NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF HEALTH, NATURAL RESOURCES AND APPLIED SCIENCES

DEPARTMENT OF NATURAL AND APPLIED SCIENCES

QUALIFICATION: BACHELOR OF SCIENCE (MAJOR AND MINOR)	
QUALIFICATION CODE: 07BOSC	**LEVEL:** 6
COURSE NAME: ELECTRICAL CIRCUIT AND ELECTRONICS	**COURSE CODE:** ECE602S
SESSION: JANUARY 2023	**PAPER:** THEORY
DURATION: 3 HOURS	**MARKS:** 100

SUPPLEMENTARY/SECOND OPPORTUNITY EXAMINATION MEMORANDUM	
EXAMINER (S)	MR EMMANUEL EJEMBI
MODERATOR:	PROF. SYLVANUS ONJEFU

INSTRUCTIONS
1. Write all your answers in the answer booklet provided. 2. Read the whole question before answering. 3. Begin each question on a new page.

PERMISSIBLE MATERIALS

Scientific Calculator

THIS QUESTIONS PAPER CONSISTS OF 8 PAGES (Including this front page)

SECTION A

QUESTION 1 **[30]**

Short Answer Question Types: Each question in this section carries two marks

1.1 Which of the following is Kirchhoff's second law? (2)

a. Kirchhoff's current law b Kirchhoff's voltage law c. Current law

b. d. None of these

1.2 Which of the following Kirchhoff's law defines incoming and outgoing sum of currents towards node are equal? (2)

a. Kirchhoff's current law b Kirchhoff's voltage law c. Current law

b. d. None of these

1.3 Which of the formula defines Kirchhoff's current law where i1, i2 are incoming currents and i3, i4 are outgoing currents from a node in a circuit? (2)

a. $i1 + i2 = i3 + i4$ b. $i1 + i3 = i2 + i4$ c. $i1 - i2 = i3 - i4$ d. $i4 - i1 = i2 + i3$

1.4 To obtain n-type semiconductor, the impurity added to a pure semiconductor is (2)

b. Trivalent b. Tetravalent c. Pentavalent d. None of these

1.5 An n-type semiconductor has electrons as a majority carriers, due to this material attains negative charge on it (2)

a. True b. False

1.6 In a p-type semiconductor the majority carriers are (2)

a. Holes b Electrons c Positive ions d. Negative ions

1.7 When a PN junction is forward biased (2)

a. It offers a low resistance and the large current flows through it.

b. It was a high resistance and small current flows through it.

c. It act as an insulator and no current flows through it.

d. The width of the depletion layer increases.

1.8 The barrier voltage at a pn junction for germanium is about (2)

a. 0.3 V b. 0.7 V c. 0.8 V d. 0.4 V

1.9 In a full wave rectifier, the current in each diode flows for (2)

a. Whole cycle of the input signal
b. Half cycle of the input signal
c. More than half cycle of the input signal
d. None of these.

(2)

1.7 Which one of the following has three layers?

a. Thyristor b. Transistor c. Diodes d. None of these

1.8 The most commonly used transistor circuit arrangement is (2)

a. Common base b. Common emitter c. Common collector d. None of these

1.9 Emitter of transistor is doped (2)

a. Heavily b. Lightly c. Moderately b. None of these

1.10 The arrowhead on the transistor symbol points in the direction of (2)

a. Electron flow in the emitter region

b. Minority carriers flow in the emitter region

c. Majority carriers flow in the emitter region

d. Conventional current flow in the emitter region

1.11 The Quiescent point Q in a voltage amplifier is selected in the middle of the active (2)

region because

a. It gives better stability
b. The circuit needs a small DC voltage
c. The biasing circuit needs less number of resistors
d. It gives a distortion less output

1.12 The base of a transistor is _____doped (2)

a. Heavily b. moderately c. Lightly d. None of the above

1.13 In an npn transistor, _____ are the minority carriers (2)

a. Holes b. Free electrons c. Donor's ions d. Acceptor ions

1.14 At the base –emitter junctions of a transistor, one find (2)

a. A reverse bias b. A wide depletion layer c. Low resistance

d. None of the above

1.15 An amplifier has Ai = 40 and Av = 30. What is the power gain by the transistor?

a. 120 b. 12000 c. 1200 d. 1300

SECTION B

QUESTION 2 **[15]**

2.1 State the superposition theorem. (2)

2.2 Write the Kirchhoff's current law equation for the principal node shown in **Figure 2.1.** (3)

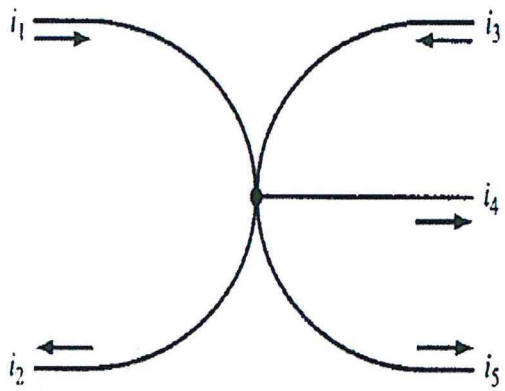

Figure 2.1

2.3 Determine the current in each branch of the network shown in **Figure 2.2** by using the superposition theorem. (10)

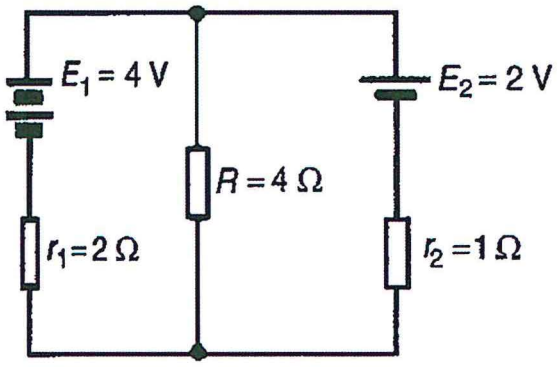

Figure 2.2

QUESTION 3 **[15]**

3.1 State the maximum power transfer theorem. (2)

3.2 A d.c. source has an open-circuit voltage of 30V and an internal resistance of 1.5Ω. State the value of load resistance that gives maximum power dissipation and determine the value of this power. (5)

3.3. State the two types of impurities used in semiconductor materials. (4)

3.4 Briefly explain why the resistance of a semiconductor decreases with temperature. (4)

QUESTION 4 **[15]**

4.1 What do you understand by the term depletion region in p-n junction diode? (2)

4.2 Briefly explain the majority and minority carriers, associated with a p-n junction semiconductor. (4)

4.3 Explain the term diode biasing. (4)

4.4 A silicon diode has an external bias voltage of $12\ V$ with an external resistor of $150\ \Omega$. What is the total forward current? (5)

QUESTION 5 **[15]**

5.1 Define the common base gain of a bipolar junction (BJT). (2)

5.2 List the three types of current flowing in the bipolar junction transistor (BJT). (3)

5.3 Show that the common base gain of a bipolar junction transistor is given by

$$\alpha = \frac{\beta}{(\beta+1)}$$ (4)

5.4 A transistor has a base current $I_B = 0.08\ mA$ and emitter current $I_E = 9.60\ mA$.

Determine its: (6)

i. collector current I_c

ii. common base gain α

iii. common emitter gain β

QUESTION 6 **[10]**

6.1 Briefly explain the following operational amplifier parameters. (3)

i. Common-mode rejection ratio (CMRR).

ii. Common-mode signal.

6.2 Draw an inverting operational amplifier circuit, showing their respective voltage and resistance. (3)

6.3 A differential amplifier has an open-loop voltage gain of 120 and a common input signal of 3.0 V to both terminals. An output signal of 24 mV results. Calculate the common mode gain and the CMRR. (4)