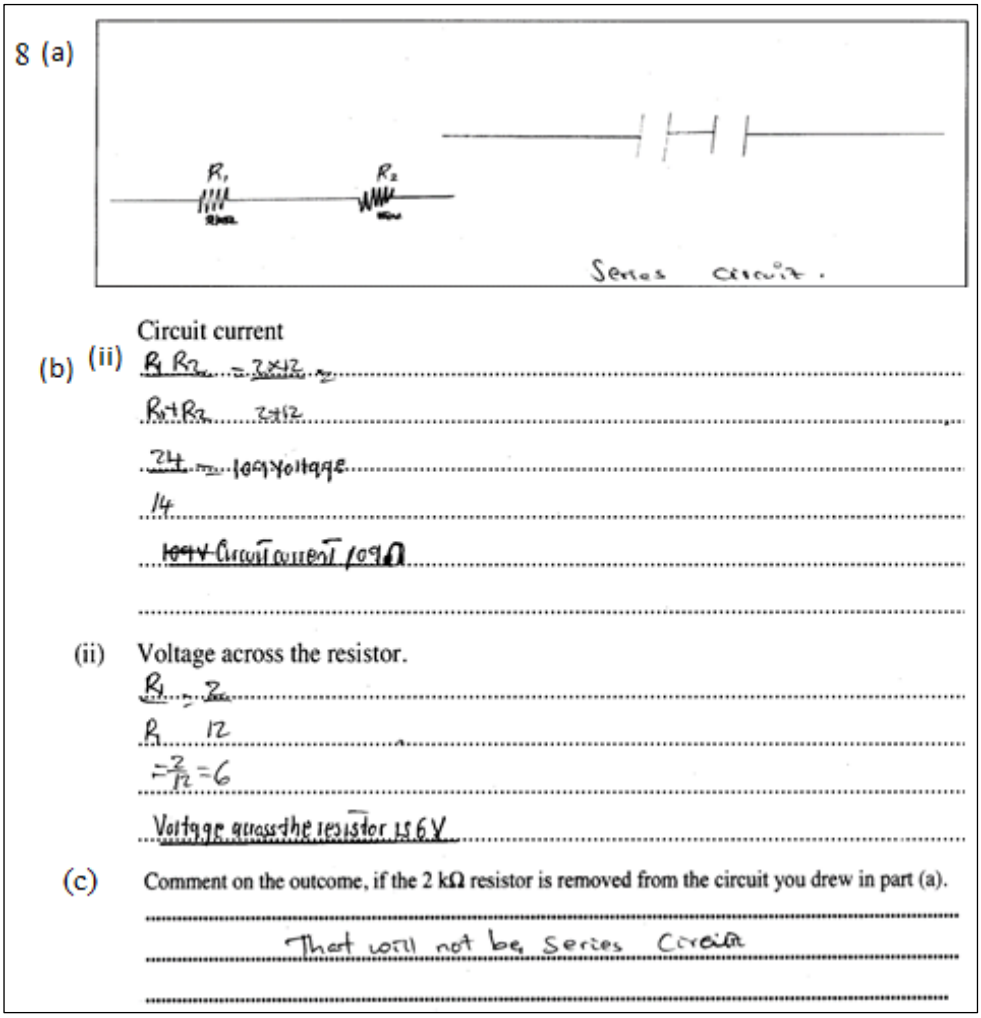


Extract 8.1: A sample of a correct response to question 8.

Extract 8.1 is a sample of correct responses from one of the students who correctly managed to construct a series circuit which would perform the same function as the given scenario. The student correctly calculated the circuit current and voltage across the resistor and correctly commented on the effect of removing the resistor in the circuit drawn in part (a).

However, some of the students attempted poorly this question. These students failed to construct a series circuit which would perform the same function as in the given scenario. For example, one student simply drew a separate group of the resistors in series and capacitors in series. In part (b)

the student failed to calculate circuit current and voltage across the resistor because he/she used a wrong formula $\frac{R1 \times R2}{R1 + R2}$ which is used to calculate resistance in parallel instead of calculating circuit current, In part (c) the student failed to comment on the effect of removing the resistor in the circuit drawn in part (a). The student commented "*that cannot be series circuit*". Extract 8.2 shows a sample of a poor response from one of the students.



Extract 8.2 A sample of an incorrect response to question 8.

Extract 8.2 is a sample of an incorrect response from a student who failed to draw the correct series circuit instead he/she drew a series resistor to

calculate circuit current and voltage by using a wrong formula $\frac{R1 \times R2}{R1 + R2}$ which is used to find the values of parallel resistors. Likewise, he failed to provide a comment on the effect of removing the resistor from the circuit.

2.2.7 Question 9: Electronic Components

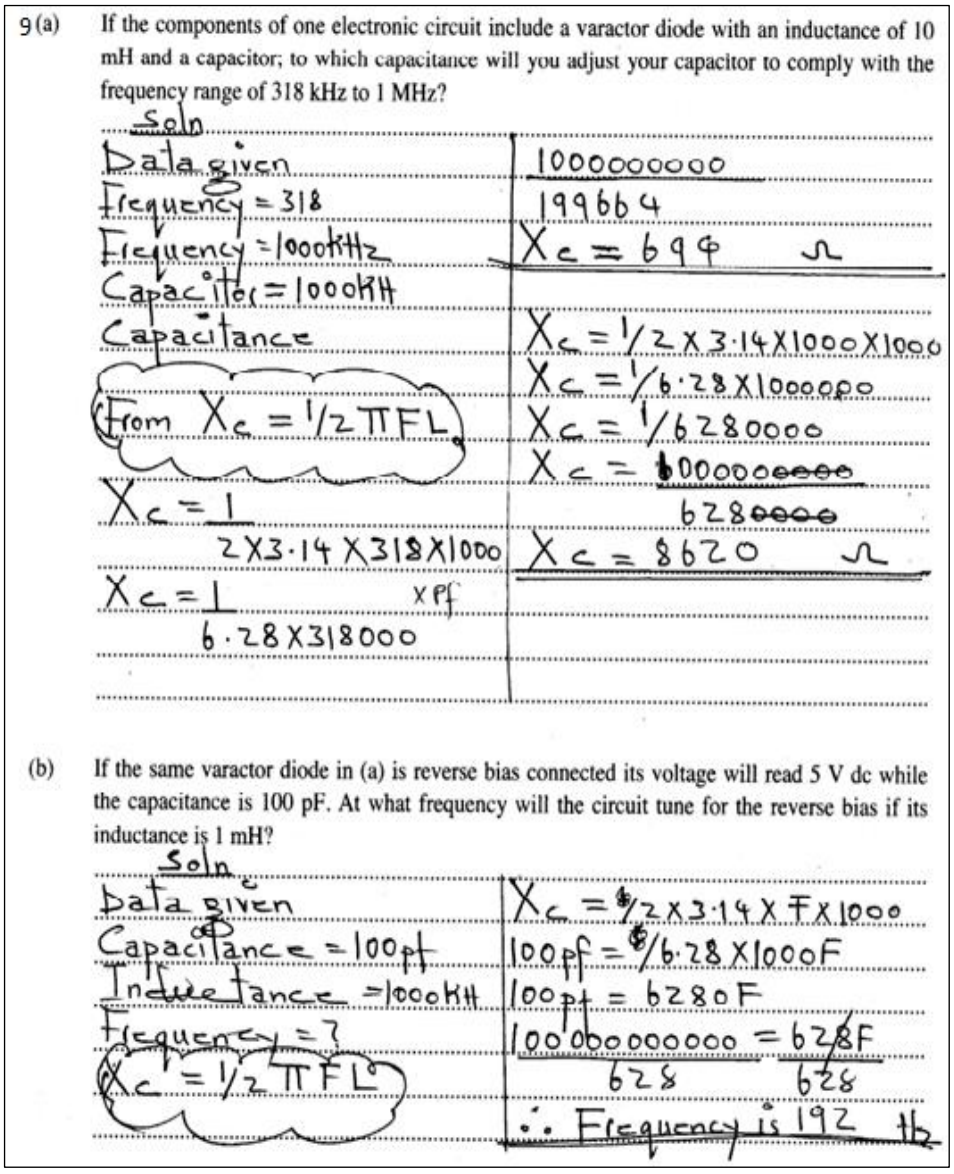
This question had two parts: part (a) and part (b). In part (a), the question was, if the components of one electronic circuit include a varactor diode with an inductance of 10mH and a capacitor, to which capacitance will you adjust your capacitor to comply with the frequency range of 318 kHz to 1MHz?

In part (a), students were required to compute the value of adjusted capacitance to comply with the frequency range of 318 kHz to 1 MHz, from the given components of one electronic circuit comprising a varactor diode with an inductance of 10 mH and a capacitor. In part (b), the question was, if the same varactor diode in (a) is reverse bias connected its voltage will read 5V dc while the capacitance is 100pF. At what frequency will the circuit tune for the reverse bias if its inductance is 1 mH? The students were required to determine the frequency of which the circuit will tune for the reverse bias, given its inductance of 1 mH, if the same varactor diode in part (a) is reverse bias connected and its voltage read 5 V dc while the capacitance is 100 pF.

The question was attempted by 190 (80.8%) students and 45 (19.1%) did not attempt the question. Out of those who attempted this question, only 3 students scored 0.5 to 2 marks and the rest scored 0.

The general performance of the students' in this question was extremely poor because 190 (100%) scored below average. These students failed to calculate the adjusted value of a capacitor to comply will the given range of frequency as well as the frequency for a given inductance because they used an incorrect formula to find capacitive reactance which is $Xc = \frac{1}{2}\Pi FL$.

Most of the students calculated capacitive reactance and inductive reactance instead of calculating capacitance of a circuit. Some of the students calculated frequencies which were not asked in the question by using the same formula. This shows that these students had insufficient knowledge in the application of the components for tuning circuits. Extract 9.1 shows a sample of incorrect responses from one of the students.



Extract 9.1: A sample of an incorrect response to question 9.

Extract 9.1 is a sample of an incorrect response from one of the students who failed to calculate the adjusted value of a capacitor to comply with the given range of frequencies as well as the value of frequency for a given inductance. Instead, he attempted to calculate reactance.

2.3 SECTION C: STRUCTURED QUESTIONS

2.3.1 Question 10: Introduction to Electricity

In this question which had two parts: (a) and (b) students were provided with a circuit which consists of four resistors R_1, R_2, R_3, and R_4, and they were required to measure their current and resistance. The measurements indicate that the current in each resistor is 0.6 A, 0.3 A, 0.2 A and 0.1 A respectively, while the total equivalent resistance of the circuit is 20 Ω. The students were required to (a) calculate the value of each resistor, and (b) create a parallel circuit diagram using the given resistors, indicating the values of the resistance and total P.D as calculated in part (a).

The question was attempted by a total of 235 (100%) students. Among the students who attempted this question 94 (40%) students scored from 0 to 4 marks, 48 (20.4%) scored from 4.5 to 09 and 93 (39.6%) scored from 10 to 15 marks. The overall students' performance is summarised in Figure 10.

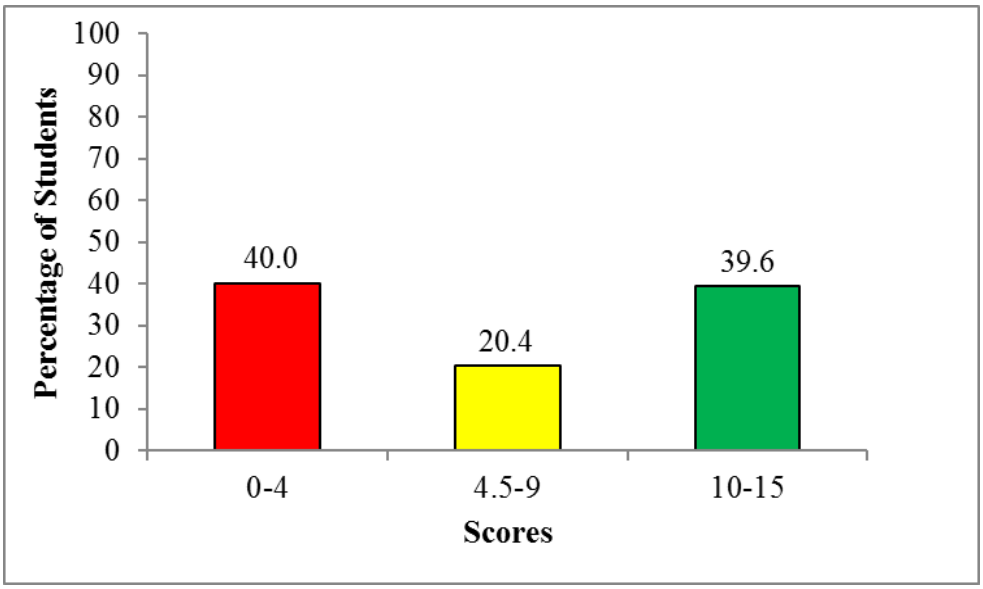
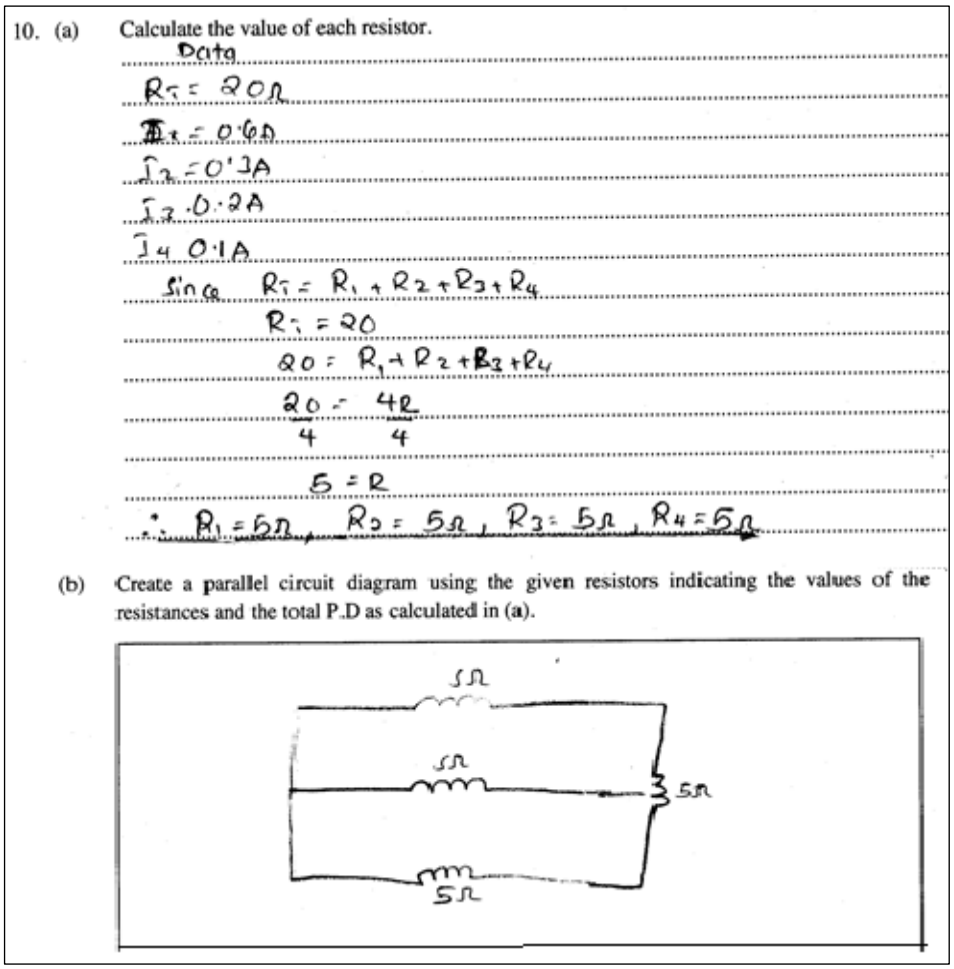


Figure 10: *Students performance in question 10.*

The statistics show that the general performance of the students in this question was average.

Despite the average performance of the students in this question, some of the students about 37.6 percent of the students scored below average. These students failed to calculate the value of resistances for the given data as well

as to create the circuit from the given scenario. For example, one of the students who poorly responded to this question failed to calculate the value of the individual resistances because of the wrong approach used, since the student assumed all resistances are equal. In addition, the student drew the circuit incorrectly. Extract 10.1 shows the sample of a response from a student who performed incorrectly in this question.



Extract 10.1: A sample of an incorrect response to question 10

Extract 10.1 is a sample of an incorrect responses provided by one of the students who failed to calculate the value of individual resistances because of the wrong approach, The student assumed that all resistors are equal and therefore incorrectly drew the circuit in part (b).

On the other hand, 39.6 percent of the students provided correct responses. These students correctly calculated the values of individual resistances from the given scenario by applying the correct formula and also managed to draw the required circuit. Extract 10.2 represents a sample of a good response from one of the students.

10. You are provided with a circuit which consists of four resistors R_1, R_2, R_3 and R_4 and you required to measure their current and resistance. The measurements indicate that the current in each resistor is 0.6 A, 0.3 A, 0.2 A and 0.1 A respectively, while the total equivalent resistance of the circuit is 20 Ω.

(a) Calculate the value of each resistor.

data given.

$I_1 = 0.6A$

$I_2 = 0.3A$

$I_3 = 0.2A$

$I_4 = 0.1A$

$R_1 = ?$

$R_2 = ?$

$R_3 = ?$

$R_4 = ?$

$R_T = 20\Omega$

$V = ?$

from $V = IR_T$

$I_T = (0.6 + 0.3 + 0.2 + 0.1)A$

$I_T = 1.2A$

$V = 1.2 \times 20$

$V = 24V$

from $R = \frac{V}{I}$

$R_1 = \frac{24}{0.6} = 40\Omega$

$R_2 = \frac{24}{0.3} = 80\Omega$

$R_3 = \frac{24}{0.2} = 120$

$R_4 = \frac{24}{0.1} = 240\Omega$

∴ Resistance of each resistor are

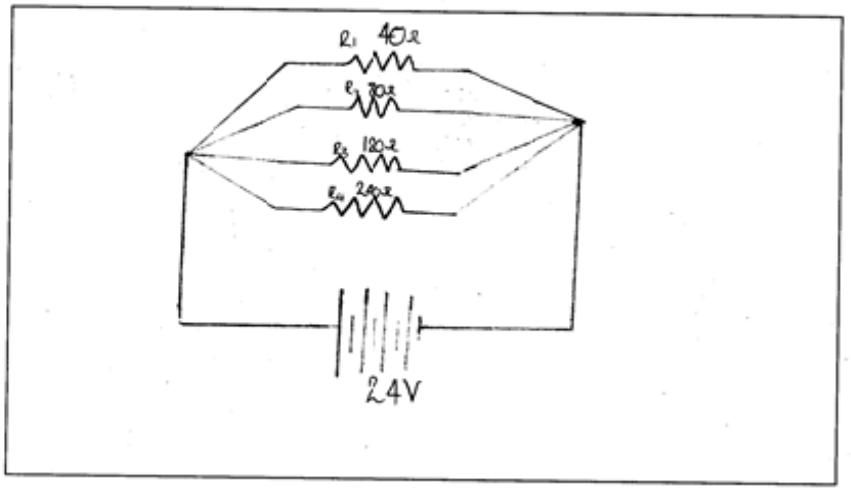
$R_1 = 40\Omega$

$R_2 = 80\Omega$

$R_3 = 120\Omega$

$R_4 = 240\Omega$.

(b) Create a parallel circuit diagram using the given resistors indicating the values of the resistances and the total P.D as calculated in (a).



Extract 10.2: A sample of correct response to question 10.

Extract 10.2 is a sample of correct response from a student who correctly calculated the values of individual resistances from the given scenario. He/she applied the correct formula and managed to draw the required circuit.

3.0 STUDENTS' PERFORMANCE ON EACH TOPIC

The analysis of students' performance on the topics which were assessed in the Electronics and Communication Engineering subject for the year 2021 indicates that students' performance was good in five topics, average in four topics and weak in one topic

The topics that had good performance include, *Electronic Drawing (83.8%). Safety Management and Rules* and *Electronics Workshop/ Laboratory practice I (83%)* and *Introduction to measurement and instrumentation (80.4%).* The good performance on these topics signifies that the candidates had sufficient knowledge, skills and competence on the tested concepts. The analysis of the students' performance in each topic further indicates that the students had a good performance of 95.7 percent in the topics which were assessed in question 1 multiple choice item

The topics which candidates performed averagely were *Introduction to Electricity (60%), Semiconductor Devices (50.2%), Electronic Components (45.1%),* and *Drawing Techniques (33.2%).* This performance suggests that the students had partial knowledge, skill and competence on these topics.

The students performed poorly in the topic of *Electronic Engineering Occupational Information (24.7%).* Most of the students lacked knowledge on this topic because it is new in the syllabus

The Appendix on the last page presents a summary of the students' performance in each topic using green, yellow and red colours to represent good, average and poor performance respectively.

4.0 CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The general performance of the students in Electronics and Communication Engineering assessment for (FTNA) 2021 was good. Out of 235 students who sat for the paper, 169 (71.9%) passed, while 66 (28.1%) failed.

The analysis of the students' responses observed few challenges faced by the students when responding to the questions. These include the students' lack of knowledge in responding to some of the questions, particularly in the topic of Electronics components and *Drawing Techniques* which was poorly performed.

Another weakness observed was inability of some of the students to understand the requirements of the questions, which led them to provide irrelevant responses.

It is expected that the weaknesses noted in this report will be used as a guideline to teachers, students and other education stakeholders during teaching and learning processes in order to improve students' performance in Electronics and Communication Engineering in future.

4.2 Recommendations

From the shortcomings observed in the analysis of students' item response, the following are recommended:

i. English subject should be given first priority so as to improve students' English proficiency.
ii. Students should develop a habit to learn through internet, and different books so that they can get different ideas from different areas.
iii. Students should be well oriented on common terms/verbs used in composing Competency Based Education and Training CBET questions in order to enable them to answer questions correctly.

Appendix

A Summary of Students' Performance in each Topic.

S/N	Topic	Question Number	Percentage of Students' Performance (%)	Remarks
1	Safety Management and rules, Drawing Techniques, Introduction to Electricity, Semiconductor, Electronic components, Introduction to Measurement and Instrumentation, Electronic Workshop practice I and II	1	95.7	Good
2	Electronic Drawing	8	83.8	Good
3	Safety Management and rules, Electronics Workshop/ Laboratory practice I	4	83	Good
4	Introduction to Measurement and Instrumentation	5	80.4	Good
5	Introduction to Electricity	10	60	Average
6	Semiconductor Devices	6	50.2	Average
7	Electronic Components	2&9	45.1	Average
8	Drawing Techniques	7	33.2	Average
9	Electronics Engineering Occupational Information	3	24.7	weak