Province of the
EASTERN CAPE
EDUCATION

NATIONAL SENIOR CERTIFICATE

GRADE 11

NOVEMBER 2019

ELECTRICAL TECHNOLOGY: ELECTRONICS

MARKS: **200**

TIME: **3 hours**

IELTTE2

This question paper consists of 13 pages including a formula sheet.

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Sketches and diagrams must be large, neat and fully labelled.
3. ALL calculations must be shown, and correctly rounded off to TWO decimal places.
4. Answers must be numbered correctly according to the numbering system used in this question paper.
5. Non-programmable calculators may be used.
6. A formula sheet is provided at the end of the question paper.
7. Write neatly and legibly.

QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY

1.1 Describe the term 'regulation' with respect to the OHS act. (2)

1.2 Name TWO unsafe acts that may result in an injury in an electrical workshop. (2)

1.3 Explain the term Ergonomics. (2)
[6]

QUESTION 2: TOOLS AND MEASURING INSTRUMENTS

2.1 Explain TWO purposes of an oscilloscope. (2)

2.2 Describe the purpose of a jigsaw. (2)

2.3 State the maximum distance between the tool rest and the grinding wheel. (1)

2.4 Give ONE advantage of using a power factor meter. (1)

QUESTION 3: COMMUNICATION SYSTEMS

3.1 Define the term *modulation* when used in radio transmission. (2)

3.2 Give TWO advantages of a continuous wave (CW). (2)

3.3 Explain the operation of a regenerative receiver. (4)

3.4 Refer to figure 3.4 below and label blocks 1–3. (3)

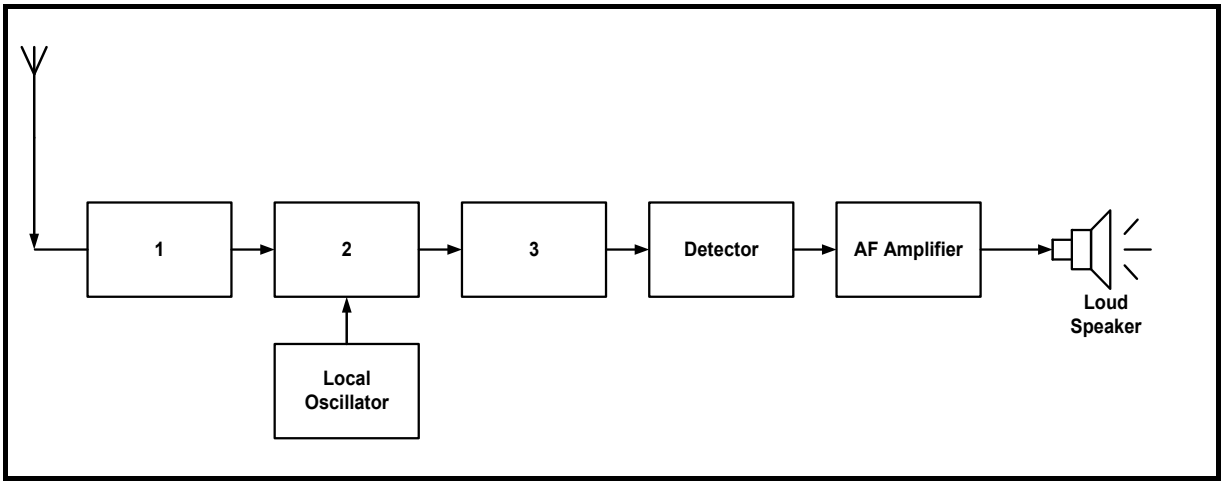

FIGURE 3.4

3.5 Draw a block diagram of a single sideband transmitter. (7)

3.6 Describe the TWO applications of single sideband transmitter (SSB) (2)

3.7 List THREE stages of phase locked loop. (3)

3.8 Describe the purpose of a continuous wave transmitter (CW) (3)

[26]

QUESTION 4: WAVEFORMS

4.1 Name THREE types of waveforms. (3)

4.2 With reference to waveforms, define the following terms:

4.2.1 Instantaneous value (3)

4.2.2 Rise time (3)

4.2.3 Average Value (3)

4.2.4 Root Mean Square Value (3)

4.2.5 Form Factor (2)

4.3 A sinewave has a maximum voltage value of 12 V and a cycle time of 20 ms. Calculate the frequency of the waveform. (3)

4.4 With reference to an integrator circuit, explain why a square wave input will produce a triangular wave output. (3)

4.5 Explain THREE reasons for using diode clipping circuits. (3)

[26]

QUESTION 5: RLC CIRCUITS

5.1 Define the term *vector.* (1)

5.2 Explain what will happen to the following reactances if the frequency of the supply voltage decreases.

5.2.1 Capacitive reactance. (1)

5.2.2 Inductive reactance. (1)

5.3 Refer to the circuit diagram in FIGURE 5.3 and answer the questions that follow.

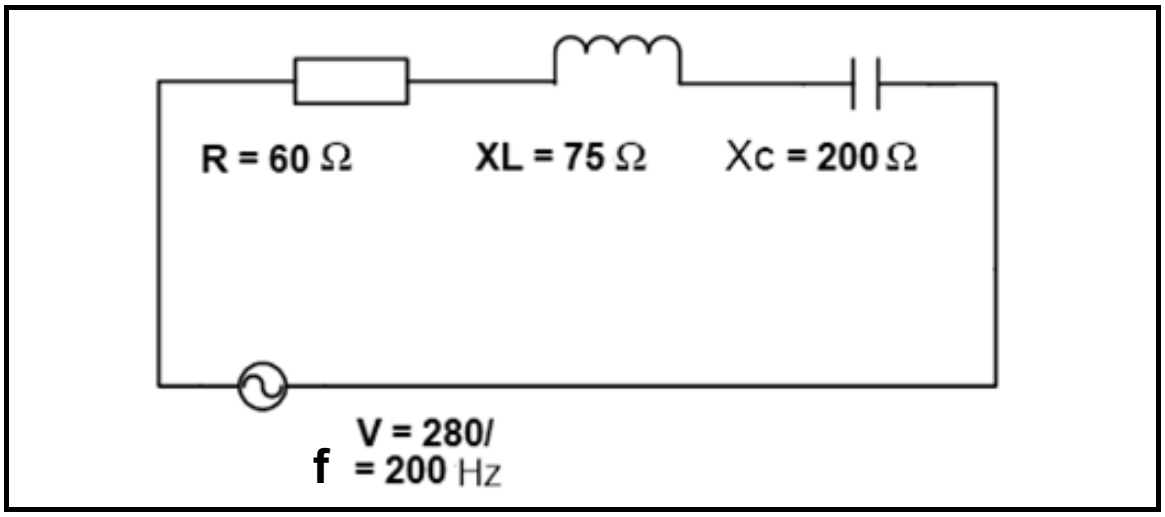

FIGURE 5.3 SERIES RLC CIRCUIT

Given: $R = 60\ \Omega$
$X_L = 175\ \Omega$
$X_C = 200\ \Omega$
$V = 280\ V$
$f = 200\ Hz$

Calculate:

5.3.1 The impedance of the circuit (3)

5.3.2 The supply current (3)

5.3.3 The true power (3)

5.3.4 The reactive power (3)

5.3.5 Apparent power (3)

5.3.6 Power factor (2)

5.4 A series circuit consists of a 50 Ω resistor, current of 0,2 A, an inductance of 40 mH and a capacitor of 5 µF connected to sinusoidal supply voltage with a constant output of 10 V

Calculate:

5.4.1 Resonant frequency (3)

5.4.2 The inductive reactance at resonance (3)

[26]

QUESTION 6: SEMICONDUCTOR DEVICES

6.1 Define the following terms:

6.1.1 Doping (1)

6.1.2 Extrinsic Material (2)

6.1.3 N-TYPE semiconductor (2)

6.2 Explain the term *Minority charge carrier* with reference to an N-Type material. (2)

6.3 Explain how a depletion region is formed in a diode. (3)

6.4 Name the THREE stages of operation of a silicon diode. (3)

6.5 Name TWO important pieces of information you can read on a data sheet. (2)

6.6 Explain the principle of operation of a zener diode. (2)

6.7 A circuit consists of a 12 Vdc supply, a diode and a load of 15 Ω.
Answer the following questions.

6.7.1 Calculate the maximum current for this diode. (3)

6.7.2 Calculate the maximum voltage for this diode. (2)

6.8 Draw a fully labelled symbol diagram for an NPN Transistor (4)

6.9 Name TWO applications of a transistor (2)

6.10 Name the TWO regions a transistor operates in. (2)

6.11 Explain TWO methods of switching an SCR on. (4)

6.12 Explain the principle of operation of a DIAC. (6)

6.13 Draw a fully labelled symbol of a DIAC. (4)

6.14 Name the advantage of a TRIAC compared to an SCR. (2)
[46]

QUESTION 7: POWER SUPPLIES

7.1 Describe the operation of a half wave rectifier. (3)

7.2 List THREE types of filters. (3)

7.3 Refer to FIGURE 7.3 below and answer the following questions.

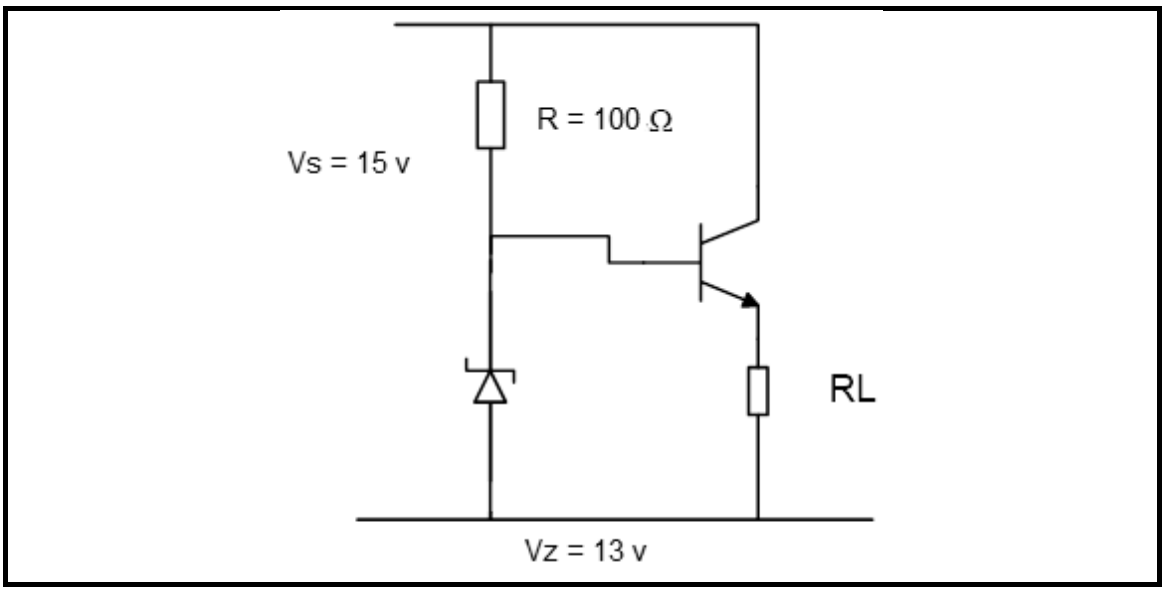

FIGURE 7.3 REGULATOR CIRCUIT

7.3.1 Determine the current flowing through the series resistor (3)

73.2 Calculate the regulated current flowing out of the zener diode (3)

7.3.3 Determine the output load current. (4)

7.4 Draw the block diagram of a series regulator. (4)

[20]

QUESTION 8: SENSORS AND TRANSDUCERS

8.1 Describe the application of a proximity sensor (2)

8.2 Explain the operation of a humidity sensor (3)

8.3 Explain the purpose of a photodiode in an electric circuit. (3)

8.4 Name TWO types of thermistors. (2)

8.5 Define the term *transducer*. (2)

[12]

QUESTION 9: AMPLIFIERS

9.1 Explain the term *feedback*. (2)

9.2 Explain the importance of correct biasing of a transistor when used as an amplifier. (2)

9.3 Refer to FIGURE 9.3 below and answer the following questions.

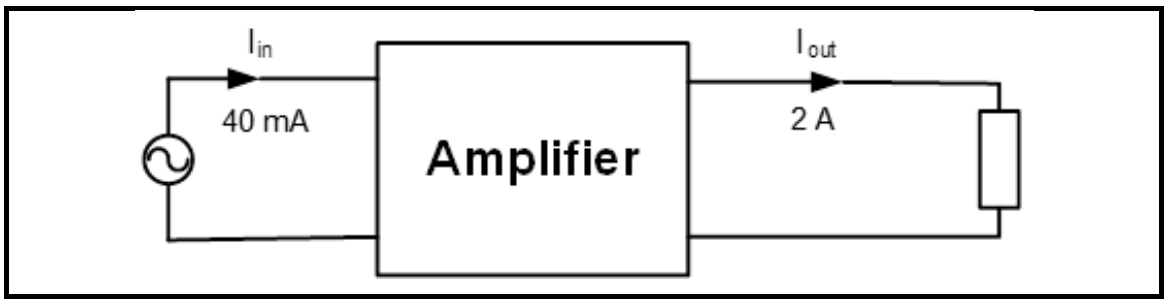

FIGURE 9.3

Calculate the following:

9.3.1 The voltage gain. (3)

9.3.2 The current gain. (2)

9.3.3 Power gain of the circuit. (3)

9.4 Refer to FIGURE 9.4 below and answer the following questions

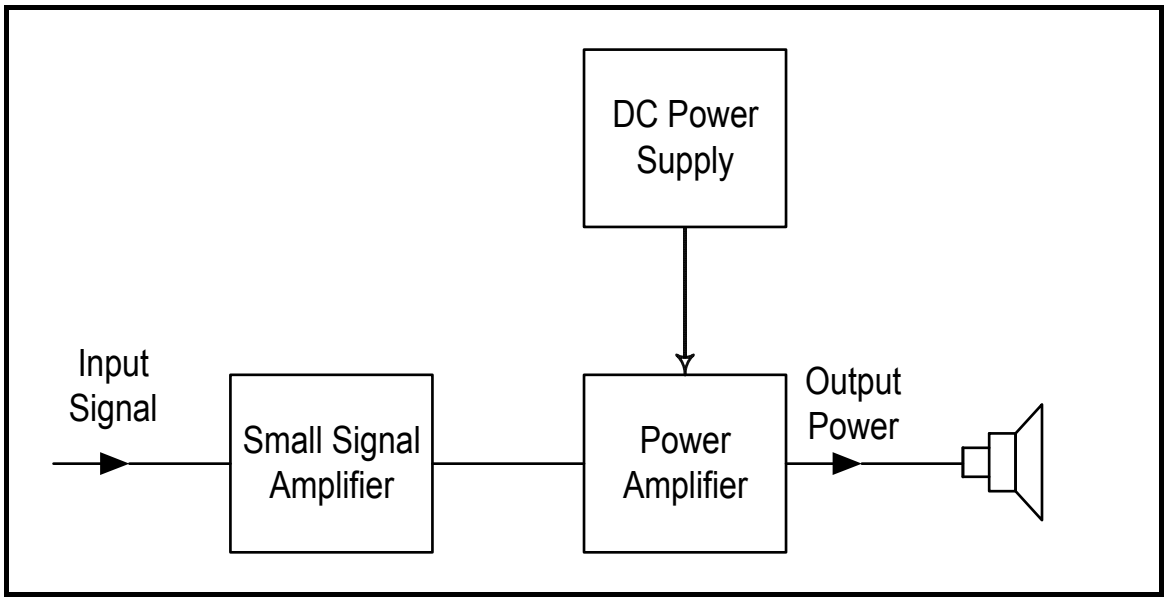

FIGURE 9.4: A BASIC AMPLIFIER

Explain the purpose of:

9.4.1 The voltage amplifier. (3)

9.4.2 Current amplifier. (1)

9.4.3 Power amplifier. (2)

9.5 Draw the circuit diagram of a voltage divider biased amplifier. (4)

9.6 Name THREE transistor operation regions. (3)

9.7 List THREE advantages of positive feedback. (3)

9.8 Draw a fully labelled circuit diagram for fixed based bias with thermal stabilising emitter resistor (4)

[32]

TOTAL: 200

ELECTRICAL TECHNOLOGY

FORMULA SHEET

WAVE FORMS

Frequency

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

Maximum value

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

RMS Value

$$V_{RMS}\ =\ V_{MAX}\ \times 0.707$$

Average value

$$V_{ave}\ =\ V_{max}\ \times 0.637$$

$$E = BlV$$

RLC CIRCUITS

Inductive reactance

$$X_L\ = 2\pi Fl$$

Capacitive reactance

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

Impendance

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

Power factor

$$COS\ \theta = \frac{R}{Z}$$

$$COS\ \theta = \frac{VR}{VZ}$$

POWER SUPPLIES

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

$$V_{OUT}\ = V_Z$$

$$V_{OUT}\ = V_Z - V_{BE}$$

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

AMPLIFIERS

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

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

$$I_C =\ \beta I_B$$

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

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