GAUTENG DEPARTMENT OF EDUCATION
SENIOR CERTIFICATE EXAMINATION

TECHNIKA (ELECTRONICS) SG

TIME: 3 hours

OCTOBER / NOVEMBER 2005
OKTOBER / NOVEMBER 2005

MARKS: 200

INSTRUCTIONS:

- Answer ALL the questions.
- Sketches and diagrams must be large, neat and labelled.
- An approved calculator may be used.
- All calculations must be shown.
- Answers must be clearly numbered in accordance with the question paper.
- An information sheet is provided at the end of the paper.

QUESTION 1
ELECTRIC CURRENT THEORY

1.1 Calculate, with reference to the circuit diagram in **Figure 1**, the

1.1.1 **capacitance** of the capacitor. (4)
1.1.2 **inductance** of the inductor. (4)
1.1.3 **total current** through the circuit. (7)
1.1.4 **voltage drop** across each component. (9)
1.1.5 power factor and phase angle of the circuit. (You need to sketch a fully labelled impedance triangle to support your answer.) (10)

1.2 Explain, by means of a fully labelled phasor diagram, the **voltage relationship** of the circuit in **Figure 1**. (6)

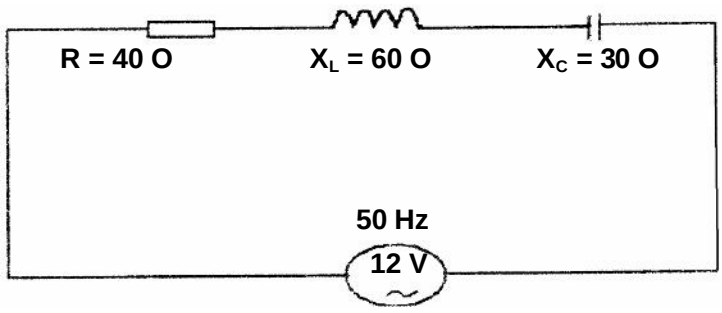


Figure 1
RLC Circuit

[40]

QUESTION 2
SEMICONDUCTOR DEVICES

2.1 Identify the following electronic components with reference to the electronic circuit diagram in **Figure 2**. For example: R3 is a 10 000 ohm resistor.

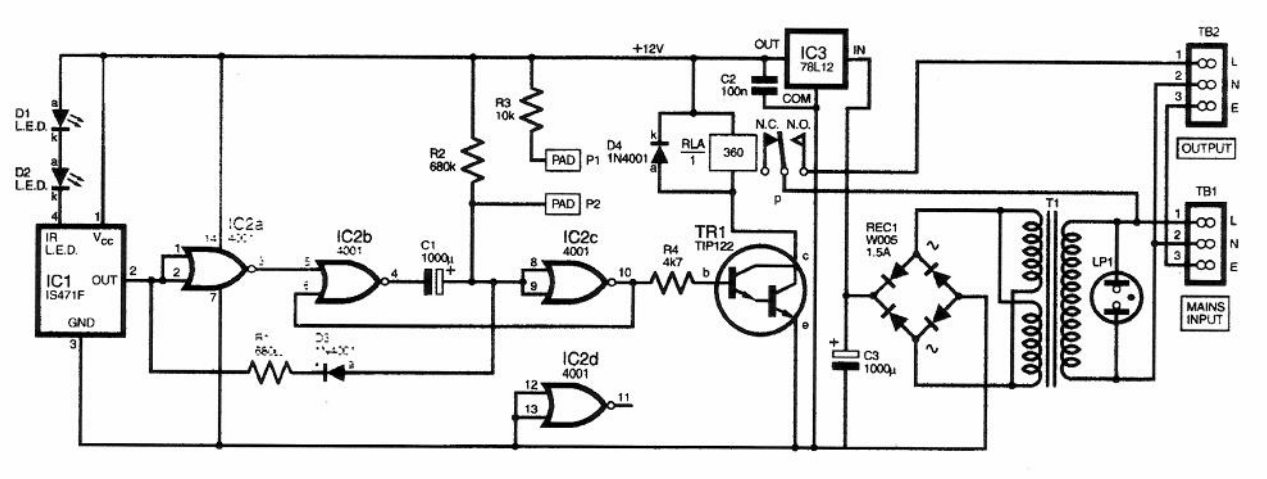


Figure 2

2.1.1 D 4 (2)
2.1.2 TR 1 (3)
2.1.3 REC 1 (1)
2.1.4 IC2B (2)
2.1.5 C 1 (2)

2.2 Explain briefly how you would test a transistor by using an analogue multimeter (Draw the necessary diagrams). (10)

2.3 Draw neat, labelled sketches to show the basic composition of the **unijunction transistor** (UJT). Also explain the basic working principle of the device. (Show the IV characteristics.) (12)

2.4 Name TWO practical uses of an **unijunction transistor** (UJT). (2)
[34]

QUESTION 3
AMPLIFIERS

3.1 Transistors are connected in different stages in amplifiers. The reason for this is to get the needed amplification. Explain with the aid of a neat, labelled diagram and a brief description the operating principle of the **balanced amplifier** or the **radio frequency amplifier**. Choose ONE. (20)

3.2 Determine, by means of calculations and a neat, labelled sketch, the load line for the circuit shown in **Figure 3**. (10)

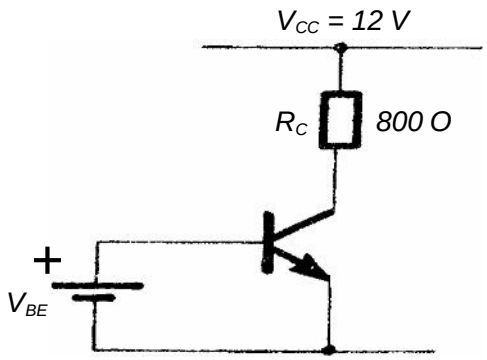


Figure 3
Common Emitter Amplifier

3.3 Draw a labelled frequency response curve for each of the following circuits:

3.3.1 Direct-coupled amplifier (3)
3.3.2 RC-coupled amplifier (5)
3.3.3 Transformer-coupled amplifier (5)
[43]

QUESTION 4
SWITCHING AND CONTROL CIRCUITS

4.1 Draw a simple transistor **series voltage-regulator circuit**. (5)

4.2 Draw a simple sketch of a **bi-stable multivibrator** that makes use of an **operational amplifier**. (10)

4.3 Draw a neat, labelled sketch to indicate how speed control can be obtained in a DC motor by using a thyristor. (8)
[23]

QUESTION 5
COMPUTER PRINCIPLES

5.1 Answer the following questions for EACH of the gates in Question 5.1.1 – 5.1.4.

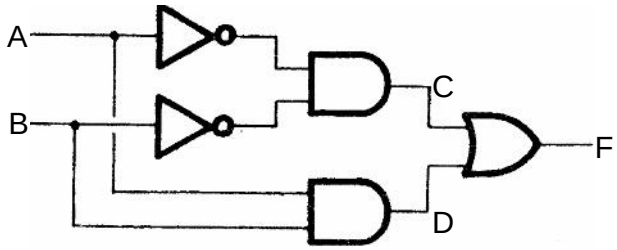
(a) Draw the **logic symbol**
(b) Write the **Boolean equation** for each gate.
(c) Draw the **truth table** for each by using binary 0's and 1's.

5.1.1 **NAD** gate (5)
5.1.2 **NOR** gate (5)
5.1.3 **AND** gate (5)
5.1.4 **OR** gate (5)

5.2 Answer the following questions for EACH of the circuits in Question 5.2.1 and 5.2.2.

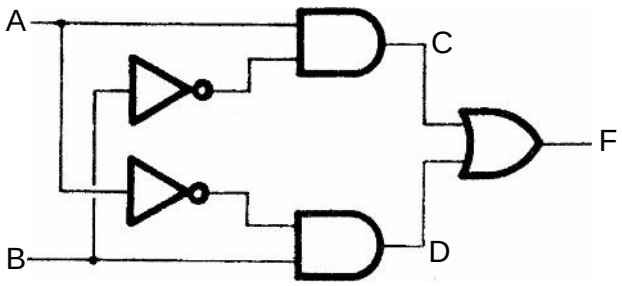
(a) Write down the **Boolean expression** for the input.
(b) Create a **truth table** to explain the equation.

5.2.1



(8)

5.2.2



(8)
[36]

QUESTION 6
INFORMATION TRANSFER

6.1 Draw a simple block diagram of an FM-radio transmitter. (7)

[7]

QUESTION 7
SAFETY PRECAUTIONS

7.1 State FOUR safety precautions that must be taken when working with an oscilloscope? (4)

7.2 Explain in THREE steps how you would act when somebody in the workshop sustained an injury and the wound is bleeding. (3)

7.3 Integrated circuits are very sensitive components. State THREE precautions that you would take when working with these components. (3)

7.4 State THREE safety precautions you would take before switching on the supply to a newly completed electrical project. (3)

7.5 Name FOUR safety measures that you would implement as workshop manager to guarantee the safety of the workers. (4)

[17]

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*

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

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

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

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

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

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

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

COMPUTER PRINCIPLES / *REKENAARBEGINSELS*

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

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

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

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

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

END / *EINDE*