Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2022

ELECTRICAL TECHNOLOGY: ELECTRONICS (EXEMPLAR)

MARKS: **200**

TIME: **3 hours**

This question paper consists of 14 pages, including a formula sheet.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of TEN questions.
2. Sketches and diagrams must be large, neat and fully labelled.
3. Show ALL calculations and round off answer correctly to TWO decimal places. Show the units for ALL answers of calculations.
4. Number the answers correctly according to the numbering system used in this question paper.
5. You may use a non-programmable calculator.
6. A formula sheet is provided at the end of this question paper.
7. Write neatly and legibly.

QUESTION 1: MULTIPLE-CHOICE QUESTIONS

Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.15) in the ANSWER BOOK, for example 1.16 D.

1.1 Ergonomics can be defined as …

A economically providing earthing to an installation.
B the science of fitting tasks, equipment and the surroundings to the end user to make them more comfortable.
C providing signs in a workshop.
D keeping the floors clean and clear of rubbish, rags and dirt. (1)

1.2 The purpose of a function generator is …

A to generate different types of waveforms as its output across a range of frequencies.
B to check the functionality of generators.
C to serve as a power supply for oscilloscopes.
D to generate electricity for power stations. (1)

1.3 It is the distance between the beginning and end of one complete sequence of waveform including one peak and one trough, measured in seconds:

A Peak-to-peak value
B Wave length
C Cycle
D Ramp wave (1)

1.4 The ratio of DC voltage relative to the given AC voltage is known as …

A effective value.
B RMS value.
C form factor.
D average value. (1)

1.5 An electronic device or circuit that increases the voltage, current of a power of signal is known as a/an ...

A transistor.
B covalent bond.
C voltage divider biasing.
D amplifier. (1)

1.6 For the normal operation of a transistor, the … junction always needs to be reverse biased.

A emitter-base
B collector-base
C unbiased
D P-N (1)

1.7 All phasors rotate in a/an … direction.

A anti-clockwise
B clockwise
C linear
D haphazard (1)

1.8 In a capacitive RLC circuit the …

A voltage leads the current.
B voltage and current are in phase.
C current lags the voltage.
D current leads the voltage. (1)

1.9 The main features of the common base transistor connection is ...

A high current gain, no voltage gain and medium power gain.
B medium current gain, medium current gain and high-power gain.
C no current gain, high voltage gain and medium power gain.
D no voltage gain, no current gain and high-power gain. (1)

1.10 The device that detects or senses and reacts to and measures physical quantities is known as a ...

A transducer.
B sensor.
C thermistor.
D piezo-electric effect. (1)

1.11 Which ONE of the following sensors is NOT a type of humidity sensor?

A Capacitive sensor
B Silicon controlled rectifier sensor
C Resistive sensor
D Thermal sensor (1)

1.12 It converts the incoming sound waves into electrical impulse of energy:

A Audio amplifier
B RF oscillator
C AM modulator (1)
D Microphone

1.13 The advantages of using negative feedback in an amplifier is ...

A improved stability against changes of temperature.
B increased distortion of the amplified signal.
C simple construction and robustness.
D provided a combination of both voltage amplification and current implication. (1)

1.14 The TWO components that form the heart of all resonant circuits are the …

A capacitor and the inductor.
B inductor and the voltage.
C capacitor and the power.
D current and the voltage. (1)

1.15 The rectifier circuit of a power supply …

A reduces the input AC voltage.
B regulates the output voltage.
C converts the AC voltage to a pulsating DC voltage.
D smoothes out the pulsating DC voltage. (1)

[15]

QUESTION 2: OCCUPATIONAL HEALTH AND SAFETY

2.1 State ONE example of each of the following categories of ergonomics in the workplace:

2.1.1 Working factors (1)

2.1.2 Environmental factors (1)

2.2 Describe how inadequate lighting is considered as an unsafe condition. (2)

2.3 Write down why it is necessary to wear personal protective clothing in the workplace. (2)

2.4 Explain the purpose of yellow, triangular safety signs. (2)

2.5 Explain why regulations are necessary in the workplace. (2)

[10]

QUESTION 3: TOOLS AND MEASURING INSTRUMENTS

3.1 State the care and maintenance required for a function generator. (3)

3.2 FIGURE 3.2 below represents an oscilloscope which shows two full cycles of a sine wave. The vertical volts per division is set to 5 V/div and the horizontal time per division is set to 2 ms/div.

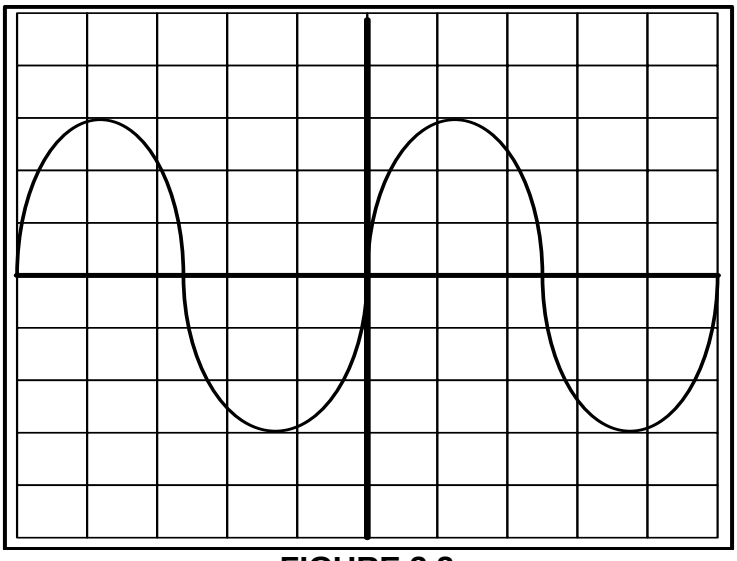


FIGURE 3.2

Given: V/div = 5 V
(T/div) = 2 ms

Calculate:

3.2.1 The maximum voltage of the waveform (3)

3.2.2 The frequency of the waveform (4)

[10]

QUESTION 4: COMMUNICATION SYSTEMS

4.1 Explain the main purpose of modulation when using a transistor. (2)

4.2 State ONE method of radio modulation. (1)

4.3 Draw the circuit diagram of a FM radio transmitter. (5)

4.4 With reference to AM transmitter circuit, explain the following:

4.4.1 Modulator (1)

4.4.2 Antenna (1)

[10]

QUESTION 5: WAVEFORMS

5.1 Name the TWO fields that combine to form a radio wave. (2)

5.2 Draw and label TWO digital pulses, one positive-going, the other negative-going. (4)

5.3 Refer to waveforms and explain the following terms:

5.3.1 Rise time (2)

5.3.2 Mark-space ratio (2)

5.3.3 Clock pulse (2)

5.4 Refer to wave shaping circuits and draw the following:

5.4.1 The circuit of a positive biased parallel clipping circuit using a 3 V biasing battery (4)

5.4.2 The output waveform when the peak sinusoidal voltage of 4 V is applied (4)

5.5 An AC supply has a RMS voltage of 12,8 V. Determine its peak voltage. (3)

5.6 Determine the periodic time of a wave with a frequency of 2 750 Hz. (3)

5.7 Determine the form factor of a sine wave if the peak voltage is 12,8 V. (4)

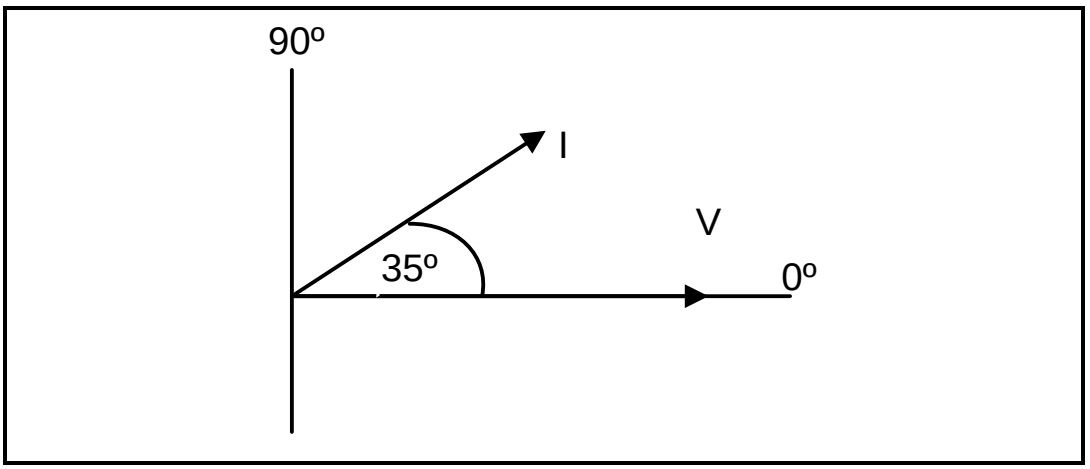
[30]

QUESTION 6: RLC CIRCUITS

6.1 State the relationship between the current and the voltage in an AC circuit, when the capacitive reactance is larger than the inductive reactance. (1)

6.2 Explain how an increase in frequency will affect the inductive reactance of a circuit. (1)

6.3 Draw the waveforms which will represent the phasor diagram below.



(2)

6.4 Define the term *power factor*. (2)

6.5 Explain how an increase in frequency will affect the current flow in a RC circuit if the supply voltage remains constant. (3)

6.6 A series RLC circuit has an apparent power of 5 VA and a power factor of 0,75. Determine the true power of the circuit.

Given: $S = 5$ VA
$\cos\theta = 0{,}75$ (3)

6.7 Refer to the circuit diagram in FIGURE 6.7 and answer the questions that follow.

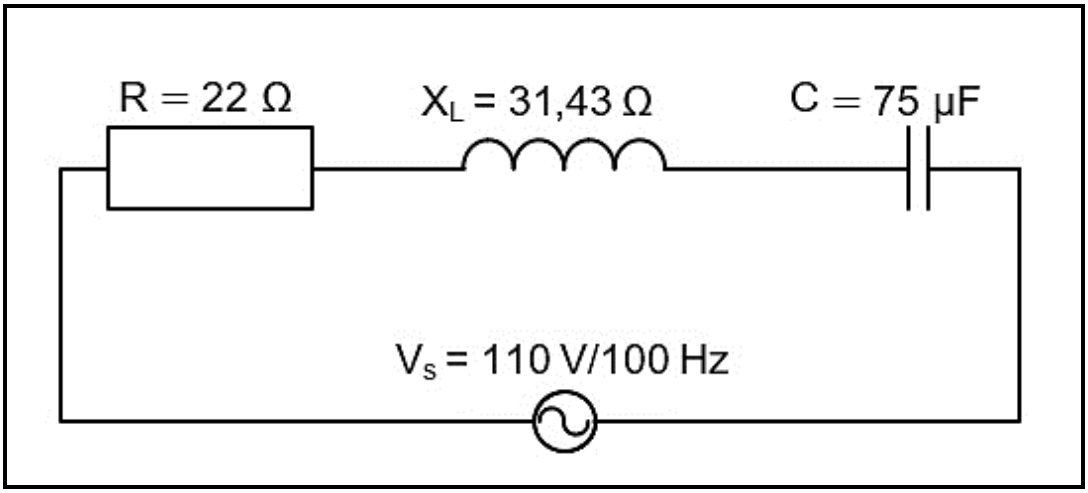


FIGURE 6.7

Given: R = 22 Ω
X_L = 31,43 Ω
C = 75 µF
V_S = 110 V
f = 100 Hz

Calculate:

6.7.1 The capacitive reactance (3)

6.7.2 The impedance of the circuit (3)

6.7.3 The current flowing through the circuit (3)

6.7.4 The apparent power (3)

6.7.5 The value of the inductor in the circuit (3)

6.7.6 The power factor if the real power is 400 W (3)

[30]

QUESTION 7: SEMICONDUCTOR DEVICES

7.1 Describe what is meant by the depletion region with reference to diodes. (4)

7.2 Give ONE application where zener diodes are used. (1)

7.3 With reference to FIGURE 7.3 below, explain the operation of a SCR by using the two-transistor analogy. (6)

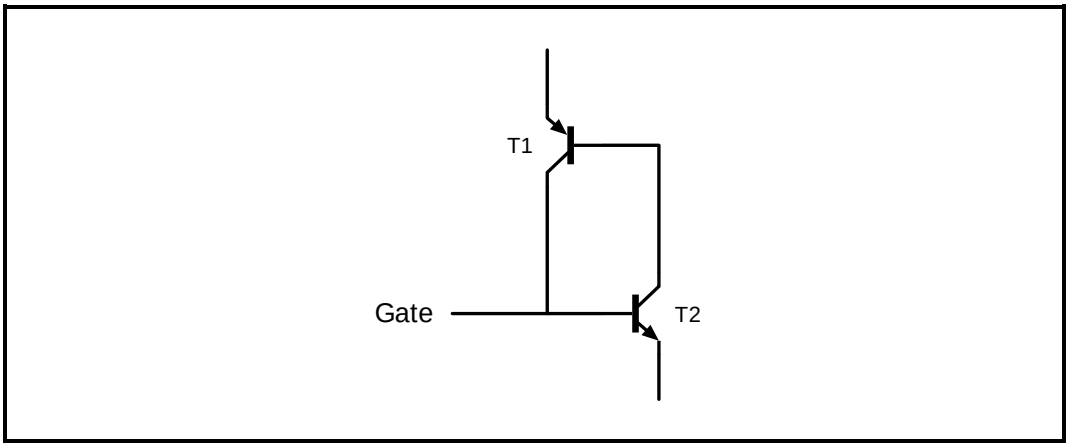


FIGURE 7.3

7.4 With reference to the transistor load line, what is meant by the Q-point? (3)

7.5 Explain how a diode connected in a circuit can be tested using a multi-meter. (2)

7.6 State the THREE regions of operation for a transistor. (3)

7.7 With the aid of sketch, briefly explain the difference between a firing angle and a conducting angle of a thyristor (SCR). (5)

7.8 Draw a characteristic curve of a Zener diode. (4)

7.9 Draw a symbol of a PNP Transistor, indicating conventional current flow direction through the transistor. (4)

7.10 A circuit consists of a 12,8 V supply, connected in series with a silicon diode with a known forward voltage of 0,8 V. The load has an impedance of 75 Ω. Draw the following:

7.10.1 The IV characteristic curve of this circuit (3)

7.10.2 The load line of the diode (5)

[40]

QUESTION 8: SENSORS AND TRANSDUCERS

8.1 Define the term *piezo electric effect.* (2)

8.2 Explain the difference between a *sensor* and a *transducer*. (4)

8.3 Explain the principal of operation of a Light Dependent Resistor (LDR). (2)

8.4 Explain the term *opto-coupler.* (2)

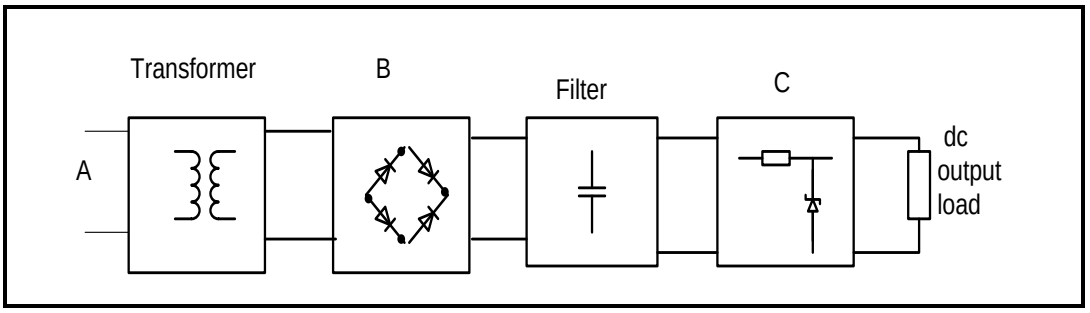
8.5 Draw the circuit symbol of a phototransistor. (3)

8.6 With reference to thermistors, explain the term *Negative Temperature Coefficient (NTC)*. (2)

[15]

QUESTION 9: POWER SUPPLIES

9.1 Refer to the block diagram below and answer the questions that follow.



BLOCK DIAGRAM OF A POWER SUPPLY

9.1.1 Label the parts marked **A**, **B** and **C**. (3)

9.1.2 Draw the output waveform after the filter in the power supply. (2)

9.1.3 Describe the function of the zener diode in the part marked **C**. (2)

9.2 Explain what is meant by *forward biasing* in diodes. (3)

9.3 Mention TWO types of circuits used to obtain full wave rectification. (2)

9.4 Calculate the value of the load resistor of a 50 Hz half wave rectifying circuit if it has a ripple factor of 115% when using a capacitor with a value of 100 µF.

Given: $f = 50$ HZ
$\gamma = 115\%$
$C = 100$ µF (3)

[15]

QUESTION 10: AMPLIFIERS

10.1 Define the term *amplifiers*. (1)

10.2 State ONE use of a class AB amplifier. (1)

10.3 Refer to FIGURE 10.3 below and calculate the circuits output voltage if the collector current Ic were to start at 8 mA, rise to 12 mA and later fall to 4 mA. (12)

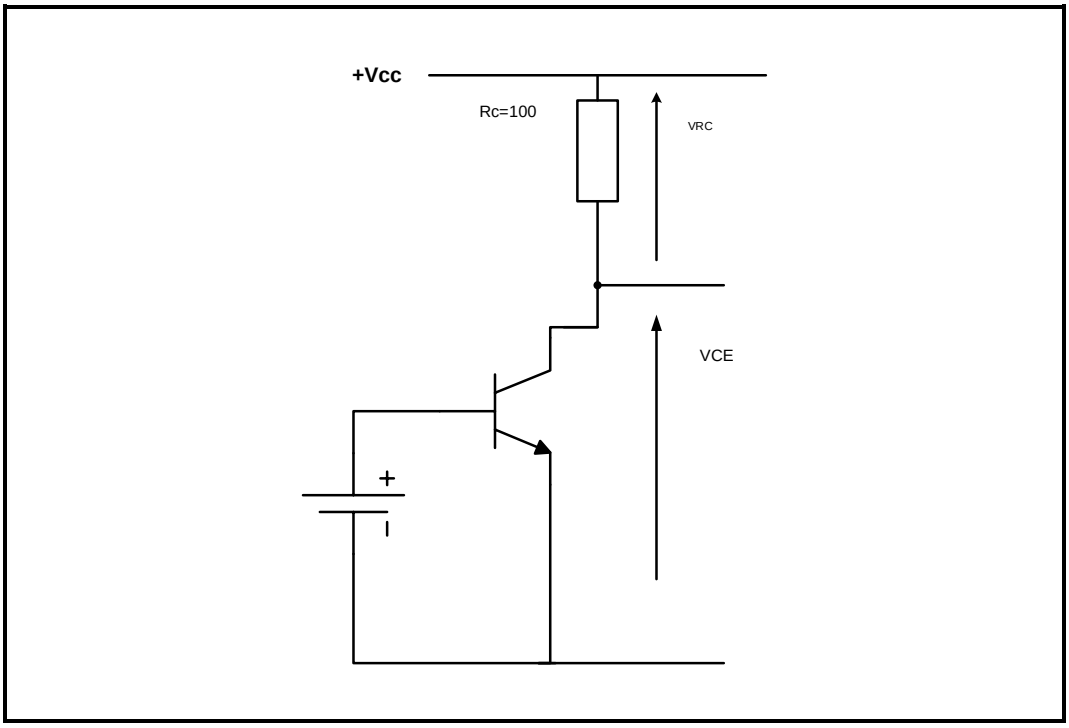


FIGURE 10.3

10.4 Draw a block diagram of voltage divider base biasing. (4)

10.5 Name THREE common types of transistor biasing connections. (3)

10.6 Refer to FIGURE 10.6 below and answer the questions that follow.

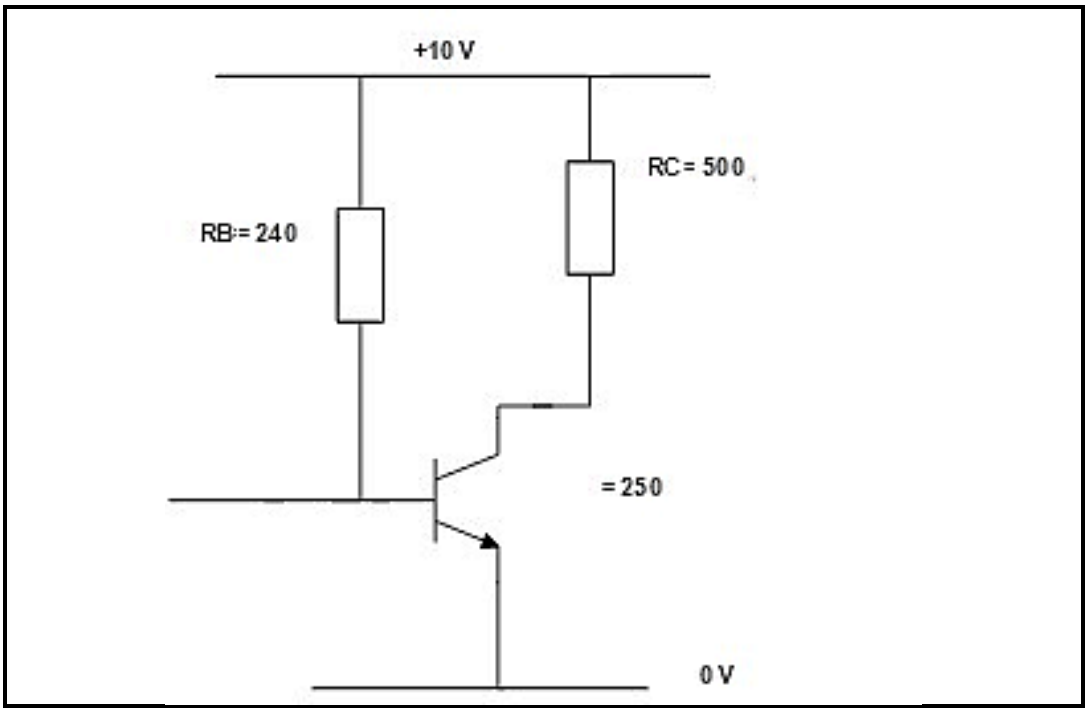


FIGURE 10.6

Calculate:

10.6.1 The quiescent base current I (3)

10.6.2 The quiescent collector current (3)

10.6.3 The quiescent collector emitter voltage (V_{CE}) (3)

[30]

TOTAL: 200

FORMULA SHEET

MEASURING INSTRUMENTS

$V_{max} = V/div. \times$ no. of divisions

$T = T/div. \times$ no. of divisions

$f = \frac{1}{T}$

RLC-CIRCUITS

$X_L = 2\pi fL$

$X_C = \frac{1}{2\pi fC}$

$I_T = I_R = I_L = I_C$

$I_T = \frac{V}{Z}$

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

$\cos\theta = \frac{R}{Z}$ and $\cos\theta = \frac{P}{S}$

WAVE FORMS

$f = \frac{1}{T}$

$V_{MAX} = V_{RMS} \times 1{,}414\ (V)$

$V_{RMS} = V_{MAX} \times 0{,}707$

$V_{ave} = V_{max} \times 0{,}637$

POWER SUPPLIES

$Vave = Vpk - \frac{1}{2} V_{RIP\ P-P}$

$V_{OUT} = V_Z$

$Vo = V_Z - V_{BE}$

$I_L = I_E\,(\beta + 1)I_B$

AMPLIFIERS

$V_{CE\,max} = V_{VCC}$

$V_{CC} = V_{CE} + I_C R_C$

$I_C = \beta I_B$

$A_V = \frac{output\ voltage}{input\ voltage}$

$A_I = \frac{output\ current}{input\ current}$