GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

TECHNIKA (ELEKTRONICS) SG

TIME: **3 hours**

MARKS: **200**

INSTRUCTIONS:

- Answer ALL the questions.
- All calculations must be shown.
- An approved pocket calculator may be used.
- Answers must be clearly numbered.
- Sketches and diagrams must be large, neat and labelled.
- Handwriting must be neat and legible.
- A formula sheet is provided at the end of the paper.

QUESTION 1

ELECTRIC CURRENT THEORY

1.1 An alternating current circuit consists of a coil with an inductance of 10 µH and an internal resistance of 0,2 Ohm which is coupled in parallel with a 10 pF capacitor. The supply voltage is 5 Volt. Sketch the circuit diagram and indicate all values. (4)

1.2 Refer to the circuit in Question 1.1 and calculate the following:

1.2.1 Resonant frequency (3)

1.2.2 Supply current at resonance (3)

1.2.3 Q factor of the circuit (3)

1.2.4 Current in the coil (9)

1.2.5 Current in the capacitor (6)

1.3 A series circuit has a coil with a resistance of 6 Ohms and inductance of 35 mH, as well as a capacitor. The circuit is supplied by a 3,5 Volt supply and resonates at 200 Hz. Calculate the following:

1.3.1 Inductive reactance (3)

1.3.2 Value of the capacitor (4)

1.3.3 Circuit impedance (2)

1.3.4 Total current at resonance (3)
[40]

QUESTION 2

SEMICONDUCTOR DEVICES

2.1 Name FOUR requirements necessary for an SCR to function correctly. (8)

2.2 Write down the standard colour code you would use to determine the value and tolerance of any resistor. (12)

2.3 State FOUR characteristics for each of the following amplifiers:

2.3.1 Common emitter amplifier (4)

2.3.2 Common base amplifier (4)

2.3.3 Common collector amplifier (4)

2.4 Sketch a neat, labelled diagram to indicate how to obtain 180 degree phase control over the speed of a motor. (7)

2.5 Sketch a neat, labelled characteristic curve of a silicon controlled rectifier (SCR). (8)
[47]

QUESTION 3

AMPLIFIERS

3.1 The push-pull amplifier is classed as a Class B amplifier, and is used in the final stage of power amplification in sound systems. Sketch a fully labelled circuit diagram for this amplifier, and explain its operation for the positive and negative half cycles of an input wave. All relevant waveforms must be shown. (20)

3.2 Sketch the output characteristic curve for a transistor and show the quiescent point (Q point) for it if it has been biased as a class B amplifier. The input and output signals, as well as the cut-off and saturation regions must be indicated. (10)
[30]

QUESTION 4

SWITCHING AND CONTROL CIRCUITS

4.1 a A practical power supply can be designed to convert 220 V AC supply voltage to desired DC voltage. Design a simple 30 volt dc power supply circuit. Your circuit should include a step-down transformer, a diode rectifier circuit, a filter circuit and a Zener diode as a protection device to external circuits. All the relevant waveforms should be indicated. (A diagram of the circuit is required.) **[16]**

QUESTION 5

COMPUTER PRINCIPLES

5.1 Explain with the aid of a neat, labelled circuit diagram and brief discussion the basic operating principle of an oscillator circuit. (9)

5.2 Name TWO applications of oscillator circuits. (2)
[11]

QUESTION 6

INFORMATION TRANSFER

6.1 Computers consist of large numbers of logic gates and memory elements organised to process data at high speed. To identify these logic circuits it is important to know their symbols. SKETCH the symbols and INDICATE the truth tables of the following gates:

6.1.1 AND Gate (6)

6.1.2 NOR Gate (6)

6.2 Indicate the Boolean Expression for the combination circuit in **Figure 6.1**. Write only the answer in your answer book. (5)

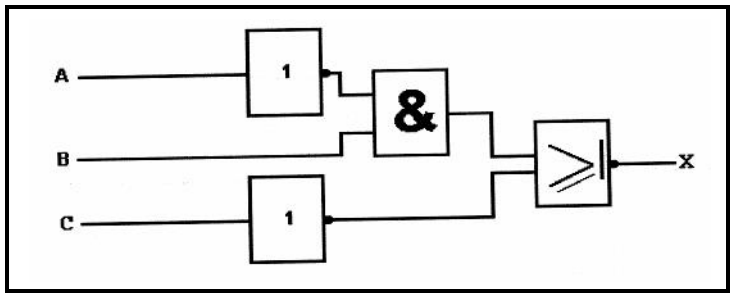


Figure 6.1
Combination diagram of logic gates

6.3 Sketch a combination circuit of logic gates to satisfy the following Boolean expression:

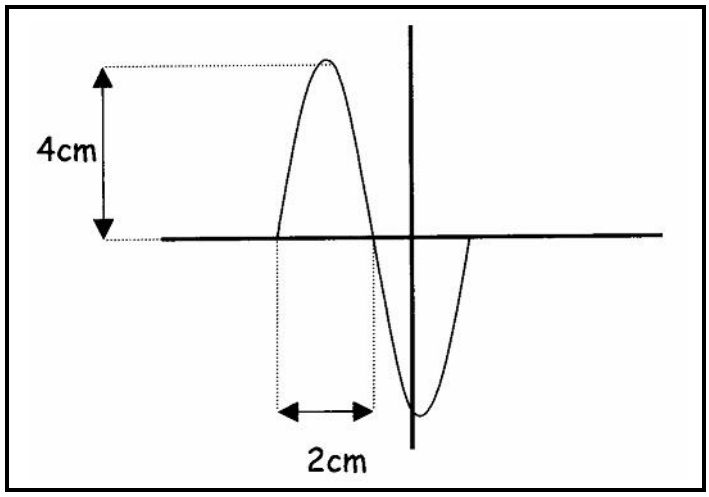
$X = (\overline{A + B}) + (C\overline{D})$ (5)

[22]

QUESTION 7

MEASURING INSTRUMENTS

7.1 The following signal is presented on an oscilloscope:



If the amplitude attenuator is set on 2 V/cm and the horizontal sweep generator is set on 1 µs/cm, determine the

7.1.1 frequency of the wave. (3)

7.1.2 amplitude of the wave. (3)

7.1.3 peak value of the wave. (3)

7.1.4 RMS value of the wave. (3)

7.1.5 average value of the wave. (3)

[15]

QUESTION 8

SAFETY PRECAUTIONS

8.1 State if the following is TRUE or FALSE. Write the question number and the word (TRUE or FALSE) in your answer book.

8.1.1 It is safe to wear loose hanging clothes in a workshop. (2)

8.1.2 You must always work fast in a workshop. (2)

8.1.3 You are allowed to play in a workshop, if your work is done. (2)

8.1.4 The Aids virus can be transmitted via the blood of a person who is HIV positive. (2)

8.1.5 You can contract Aids by using the same tools that were used by an HIV positive person. (2)

8.1.6 Electrical cords do not have to be inspected regularly. (2)

8.2 A person gets a cut wound in the workshop. Which precautions will you take if you had to treat this person. Keep in mind this person might have Aids. (4)

8.3 Explain how Aids can be transmitted from one person to another person. (3)

[19]

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

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

$$V_L = V_P$$

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

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

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

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

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

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

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

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

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

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

$$V_X = V_L - V_C$$

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

$V_C = I_T \times X_C$

$V_L = I_T \times X_L$

$V_R = I_T \times R$

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

$V_X = V_C \simeq V_L$

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

$I_X = I_C \simeq I_L$

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

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

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

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

$X_X = X_L \simeq X_C$

AMPLIFIERS / *VERSTERKERS*

$I_c + I_b$

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

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

DECIBEL RATIOS / *DESIBELVERHOUDINGS*

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

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

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

OPERATIONAL AMPLIFIERS / *OPERASIONELE VERSTERKERS*

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

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

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

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

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

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

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

COMPUTER PRINCIPLES / *REKENAARBEGINSELS*

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

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

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

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

$A + 0 = A$
$A + 1 = 1$
$A.0 = 0$
$A.1 = A$
$A + \underline{A} = A$
$A + \overline{A} = 1$
$A.\underline{A} = A$
$A.\overline{A} = 0$

END / EINDE