GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

ELECTRONICS SG

FEB / MAR 2006

TIME: 3 hours

MARKS: 200

INSTRUCTIONS:

- Answer ALL the questions.
- Sketches and diagrams must be large, neat and labelled.
- All calculations must be shown.
- Answers must be clearly numbered.
- An approved pocket calculator may be used.
- An information sheet may be found on pages 6 to 9.

QUESTION 1
ELECTRICAL CURRENT THEORY

1.1 A 240 V/50 Hz supply is connected to a series circuit. The series circuit has a pure resistance of 12 ohm, an inductance of 175 mH and a capacitance of 75 microfarad.

Calculate

1.1.1	the inductive reactance.	(3)
1.1.2	the capacitive reactance.	(3)
1.1.3	the impedance of the circuit.	(3)
1.1.4	the current flow in the circuit.	(3)
1.1.5	the phase angle.	(3)
1.1.6	the total power developed.	(3)

1.2 A circuit comprises a non-inductive resistor of 45 ohm, an inductor of 0,3 henry and a capacitor of 150 micro-farad, all connected in parallel across a 250 V/50 Hz supply.

Calculate

1.2.1 the current through each component. (15)
1.2.2 the total current. (3)
1.2.3 the dynamic impedance. (3)
1.2.4 the phase angle. (3)
1.2.5 the Q factor. (3)

1.3 Draw a phasor diagram (not to scale, but in proportion). (7)
[52]

QUESTION 2
THREE-PHASE ALTERNATING-CURRENT SYSTEMS

2.1 Three pure resistances of 50 ohm each are connected in star to a 380 volt three-phase supply.

Calculate

2.1.1 the phase voltage. (3)
2.1.2 the phase current. (3)
2.1.3 the line current. (1)

2.2 Three pure resistances of 50 ohm each are connected in delta to a 380 volt three-phase supply.

Calculate

2.2.1 the phase voltage. (1)
2.2.2 the phase current. (3)
2.2.3 the line current. (3)
[14]

QUESTION 3
SEMICONDUCTORS

3.1 Draw a neat, labelled circuit diagram of a transistor which is connected in the common-base configuration. Input and output waveforms must be shown. State the properties of the transistor when connected in this configuration. (10)

3.2 Show by means of a neatly labelled circuit how an SCR is connected to an alternating-current supply. Draw the output wave over the load and over the SCR in good relation to the trigger pulse. (8)

3.3 Briefly describe the difference in operation of PNP and NPN transistors. (6)
[24]

QUESTION 4
AMPLIFIERS

4.1 Draw a neatly labelled diagram of an RC-coupled amplifier. (17)

4.2 Sketch a neatly labelled curve of a load line for a common-emitter amplifier. Show all calculations. The following data is given:

Load resistance	=	3 kO
Supply voltage	=	15 volts

(11)
[28]

QUESTION 5
SWITCHING AND CONTROL CIRCUITS

5.1 Explain with the aid of a neatly labelled circuit diagram and a brief description how the speed of a DC motor can be controlled by using thyristors. (10)

5.2 Draw a neatly labelled circuit diagram of a bistable multivibrator. (10)

5.3 Explain by means of a diagram and waveforms how a 6 volt peak-to-peak wave is clamped to a positive DC level. (8)
[28]

QUESTION 6
OSCILLATORS

Explain, with the aid of a neatly labelled circuit diagram, the operating principle of the crystal-controlled oscillator. **[10]**

QUESTION 7
COMPUTER PRINCIPLES

7.1 Sketch the symbol and indicate the truth table of the OR gate. (7)

7.2 Design a NOR-gate network for the following Boolean expression:

$X = (A+\overline{B})(C+D)$ (6)

7.3 Prove by means of Boolean algebra that:

$(X+Y)(X+Z) = X + YZ$ (6)

7.4 Design a combination circuit of logic gates to satisfy the following Boolean expression:

$X = \overline{AB} + CD.EF$ (7)

7.5 Give the Boolean expression for the combination circuit in **Figure 7.5**. Write only the **answer** in your **answer book**. (6)

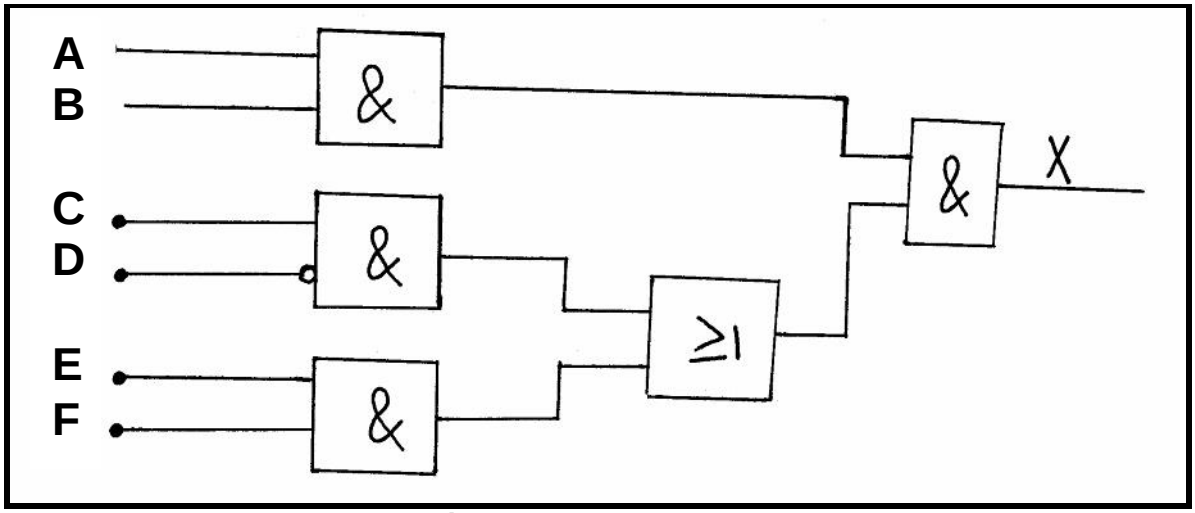

Figure 7.5

[32]

QUESTION 8
ELECTRONIC DEVICES

Sketch a neatly labelled block diagram of an FM transmitter. **[7]**

QUESTION 9
SAFETY PRECAUTIONS

9.1 Explain what safety precautions you would institute in your workshop to prevent the spread of Aids. (2)

9.2 List THREE dangerous actions in the workshop. (3)
[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

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

$$V_L = V_P$$

$$X_C = \frac{1}{2 \times p \times F \times C} \qquad f_r = \frac{1}{2 \times p \times \sqrt{LC}}$$

$X_L = 2 \times p \times F \times L$	$f_r = \frac{1}{2 \times p} \times \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$
$V_T = \sqrt{V_R^2 + V_C^2}$	$Q = \frac{X_L}{R}$
$V_T = \sqrt{V_R^2 + V_L^2}$	$Q = \frac{X_C}{R}$
$V_T = \sqrt{V_R^2 + V_X^2}$	$Q = \frac{1}{R}\sqrt{\frac{L}{C}}$
$V_X = V_L - V_C$	$\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$
$V_C = I_T \times X_C$	
$V_L = I_T \times X_L$	$\frac{N_1}{N_2} = \sqrt{\frac{Z_1}{Z_2}}$
$V_R = I_T \times R$	

MEASURING INSTRUMENTS / *MEETINSTRUMENTE*

$V_T = \sqrt{V_R^2 + V_X^2}$	$Z = \sqrt{R^2 + X_C^2}$
$V_X = V_C - V_L$	$Z = \sqrt{R^2 + X_L^2}$
$I_T = \sqrt{I_R^2 + I_X^2}$	$Z = \sqrt{R^2 + X_X^2}$
$I_X = I_C - I_L$	$X_X = X_L - X_C$

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*

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

$$V_{OUT} = A_V \text{ x } V_I$$

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

$$V_{OUT} = A_V \text{ x } V_I$$

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

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

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

COMPUTER PRINCIPLES / *REKE NAARBEGI NSE LS*

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

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

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

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

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

END/*EINDE*

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END/*EINDE*