**NATIONAL
SENIOR CERTIFICATE**

GRADE 11

NOVEMBER 2020

**ELECTRICAL TECHNOLOGY: ELECTRONICS
(EXEMPLAR)**

MARKS: 200

TIME: 3 hours

IELTTE2

This question paper consists of 11 pages, including a 1-page formula sheet.

INSTRUCTIONS AND INFORMATION

1.   This question paper consists of NINE questions.

2.   Sketches and diagrams must be large, neat and fully labelled.

3.   Show ALL calculations and round off answers 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 legible.

QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY

1.1   Name TWO instances where the user is not required to supply an earth to roofs, gutters, downpipes and wastepipes, on a premises to which electrical energy is supplied.   (2)

1.2   Explain how the following environmental factors could impact negatively on a worker in the workshop:

      1.2.1   Lack of space   (1)

      1.2.2   Lighting   (1)

1.3   Describe the term *anthropometrics*.   (2)
                                           [6]

QUESTION 2: TOOLS AND MEASURING INSTRUMENTS

2.1   What is the purpose of a crimping lug?   (1)

2.2   Explain the advantage of a clamp meter over a digital multimeter when measuring current.   (2)

2.3   Why is it important to stand aside to allow the grinder wheel to run up to full speed before using it?   (2)

2.4   Explain the purpose of a time-base generator in an oscilloscope.   (1)
                                           [6]

QUESTION 3: COMMUNICATION SYSTEMS

3.1   Explain the term *resonance*.   (2)

3.2   Name THREE types of oscillators.   (3)

3.3   Explain the purpose of a Wien bridge oscillator.   (6)

3.4   Explain the purpose of a variable frequency oscillator.   (3)

3.5   Name the applications of continuous wave transmitter.   (2)

3.6   Explain the term *demodulation*.   (2)

3.7   Draw a block diagram of an AM receiver.   (6)

3.8   Describe the purpose of frequency shift keying.   (2)
                                         [26]

QUESTION 4: WAVEFORMS

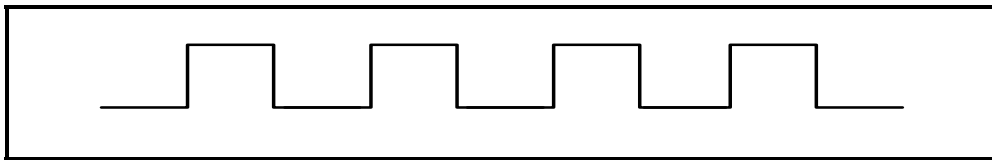4.1   Identify the following waveforms as shown in FIGURES 4.1.1 to 4.1.4.

4.1.1
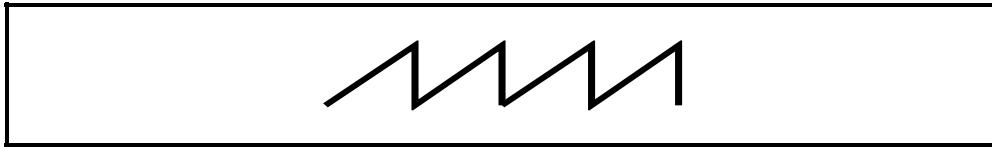
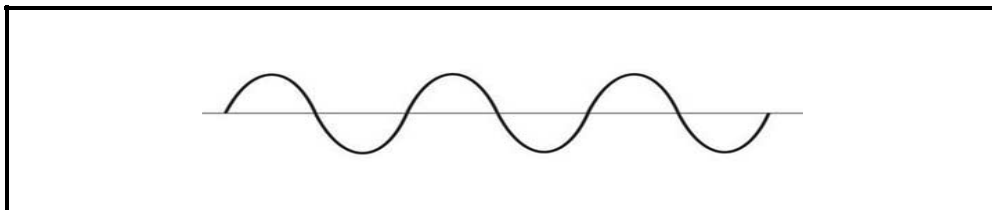**FIGURE 4.1.1**   (1)

4.1.2

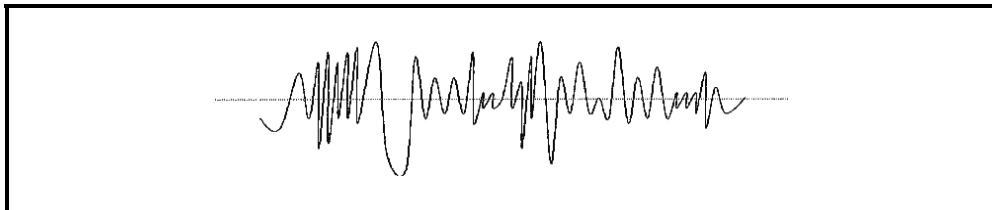**FIGURE 4.1.2**   (1)

4.1.3

FIGURE 4.1.3   (1)

4.1.4

FIGURE 4.1.4   (1)

4.2   Define the term *period* with reference to a wave form.   (3)

4.3   For a digital pulse waveform, explain the following terms:

    4.3.1   Pulse width   (3)

    4.3.2   Fall time   (3)

4.4   An AC supply has an rms voltage of 9 V. Determine its peak voltage.   (3)

4.5   Determine the periodic time of a wave with a frequency of 500 Hz.   (3)

4.6   Describe the concept of *clamping* in electronics.   (4)

4.7   Mention THREE applications of a radio wave.   (3)

[26]

QUESTION 5: RLC-CIRCUITS

5.1   Mention ONE factor that directly affects the capacitive reactance of an AC circuit with RC components.   (1)

5.2   Name TWO methods of finding the combined impedance of a series connected circuit.   (2)

5.3   Draw a neatly labelled graph showing the relationship between the inductive reactance and the frequency in an RLC series circuit.   (3)

5.4   Study FIGURE 5.4 below and answer the questions that follow.
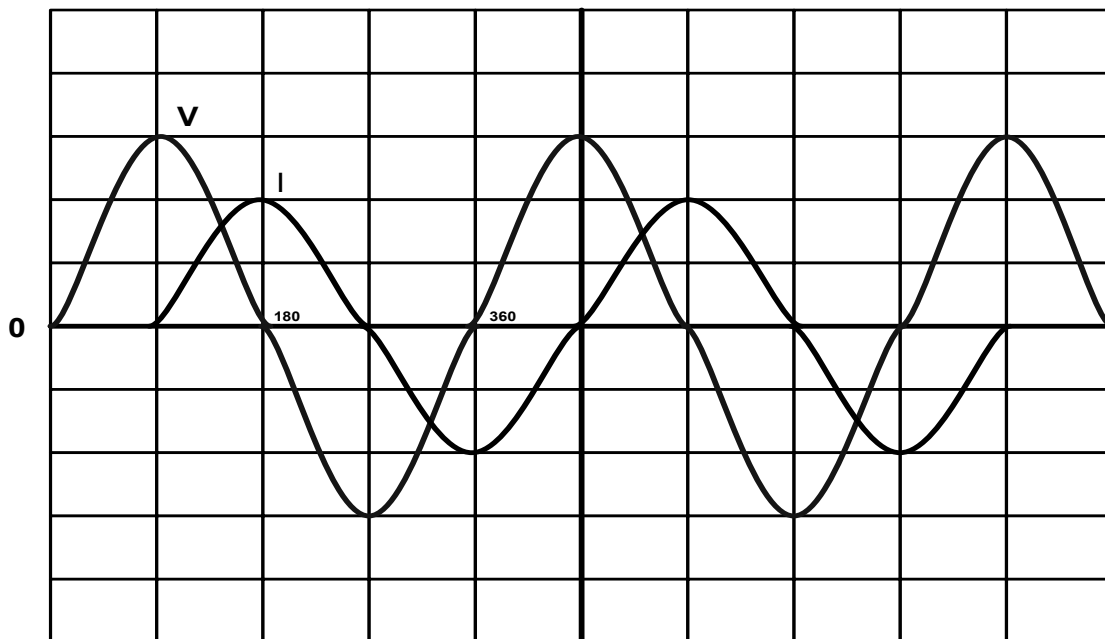
FIGURE 5.4: RL CIRCUIT WAVEFORMS

5.4.1   Describe the relationship between the voltage and the current waveforms.   (1)

5.4.2   Explain how an increase in frequency would affect the current waveform.   (3)

5.5   Refer to the circuit diagram in FIGURE 5.5 and answer the questions that follow.
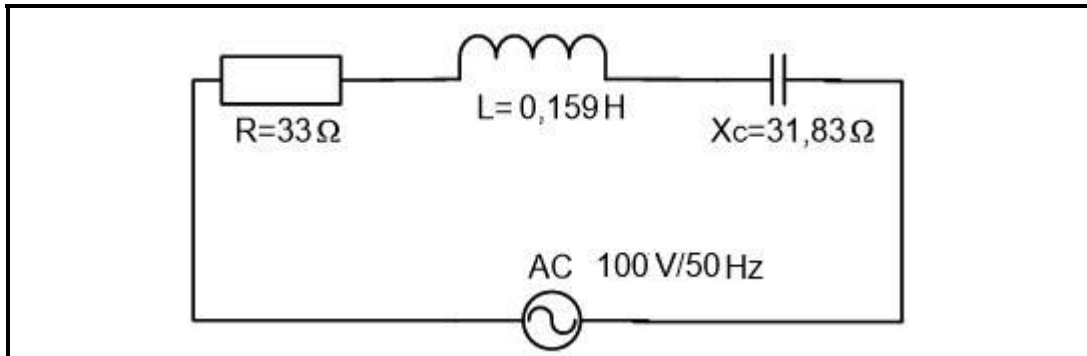
FIGURE 5.5

Given: R = 33 Ω
         L = 0,159 H
         X_C = 31,83 Ω
         V = 100 V
         f = 50 Hz

Calculate:

5.5.1   The inductive reactance of the coil   (3)

5.5.2   The total impedance of the circuit   (3)

5.5.3   The current flowing through the circuit   (3)

5.5.4   The value of the capacitor in the circuit   (3)

5.6   Given a series circuit with a 600 Ω resistor, an inductive reactance of 37,7 Ω and a capacitive reactance of 665 Ω. Describe what occurs to the impedance of a series circuit when it reaches the point of resonance.   (4)

[26]

QUESTION 6: SEMICONDUCTOR DEVICES

6.1 Describe the term *semiconductor*.   (2)

6.2 What is the Q-point of a diode?   (2)

6.3 Briefly explain the term *majority carriers* in a P-type silicon semiconductor. (2)

6.4 Draw a fully labelled characteristic curve of a TRIAC.   (4)

6.5 Semiconductors are mass produced and are often small in physical size. Manufactures supply component data sheets. Answer the following questions with reference to component data sheets.

    6.5.1 State ONE source where such data sheets may be found. (1)

    6.5.2 Working temperature may be displayed on the sheet. Explain why this information is important.   (3)

    6.5.3 Other than working temperature, state TWO types of information given on data sheets.   (2)

6.6 Draw fully labelled circuit symbols of the following:

    6.6.1 SCR   (3)

    6.6.2 TRIAC   (3)

6.7 Explain the difference between *conventional* current flow and *electron* flow. (4)

6.8 Describe the term *solid state*, with reference to semiconductors.   (2)

6.9 Describe how N-type material is formed.   (5)

6.10 How does a zener diode differ from other diodes?   (3)

6.11 For the normal operation of a transistor as a switch, which junction should always be:

    6.11.1 Forward biased?   (2)

    6.11.2 Reverse biased?   (2)

6.12 Briefly explain TWO ways of switching on the SCR.   (4)

6.13 Name any TWO impurities which are added to pure silicon to create P-type material.   (2)

                              [46]

                       Please turn over

QUESTION 7: POWER SUPPLIES

7.1   Explain the purpose of a transformer.   (3)

7.2   Draw a circuit diagram for a half wave rectifier.   (5)

7.3   Draw the block diagram of the series voltage regulator.   (3)

7.4   Refer to the circuit diagram in FIGURE 7.4 below and answer the questions that follow.
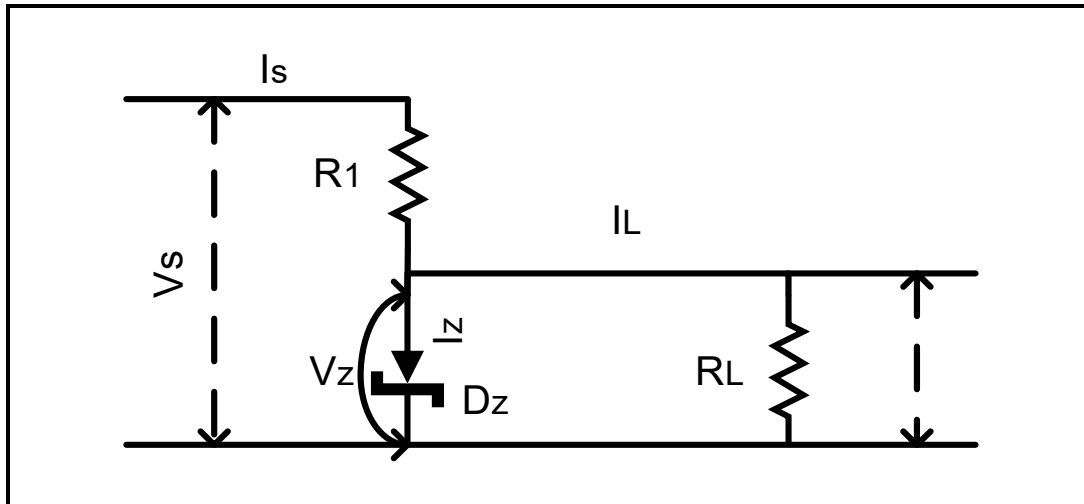
FIGURE 7.4

Given:

P_z = 2 W
V_s = 12 V
V_z = 5 V
R_L = 1 kΩ

Calculate:

7.4.1   The maximum current flowing through the Zener diode (I_z)   (3)

7.4.2   The minimum value of the series resistor, R_s (3)

7.4.3   The load current (I_L) if a load resistor of 1 kΩ is connected across the zener diode   (3)

[20]

QUESTION 8: SENSORS AND TRANSDUCERS

8.1   Define the term '*sensor*' as used in sensors and transducers.   (2)

8.2   Describe the basic operation of a dynamic microphone.   (4)

8.3   List TWO types of humidity sensors.   (2)

8.4   Explain the principle of operation of a *Light Dependant Resistor (LDR).*   (4)
                            [12]

QUESTION 9: AMPLIFIERS

9.1   Describe how class C amplification is obtained.   (2)

9.2   Name ONE use of class AB amplifiers.   (1)

9.3   List THREE common types of transistor configurations.   (3)

9.4   Give TWO types of biasing as used in amplifier design.   (2)

9.5   Refer to FIGURE 9.5 below and answer the questions that follow.
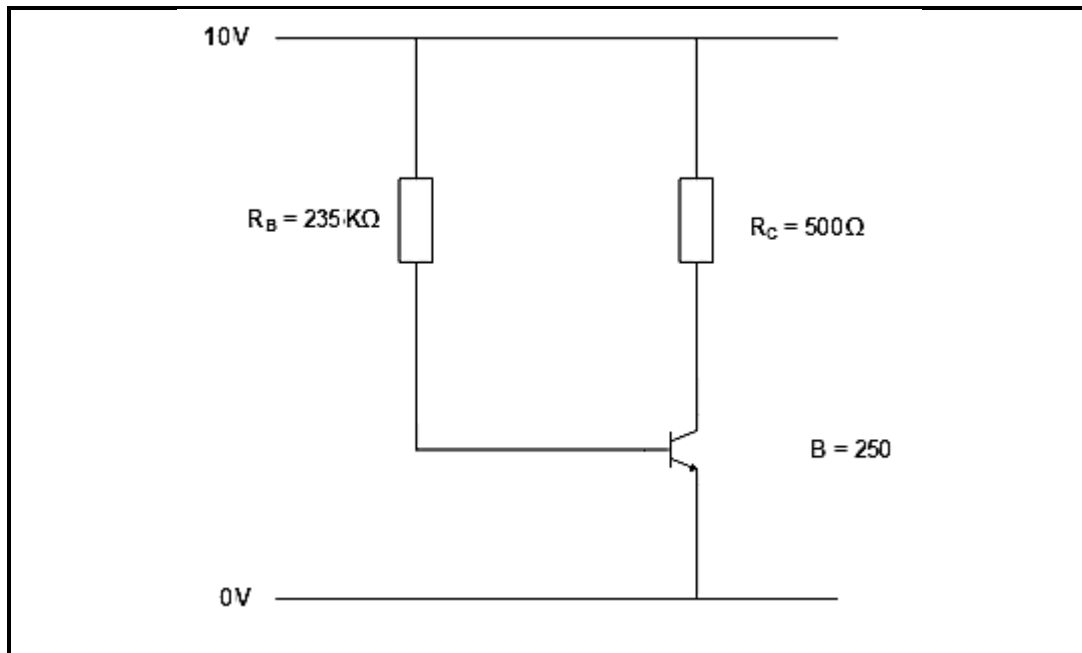
FIGURE 9.5

Calculate:

9.5.1   The quiescent base current   (3)

9.5.2   The quiescent collector current   (3)

9.5.3   The quiescent collector-emitter voltage   (3)

9.6   Name TWO advantages of negative feedback.   (2)

9.7   Draw a block diagram of negative feedback.   (5)

9.8   List THREE types of transistor operation regions.   (3)

9.9   With reference to a basic amplifier. Explain the purpose of following:

9.9.1   The voltage amplifier   (3)

9.9.2   The current amplifier   (2)

                                                              [32]

                                        TOTAL: 200

FORMULA SHEET	
WAVE FORMS	**RLC CIRCUITS**

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

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

POWER SUPPLIES

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

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

$$Vo = V_Z - V_{BE}$$

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

RLC CIRCUITS

Inductive reactance

$$X_L\ =\ 2\pi Fl$$

Capacitive reactance

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

Impendence

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

Power factor

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

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

AMPLIFIERS

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

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

$$I_C\ =\ \beta I_B$$

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

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