SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

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ELECTRONICS

ELEKTRONIKA

SG 704-2/0

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ELECTRONICS SG

704 2 0 SG

GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIORSERTIFIKAAT-EKSAMEN

ELEKTRONIKA SG

TYD: 3 uur

PUNTE: 200

INSTRUKSIES:

- Beantwoord AL die vrae.
- 'n Goedgekeurde sakrekenaar mag gebruik word.
- Sketse en diagramme moet groot, netjies en benoem wees.
- Formules en berekenings moet, waar van toepassing, getoon word.
- 'n Lys formules word op die laaste bladsy van die vraestel verskaf.

VRAAG 1
ELEKTRIESE STROOMTEORIE

1.1 'n Seriekring met 'n 200 μF-kapasitor en 'n 100 mH-spoel met interne weerstand van 100 Ω is verbind aan 'n 24V/50Hz-toevoer.

Bereken die volgende:

1.1.1 Die reaktansie van elke komponent (6)
1.1.2 Die kringimpedansie (4)
1.1.3 Die totale stroom (3)
1.1.4 Die spanningsval oor elke komponent (9)

1.2 Teken 'n netjies benoemde fasordiagram. (6)

1.3 Bereken die resonante frekwensie van 'n stroomkring met:

L=5 mH en C=24 μF (6)

1.4 Noem VIER toestande waaronder serie-resonasie plaasvind. (4)

1.5 Noem TWEE toepassings van die RLC-kring in die praktyk. (2)

[40]

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.
- Sketches and diagrams must be large, neat and labelled.
- Formulae and calculations must, where applicable, be indicated.
- A list of formulae, which may be used when applicable, is given on the last page of the question paper.

QUESTION 1
ELECTRICAL CURRENT THEORY

1.1 A series circuit with a 200μF capacitor and a 100 mH coil with an internal resistance of 100 Ω is coupled across a 24V/50HZ supply.

Calculate:

1.1.1 The reactance of each component (6)
1.1.2 The circuit impedance (4)
1.1.3 The total current (3)
1.1.4 The voltage drop across each component (9)

1.2 Draw a neatly labelled phasor diagram. (6)

1.3 Calculate the resonant frequency of a circuit with:

L=5 mH and C=24 μF (6)

1.4 Name FOUR conditions at which series resonance occurs. (4)

1.5 Name TWO applications of RLC circuits in practice. (2)
[40]

VRAAG 2
DRIEFASIGE WISSELSTROOMSTELSELS

2.1 Wat is die fasevolgorde van 'n driefasige, driedraad-wisselstroomtoevoer? (3)

2.2 Die lynspanning van 'n sterverbinde generator dui 400 volt op 'n WS-voltmeter aan, en 'n lynstroom van 30 ampère word met 'n WS-ammeter waargeneem.

2.2.1 Bereken die fasespanning van die stelsel. (4)
2.2.2 Bereken die fasestroom van die stelsel. (2)

2.3 Beskryf aan die hand van 'n netjies benoemde skets hoe halfgolf-gelykrigting in 'n driefasige wisselstroomstelsel verkry word. (6)
[15]

VRAAG 3
HALFGELEIERS

3.1 Indien die emitterstroom in 'n transistor 12,45 mA is en die kollektorstroom 12,4 mA is, wat is die basisstroom? (3)

3.2 Teken die kenkromme van 'n Zenerdiode wat die volgende duidelik aantoon:

3.2.1 Die Zenerstortspanning (2)
3.2.2 Die meevoorspanningsgebied (2)
3.2.3 Die grootte van die teenlekstroom (2)
3.2.4 Die teengeleiding-gebied (2)

3.3 Verduidelik aan die hand van netjies benoemde sketse en kort beskrywings die basiese SAMESTELLING, asook die funksionele werking van 'n beheerde silikongelykrigter (BSG). (12)

3.4 Noem een toepassing van 'n BSG in die praktyk. (1)
[24]

VRAAG 4
VERSTERKERS

4.1 'n Transistor met 'n wins (β) van 100 word verbind in 'n vastebasis-voorspanningkring wat 'n basisstroom van 20 µA lewer. Die toevoerspanning is 12 V en die kollektorweerstand is 2 000 Ω.

4.1.1 Bereken die kollektorstroom. (6)
4.1.2 Teken 'n netjies benoemde uitsetkenkromme van die kring en dui die posisie van die Q-punt op die laslyn aan. (7)

4.2 Noem DRIE voordele van negatiewe terugvoering. (3)

4.3 Teken 'n kringdiagram van 'n tweetrap-transformatorgekoppelde NPN-tipe transistor-versterker. (12)
[28]

QUESTION 2
THREE-PHASE ALTERNATING-CURRENT SYSTEMS

2.1 What is the phase sequence of a three-phase, three-wire, alternating current supply? (3)

2.2 The line voltage of a star-connected generator reads 400 volts on an AC voltmeter, and a line current of 30 amperes is measured with an AC ammeter.

2.2.1 Calculate the phase voltage of this system. (4)
2.2.2 Calculate the phase current of this system. (2)

2.3 Describe, by means of a neatly labelled sketch, how half-wave rectification is obtained in a three-phase alternating-current system. (6)
[15]

QUESTION 3
SEMICONDUCTORS

3.1 If the emitter current in a transistor is 12,45 mA and its collector current is 12,4 mA, what is its base current? (3)

3.2 Draw the characteristic curve of a Zenerdiode clearly showing the following:

3.2.1 The Zener breakdown voltage (2)
3.2.2 The forward bias region (2)
3.2.3 The size of the reverse leakage current (2)
3.2.4 The reverse conduction region (2)

3.3 Explain by means of neatly labelled sketches and brief descriptions, the basic CONSTRUCTION and the functional operation of the silicon-controlled rectifier (SCR). (12)

3.4 Name one application of an SCR in practice. (1)
[24]

QUESTION 4
AMPLIFIERS

4.1 A transistor with a gain (β) of 100 is connected into a fixed base bias circuit that supplies a base current of 20μA. The supply voltage is 12V and the collector resistance is 2 000 Ω.

4.1.1 Calculate the collector current. (6)
4.1.2 Draw a neatly labelled output characteristic curve of the circuit and indicate the position of the Q point on the load line. (7)

4.2 Give THREE advantages of negative feedback. (3)

4.3 Draw a circuit diagram of a two-stage transformer-coupled NPN-type transistor amplifier. (12)
[28]

VRAAG 5
SKAKEL- EN BEHEERKRINGE

5.1 Teken 'n netjies benoemde kringdiagram van 'n heelgolf-bruggelykrigter met 'n "Pi"-tipe filter. Alle golfvorms moet aangedui word. (15)

5.2 Verduidelik aan die hand van 'n netjies benoemde kringdiagram en 'n kort beskrywing hoe die helderheid van 'n lamp met tiristors beheer kan word. Alle relevante golfvorms moet aangetoon word. (16)

5.3 Teken 'n netjies benoemde kringdiagram van 'n seriereëlaar. Die komponente is weerstande, 'n transistor en 'n Zenerdiode. (8)
[39]

VRAAG 6
OSSILLATORS

6.1 Teken 'n netjies benoemde kringdiagram van 'n induktiewe gekoppelde ossillator. (11)

6.2 Verduidelik kortliks die piëso-elektriese effek met verwysing na kristalle. (2)
[13]

VRAAG 7
REKENAARBEGINSELS

7.1 Rekenaars bestaan uit 'n groot getal georganiseerde logikahekke en geheue-elemente om data so vinnig as moontlik te verwerk. Om hierdie logikahekke te kan identifiseer is dit nodig om die simbole daarvan te ken. Skets die simbole en dui die waarheidstabelle van die volgende hekke aan:

7.1.1 NOF-hek (5)
7.1.2 NEN-hek (5)

7.2 Skets 'n kombinasiekring van logikahekke om aan die volgende Boole-vergelyking te voldoen:

$X=AB(C\overline{D}+EF)$ (6)

7.3 Berekeninge met 'n rekenaar kan slegs volledig gedoen word, indien 'n vol-opteller gebruik word wat voorsiening maak vir die oordra-inset. Skets 'n netjies benoemde logikaheknetwerk van 'n vol-opteller. (8)
[24]

QUESTION 5
SWITCHING AND CONTROL CIRCUITS

5.1 Draw a neatly labelled circuit diagram of a full-wave bridge rectifier with a "Pi" type filter. All waveforms should be indicated. (15)

5.2 Explain, with the aid of a neatly labelled circuit diagram and a brief description, how the brightness of a lamp can be controlled by making use of thyristors. All relevant waveforms should be indicated. (16)

5.3 Draw a neatly labelled circuit diagram of a series regulator. The components are resistors, a transistor and a Zener diode. (8)
[39]

QUESTION 6
OSCILLATORS

6.1 Draw a neatly labelled circuit diagram of an inductive-coupled oscillator. (11)

6.2 Briefly explain the piezo-electrical effect with reference to crystals. (2)
[13]

QUESTION 7
COMPUTER PRINCIPLES

7.1 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 symbol and indicate the truth table of the following gates:

7.1.1 NOR gate (5)
7.1.2 NAND gate (5)

7.2 Sketch a combination circuit of logic gates to satisfy the following Boolean equation:

$X=AB(C\overline{D}+EF)$ (6)

7.3 To perform a complete addition with a computer, we need a full-adder circuit capable of handling the carry input. Sketch a neatly labelled logic gate network of a full-adder. (8)
[24]

VRAAG 8
ELEKTRONIESE APPARAAT

8.1 Skets 'n netjies benoemde blokdiagram van 'n FM-radiosender. (7)

8.2 'n Golfvorm wat op 'n ossilloskoop vertoon word, beslaan vyf verdelings van piek tot piek in 'n siklus. Indien die vertikale verswakker op 2V/div gestel is, bereken die piek-tot-piek-spanning van die golfvorm. (4)
[11]

VRAAG 9
BEROEPSVEILIGHEID-MAATREËLS

9.1 Noem TWEE belangrike aspekte wat in gedagte gehou moet word wanneer draagbare elektriese toestelle nagegaan word. (2)

9.2 Noem TWEE werkwinkelveiligheid-maatreëls wat gedurende die jaar in die werkwinkel toegepas is. (2)

9.3 Verduidelik hoe Vigs van een persoon na 'n ander oorgedra kan word. (2)
[6]

TOTAAL: 200

QUESTION 8
ELECTRONIC APPARATUS

8.1 Sketch a neatly labelled block diagram of an FM radio transmitter. (7)

8.2 A waveform displayed on an oscilloscope covers five divisions from peak to peak in a cycle. If the vertical attenuator is set to 2V/div., calculate the peak-to-peak voltage of the waveform. (4)
[11]

QUESTION 9
OCCUPATIONAL SAFETY PRECAUTIONS

9.1 State TWO important aspects to bear in mind when inspecting portable electrical appliances. (2)

9.2 Name TWO workshop safety precautions that were applied in your workshop this year. (2)

9.3 Explain how HIV/AIDS can be spread from one person to another. (2)
[6]

TOTAL: 200

INFORMATION SHEET / *INLIGTINGSBLAD*

ELECTRIC CURRENT THEORY / *ELEKTRIESE STROOMTEORIE*

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

$$P = V \times 1 \text{ WATT}$$

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

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

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

STAR / *STER*

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

$$I_L = I_P$$

DELTA

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

$$V_L = V_P$$

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

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

$V_C = I_T \times X_C$	
$V_L = I_T \times X_L$	$\frac{N_1}{N_2} = \sqrt{\frac{Z_1}{Z_2}}$
$V_R = I_T \times R$	

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 / *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*

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

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

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

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

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

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

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

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*