GAUTENG DEPARTMENT OF EDUCATION
SENIOR CERTIFICATE EXAMINATION

FEB / MAR 2006

TECHNIKA (ELECTRONICS) SG

TIME: 3 hours

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 Study the parallel circuit in **Figure 1** and calculate the following:

1.1.1 The reactance of each component (4)
1.1.2 The current which will flow through each branch (6)
1.1.3 The total supply current (3)
1.1.4 The total circuit impedance (3)

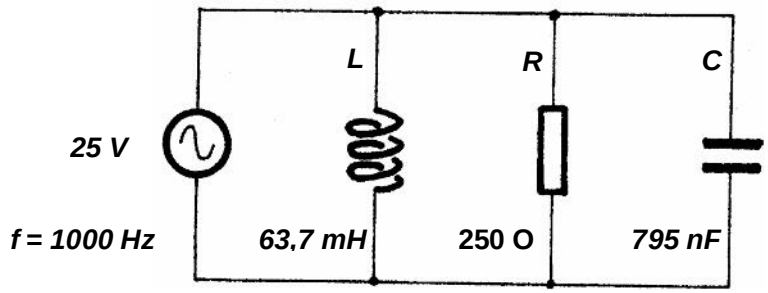


Figure 1
RLC Circuit

1.2 A series RLC-tuned circuit has a resonant frequency of 95 MHz and a bandwidth of 200 kHz. If the capacitor is a 2,5 pF and the wire used to wind the coil has zero resistance, calculate the

1.2.1 Q-factor of the circuit. (3)
1.2.2 size of the necessary coil. (5)
1.2.3 resistance of the circuit. (3)
[27]

QUESTION 2
SEMICONDUCTOR DEVICES

2.1 The "Darlington pair" transistor is a widely implemented device in power electronics such as car amplifiers and Hi-Fi systems. Explain, by means of a neat, labelled sketch and a brief description, the basic construction and functional operation of a Darlington transistor (Darlington pair). (12)

2.2 With the aid of sketches and a brief explanation, describe any project you did this year regarding semiconductor devices. (10)

2.3 Using your knowledge of semiconductors, draw the circuit symbol for each of the following:

2.3.1 NPN-transistor (2)
2.3.2 FET-transistor (2)
2.3.3 SCR (Silicon-controlled rectifier) (2)
2.3.4 UJT transistor (2)
[30]

QUESTION 3
AMPLIFIERS

3.1 Transistors are connected in different stages in amplifiers to get the necessary amplification. Explain with the aid of a neat, labelled sketch and a brief description the working principle of the **balanced coupled amplifier** OR the **resistor-capacitor coupled amplifier**. (20)

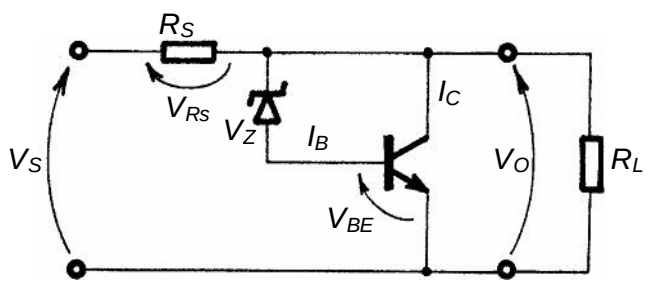
3.2 Show, by means of neatly labelled **graphs**, the difference between the **Class B** and **Class C amplifiers**. The position of the static working point (the Q- point) and all in- and output wave forms must be shown on each graph. (10)

3.3 Explain briefly what is understood by **bandwidth** with regards to amplifiers. (4)
[34]

QUESTION 4
SWITCHING AND CONTROL CIRCUITS

4.1 Identify the following circuits and write brief notes to explain the working principle of each:

4.1.1



(6)

Figure 2

4.1.2

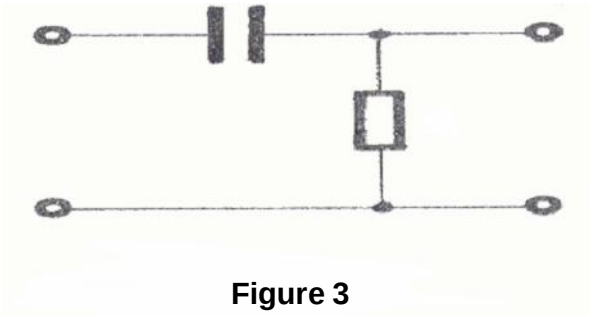


Figure 3

(6)

4.1.3

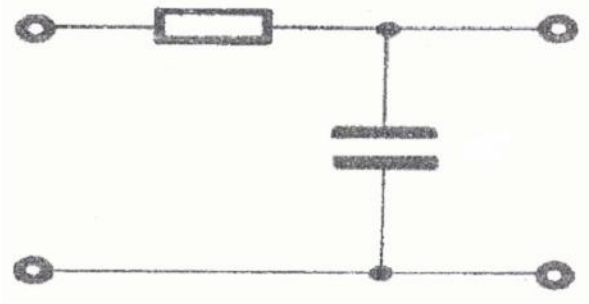
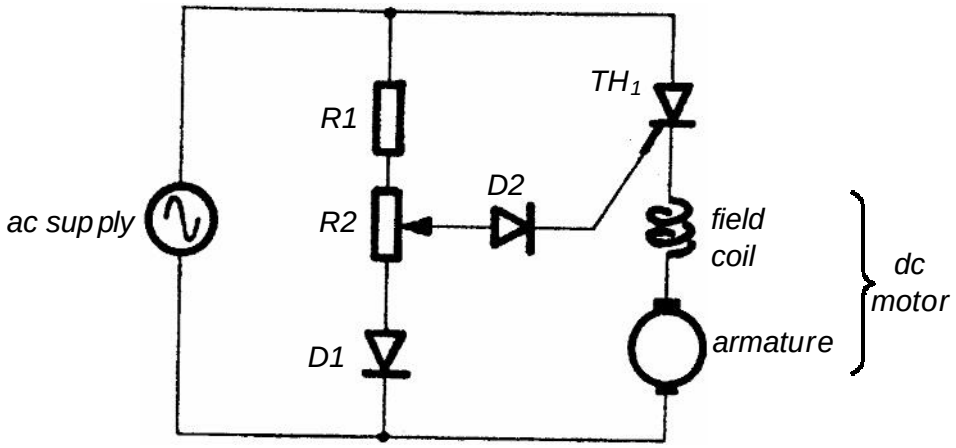


Figure 4

(6)

4.1.4



(6)

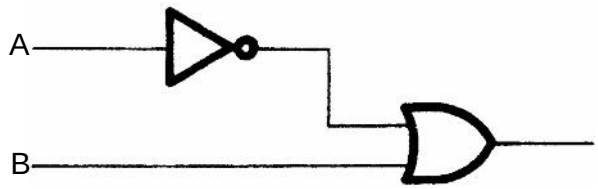
Figure 5 **[24]**

QUESTION 5
COMPUTER PRINCIPLES

5.1 For each of the following circuits (5.1.1 – 5.1.4):

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

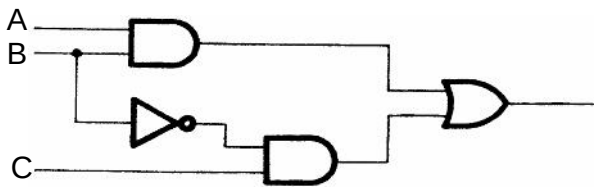
5.1.1



(7)

Figure 6

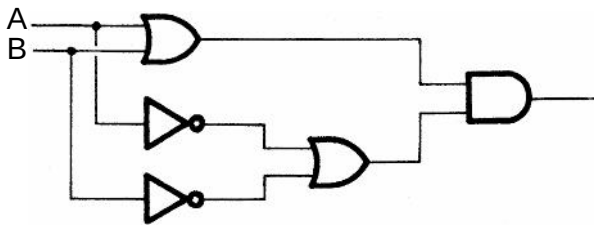
5.1.2



(13)

Figure 7

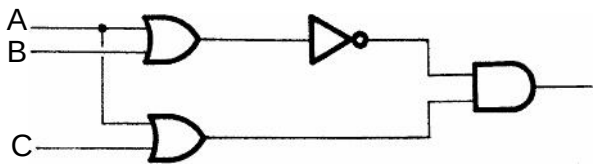
5.1.3



(13)

Figure 8

5.1.4



(10)

Figure 9

[43]

QUESTION 6
MEASURING INSTRUMENTS

6.1 Draw a neat, labelled block diagram to explain the working principle of an oscilloscope. (15)

6.2 State THREE uses of a multimeter. (3)

6.3 Draw a neat, labelled block diagram explaining the working principle of a digital multimeter. (6)

[24]

QUESTION 7
SAFETY PRECAUTIONS

7.1 What is the difference between an **unsafe act** and an **unsafe condition**? (3)

7.2 State FOUR unsafe acts. (4)

7.3 State FOUR unsafe conditions. (4)

7.4 Why should direct pressure be applied to a gushing wound? (5)

7.5 State TWO safety measures, which must be adhered to when working with a multimeter. (2)

[18]

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*

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

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

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

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

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

END / *EINDE*