GAUTENG DEPARTMENT OF EDUCATION
SENIOR CERTIFICATE EXAMINATION

ELECTRONICS SG

TIME: 3 hours

MARKS: 200

INSTRUCTIONS:

- Answer ALL the questions.
- An approved pocket calculator may be used.
- Answers must be clearly numbered.
- Keep questions and subsections of a question together.
- Sketches and diagrams must be large, neat and labelled.
- A list of formulae, which may be used when applicable, is given on pages 6 to 9 of the question paper.

QUESTION 1
ELECTRIC CURRENT THEORY

1.1 A capacitor of 40 microfarads, an inductor of 0,1 henry and a resistor of 20 ohms are connected in series. An alternating current supply of 100 Volts / 100 hertz is connected to the circuit.

Calculate the:

1.1.1	Inductive reactance	(3)
1.1.2	Capacitive reactance	(3)
1.1.3	Impedance	(4)
1.1.4	Current	(3)
1.1.5	Power factor	(3)
1.1.6	Phase angle	(3)
1.1.7	True power	(3)
1.1.8	Reactive power	(3)
1.1.9	Apparent power	(3)
1.1.10	Voltage drop across each component	(9)

1.2 Determine the Q-factor of the circuit in Question 1.1. (3)

[40]

QUESTION 2
THREE-PHASE ALTERNATING-CURRENT SYSTEMS

2.1 A three-phase 380 V star-connected motor has an output of 50 kW with a power factor of 0,85 and an efficiency of 90%.
Calculate the following:

2.1.1 Current drawn at full load (4)

2.1.2 Apparent power (3)

2.1.3 Phase voltage (3)

2.2 Describe, with the aid of a neat, labelled sketch, how full-wave rectification is obtained in a three-phase AC-system. (10)
[20]

QUESTION 3
SEMICONDUCTORS

3.1 If the base current of a transistor is 20 µA when the emitter current is 6,4 mA, what is the collector current? (3)

3.2 Draw a correctly biased NPN transistor in block form.

Clearly indicate the following:

- Depletion region
- Direction of movement of charge carriers
- The majority carriers
- ALL the biasing voltages and the conventional directions (10)

3.3 Draw a circuit diagram to demonstrate the operation of a silicon controlled rectifier (SCR). (5)
[18]

QUESTION 4
AMPLIFIERS

4.1 Draw a circuit diagram of a complete Resistor-capacitor (RC) coupled amplifier. Clearly label all resistors and capacitors on the circuit. (18)

4.2 Explain the purpose of the following components used in a transistor amplifier circuit:

4.2.1 Coupling capacitor (2)

4.2.2 Emitter bypass capacitor (2)

4.2.3 Emitter resistor (2)

4.3 Sketch a transistor amplifier that makes use of negative feedback. (6)
[30]

QUESTION 5
SWITCHING AND CONTROL CIRCUITS

5.1 Name the TWO methods by which a regulator circuit can be connected to a load. (2)

5.2 Draw an operating circuit of a simple Zener diode regulator. (6)

5.3 Draw a block diagram showing the four stages of a power supply circuit. Clearly label each stage. Include a simple circuit symbol in each block. (10)

5.4 Draw the voltage wave shape that will appear at each stage in Question 5.3. (10)

5.5 In point form, write down the operation of each stage in Question 5.3. (8)

[36]

QUESTION 6
OSCILLATORS

6.1 Draw a neat, labelled circuit diagram of an inductively coupled oscillator. (12)

6.2 Explain briefly the piezo-electrical effect with reference to crystals. (2)

[14]

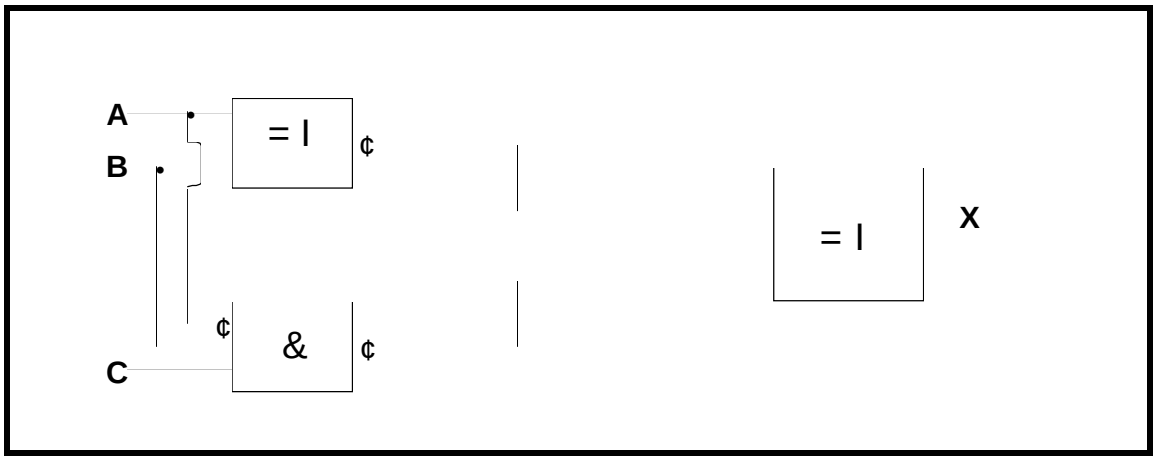
QUESTION 7
COMPUTER PRINCIPLES

7.1 Draw the Boolean equation, truth table and the electrical equivalent circuit of the two inputs OR gate. (10)

7.2 Prove by means of Boolean algebra that:

$AB + BC + AC = BC + AC$ (7)

7.3 Write the Boolean expression for the following circuit diagram: (4)



[21]

QUESTION 8
ELECTRONIC APPARATUS

8.1 Draw a complete block diagram of an oscilloscope showing each main control circuit. (13)

8.2 Explain what is meant by: **Calibrate a scale**. (3)
[16]

QUESTION 9
OCCUPATIONAL SAFETY PRECAUTIONS

9.1 Name THREE rules applicable to the workshop in which you worked this year. (3)

9.2 Explain TWO ways in which Aids can be spread from one person to another. (2)
[5]

TOTAL: 200

INFORMATION SHEET / *INLIGTINGSBLAD*

ELECTRIC CURRENT THEORY / *ELEKTRIESE STROOMTEORIE*

$$I = \frac{V}{R} \text{ AMPS}$$

$$P = V \times I \text{ WATT}$$

$$t = \frac{1}{F} \text{ seconds / } \textit{sekondes}$$

$$V_{ave./\ gem.} = V_m \times 0{,}637$$

$$V_{rms./\ wgk.} = V_m \times 0{,}707$$

STAR / *STER*

$$V_L = \sqrt{3} \times V_P$$

$$I_L = I_P$$

DELTA

$$I_L = \sqrt{3} \times I_P$$

$$V_L = V_P$$

$$X_C = \frac{1}{2 \times p \times F \times C}$$

$$f_r = \frac{1}{2 \times p \times \sqrt{LC}}$$

$X_L = 2 \times p \times F \times L$

$f_r = \frac{1}{2 \times p} \times \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$

$V_T = \sqrt{V_R^2 + V_C^2}$

$Q = \frac{X_L}{R}$

$V_T = \sqrt{V_R^2 + V_L^2}$

$Q = \frac{X_C}{R}$

$V_T = \sqrt{V_R^2 + V_X^2}$

$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$

$V_X = V_L - V_C$

$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$

$V_C = I_T \times X_C$

$V_L = I_T \times X_L$

$V_R = I_T \times R$

$\frac{N_1}{N_2} = \sqrt{\frac{Z_1}{Z_2}}$

$V_T = \sqrt{V_R^2 + V_X^2}$

$V_X = V_C - V_L$

$Z = \sqrt{R^2 + X_C^2}$

$Z = \sqrt{R^2 + X_L^2}$

$I_T = \sqrt{I_R^2 + I_X^2}$

$I_X = I_C - I_L$

$Z = \sqrt{R^2 + X_X^2}$

$X_X = X_L - X_C$

AMPLIFIERS / *VERSTERKERS*

$I_e = I_c + I_b$

$V_{cc} = V_{Rc} + V_{ce}$

$I_c = \frac{V_{cc}}{Rc}$

DECIBEL RATIOS / *DESIBEL VERHOUDINGS*

$$G_I = 20 \text{LOG} \frac{I_2}{I_1}$$

$$G_V = 20 \text{LOG} \frac{V_2}{V_1}$$

$$G_P = 10 \text{LOG} \frac{P_2}{P_1}$$

OPERATIONAL AMPLIFIERS / *OPERASIONELE VERSTERKERS*

$$A_V = -\frac{R_F}{R_1}$$

$$V_{OUT} = A_V \times V_I$$

$$A_V = 1 + \frac{R_F}{R_1}$$

$$V_{OUT} = A_V \times V_I$$

$$V_{OUT} = \frac{1}{RC} \int V_1 \, dt$$

$$V_{OUT} = -RC \frac{dv}{dt}$$

$$V_{OUT} = -\left(V_1 \frac{R_F}{R_1} + V_2 \frac{R_F}{R_2} + V_3 \frac{R_F}{R_3}\right)$$

COMPUTER PRINCIPLES / *REKE NAARBEGI NSE LS*

$$A.B = B.A$$
$$A + B = B + A$$

$$A.(B.C) = (A.B).C$$
$$A + (B + C) = (A + B) + C$$

$$A.(B + C) = AB + AC$$
$$A + (B.C) = (A + B) + (A + C)$$

$$A(A + B) = A$$
$$A + (AB) = A$$

$$A + 0 = A$$
$$A + 1 = 1$$
$$A.0 = 0$$
$$A.1 = A$$
$$A + A = A$$
$$A + A = 1$$
$$A.A = A$$
$$A.A = 0$$

END / *EINDE*