SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

OCTOBER / NOVEMBER
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2004

TECHNIKA (ELECTRONICS)

TECHNIKA (ELEKTRONIES)

HG **714-1/0**

13 pages
13 bladsye

TECHNIKA ELECTRONICS HG

714 1 0 HG

APPROVED BY UMALUSI / *GOEDGEKEUR DEUR UMALUSI*

GAUTENGSE DEPARTEMENT VAN ONDERWYS
SENIORSERTIFIKAAT-EKSAMEN

TECHNIKA (ELEKTRONIES) HG

TYD: 3 uur

PUNTE: 300

INSTRUKSIES:

- Beantwoord AL die vrae.
- Sketse en diagramme moet groot, netjies en van byskrifte voorsien wees.
- Alle berekeninge moet getoon word.
- Antwoorde moet duidelik genommer word, in ooreenstemming met die nommers wat op die vraestel gebruik is.
- 'n Formuleblad (bladsye 11 – 13) is aan die einde van die vraestel aangeheg.

VRAAG 1
ELEKTRIESE STROOMTEORIE

1.1 'n Parallele kring bestaan uit 'n spoel met 'n induktansie van 20 mH, 'n kapasitor met 'n kapasitasie van 100 µF en 'n resistor met 'n weerstand 5 Ω. Die kring is aan 'n 10 Volt / 50 Hz-toevoer verbind.

Bereken

1.1.1 die stroom in elke vertakking. (15)

1.1.2 die totale stroom deur die kring. Teken 'n netjies benoemde fasordiagram wat die strome verteenwoordig. (12)

1.1.3 die impedansie van die kring met inagname van die spanning en stroomvloei deur die kring. (3)

1.2 'n Serie RC-kring neem 1 ms (een millisekonde) om tot 63% van die toegepaste spanning te laai. Indien die waarde van R = 100 kΩ en V totaal = 6 V is, bereken die waarde van die kapasitor. (4)

1.3 Om die masimum oordrag van krag te verseker vanaf 'n kringbaan na 'n las, is dit nodig dat die totale impedansie gelyk aan mekaar moet wees, of by die interne impedansie van die kringbaan moet pas. Bereken die effektiewe weerstand (interne impedansie) van die kringbaan indien die impedansie-aanpassingstransformator 'n draaiverhouding van 15:1 het, en aan 'n las van 8 Ω verbind is. (5)
[39]

GAUTENG DEPARTEMENT OF EDUCATION
SENIOR CERTIFICATE EXAMINATION

TECHNIKA (ELECTRONICS) HG

TIME: 3 hours

MARKS: 300

INSTRUCTIONS:

- Answer ALL the questions.
- Sketches and diagrams must be large, neat and labelled.
- All calculations must be shown.
- Answers must be clearly numbered in accordance with the numbers used on the paper.
- A formula sheet (pages 11 – 13) is provided at the end of the paper.

QUESTION 1
ELECTRIC CURRENT THEORY

1.1 A parallel circuit consists of a coil with an inductance of 20 mH, a capacitor with a capacitance of 100 µF and a resistor with a resistance of 5 Ω. The circuit is supplied from a 10 Volt / 50 Hz supply.

Calculate

1.1.1 the current in each branch. (15)

1.1.2 the total current in the circuit. Sketch a neatly labelled phasor diagram representing the currents. (12)

1.1.3 the impedance of the circuit taking into account the voltage and current flow through the circuit. (3)

1.2 A series RC circuit takes 1 ms (one millisecond) to charge up to 63% of the applied voltage. If the value of R = 100 kΩ and V total = 6 V, calculate the value of the capacitor. (4)

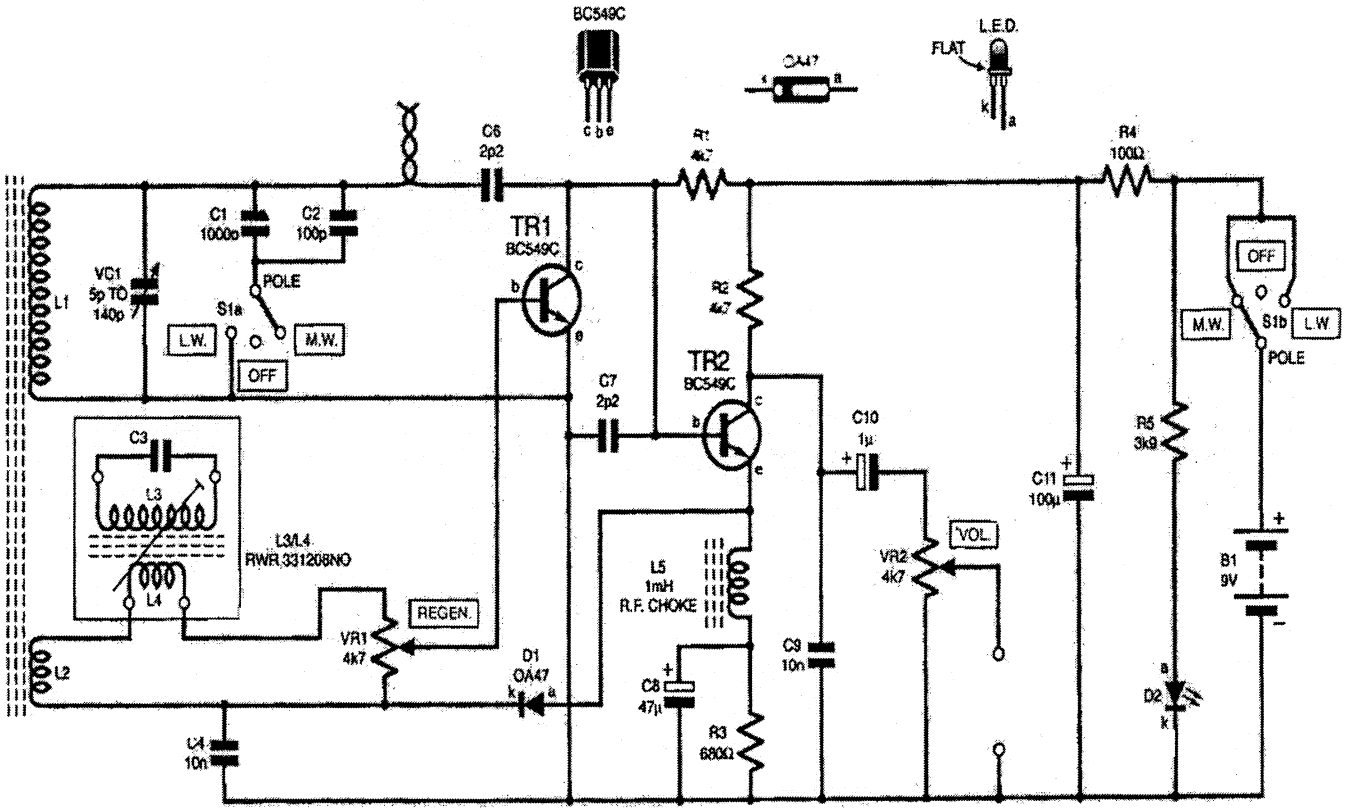
1.3 In the transfer of maximum power from a source to a load, the load impedance must equal, or match, the internal impedance of the source. Calculate the effective resistance (internal impedance) of the circuit if the impedance transfer transformer has a turns ratio of 15:1 transformer connected to an output load of 8 Ω. (5)

[39]

VRAAG 2
HALFGELEIER-TOESTELLE

2.1 Identifiseer die volgende elektroniese komponente met verwysing na die elektroniese kringdiagram in **Figuur 2.1**.
Voorbeeld: R3 is 'n 10 kΩ weerstand.

2.1.1 D2 (2)
2.1.2 TR1 (2)
2.1.3 VC1 (4)
2.1.4 D1 (1)
2.1.5 L3 (3)



Figuur 2.1

2.2 Verduidelik deur middel van netjies benoemde sketse en kort verduidelikings die basiese **konstruksie** en **funksionele werking** van die eenvoegvlak-transistor ("UJT"). Jou verduidelikings moet 'n kenkromme insluit. (15)

2.3 Noem VIER voorsorgmaatreëls wat geneem moet word wanneer CMOS-toestelle hanteer word. (4)

2.4 Verduidelik kortliks die betekenis van die volgende terme, met verwysing na die kenmerke van 'n beheerde silikon-gelykrigter (BSG):

2.4.1 Voorwaartse deurbreekspanning (2)
2.4.2 Houstroom (2)
2.4.3 Voorwaartse en tru-spergebied (2)
2.4.4 Tru-deurbreekspanning (2)
[39]

QUESTION 2
SEMICONDUCTOR DEVICES

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

2.1.1 D2 (2)
2.1.2 TR1 (2)
2.1.3 VC1 (4)
2.1.4 D1 (1)
2.1.5 L3 (3)

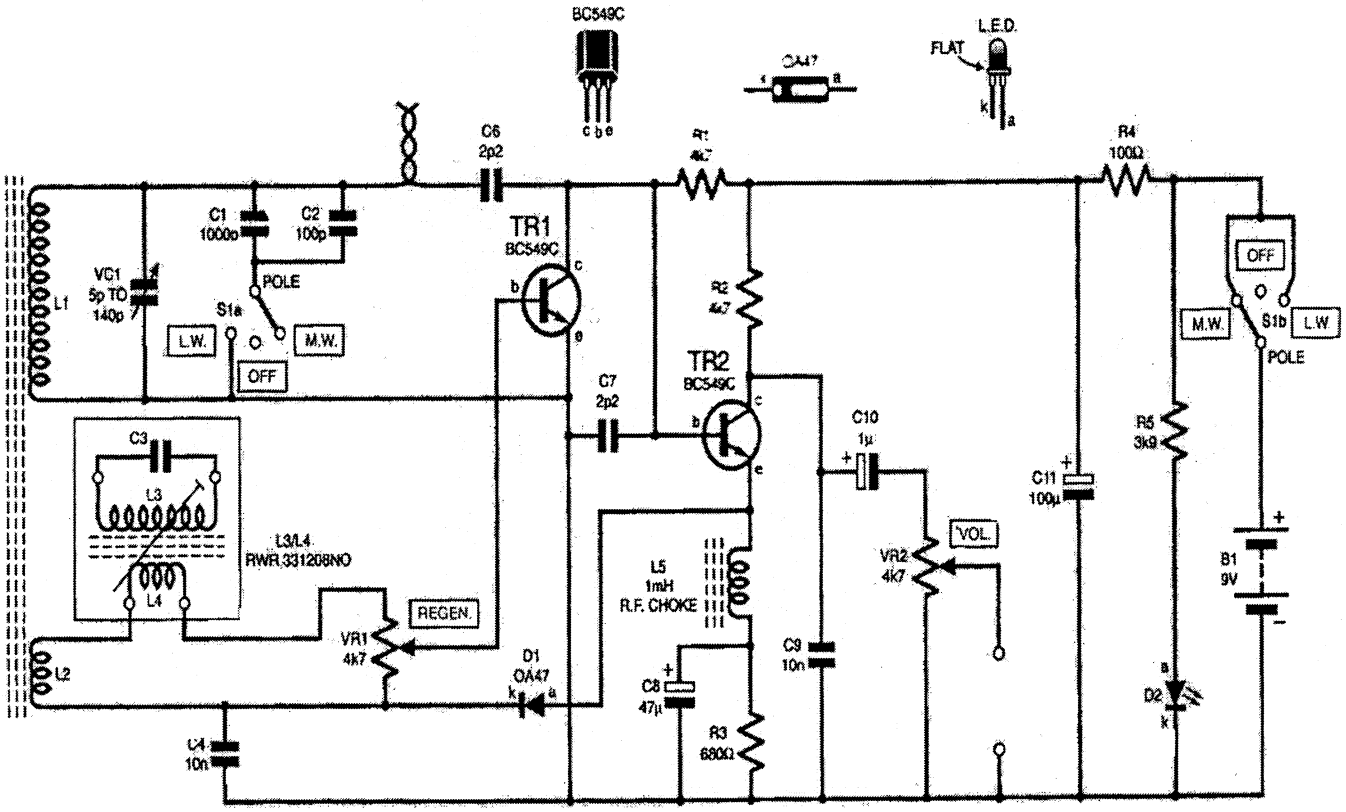


Figure 2.1

2.2 Explain, by means of neatly labelled sketches and brief descriptions, the basic **construction** and **functional operation** of the Uni-junction Transistor (UJT). Your explanation should include a characteristic curve. (15)

2.3 Name FOUR precautions that must be taken into account when handling CMOS devices. (4)

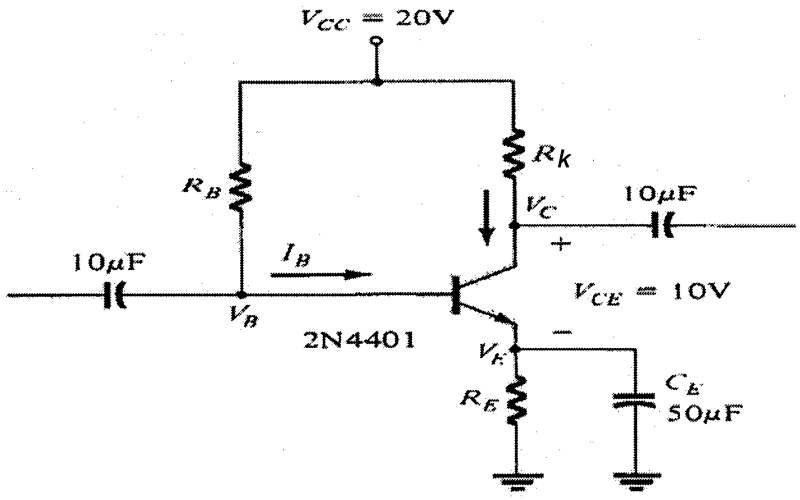
2.4 Briefly explain the following terms with reference to the characteristics of a Silicon Controlled Rectifier (SCR):

2.4.1 Forward breakover voltage (2)
2.4.2 Holding current (2)
2.4.3 Forward and reverse blocking regions (2)
2.4.4 Reverse breakdown voltage (2)

[39]

VRAAG 3
VERSTERKERS

3.1 Bereken die weerstandwaardes van Re, Rk en Rb vir 'n transistor-versterkerkring soos in **Figuur 3.1** aangedui. Die stroomwins van die NPN 2N4401-transistor is tipies 90 teen 'n kollektorstroom van 5 mA. Die toevoerspanning is 20 Volt. (23)



Figuur 3.1: Gemeenskaplike emitter kring

3.2 'n 741 operasionele versterker is in die omkeer modus gekoppel. Dit versterk 'n sein van 5 mV tot 1 V. Die insetimpedansie is 2 MΩ.

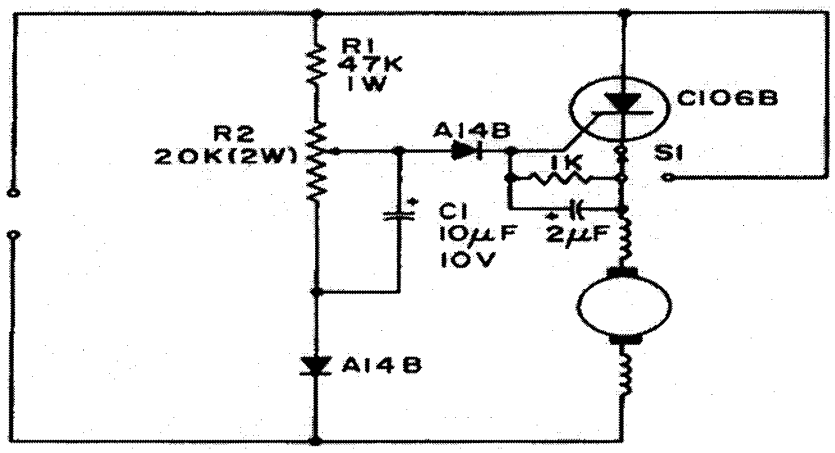
3.2.1 Skets 'n netjies benoemde diagram van die kring. (10)

3.2.2 Bereken die waarde van die terugvoerweerstand. (7)

[40]

VRAAG 4
SKAKEL- EN BEHEERKRINGE

4.1 **Figuur 4.1** illustreer die spoedbeheer van 'n universele-motor. Verduidelik die werkbeginsel van die kring. (9)



Figuur 4.1: Spoedbeheer van 'n universele-motor

QUESTION 3
AMPLIFIERS

3.1 Calculate the resistor values Re, Rc and Rb for a transistor amplifier circuit as shown in **Figure 3.1**. The current gain of an NPN 2N4401 transistor is typically 90 at a collector current of 5 mA. The supply voltage is 20 Volt. (23)

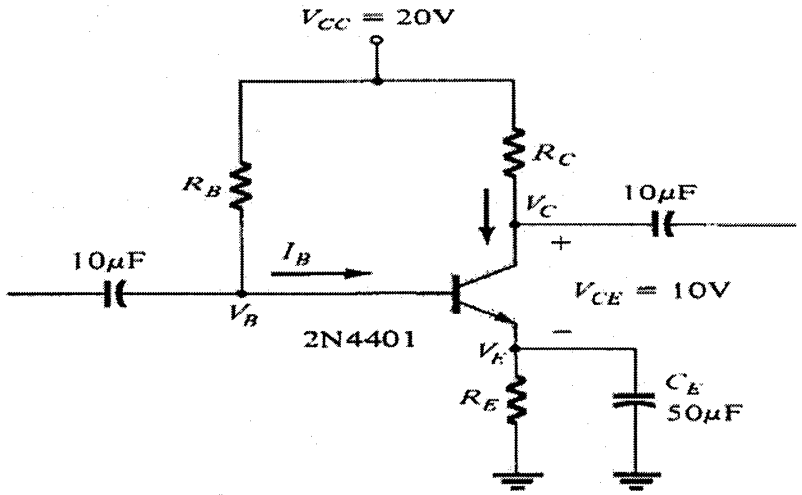


Figure 3.1: Common emitter circuit

3.2 A 741 operational amplifier is connected in the inverting mode. It amplifies a signal of 5 mV to 1 V. The input impedance is 2 MΩ.

3.2.1 Draw a neatly labelled diagram of the circuit. (10)

3.2.2 Calculate the value of the feedback resistor. (7)

[40]

QUESTION 4
SWITCHING AND CONTROL CIRCUITS

4.1 **Figure 4.1** illustrates a universal motor speed control. Explain the working principle of this circuit. (9)

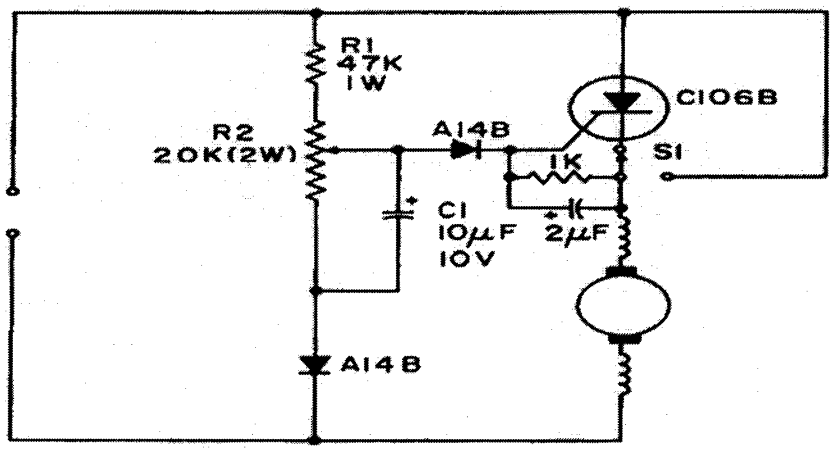
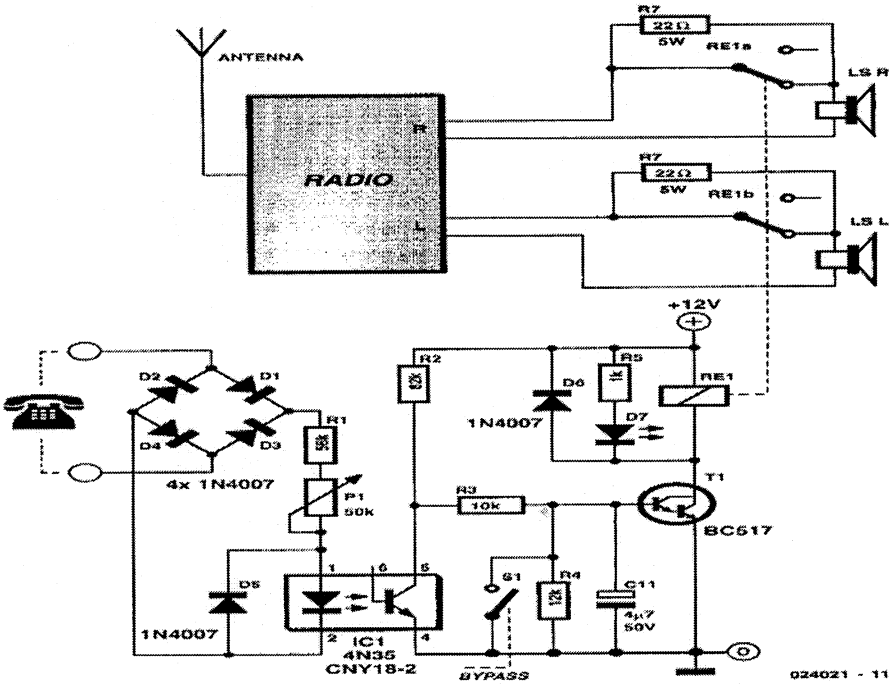


Figure 4.1: Universal motor speed control

4.2 Heelwat mense verkies agtergrondmusiek terwyl hulle werk, maar vind dit steurend terwyl hulle 'n telefoonoproep neem. Die elektroniese stroomkring in **Figuur 4.2** word gebruik om die radio se volume outomaties sagter te stel indien die telefoon beantwoord word. Verduidelik die werkbeginsel van hierdie stroomkring (neem asseblief kennis dat die telefoon se lynspanning hoog sal wees solank as wat die telefoon nie beantwoord word nie, d.i. die liguitstralende diode sal aan wees). (12)



Figuur 4.2: Outomatiese volumevermindering-stroomkring

4.2 Many people like to have the radio on while working, but may find the volume annoying as soon as a phone call has to be made or answered. The electronic circuit in **Figure 4.2** will automatically reduce the music volume when the phone is taken off the hook. Explain the working principle of this circuit (please note that the phone line voltage will be high as long as the receiver is on the hook, i.e. the LED will be on). (12)

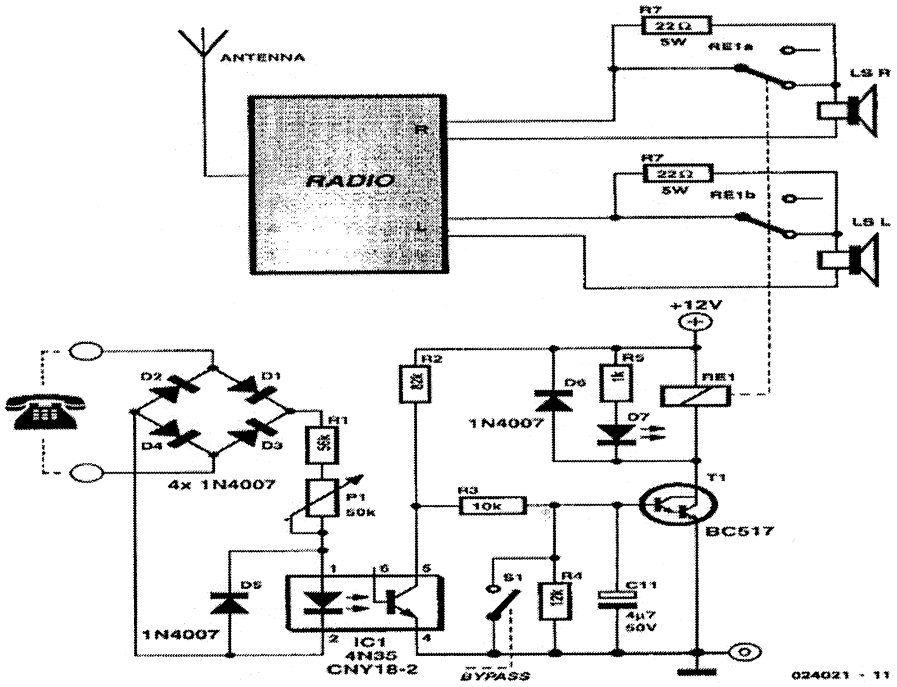
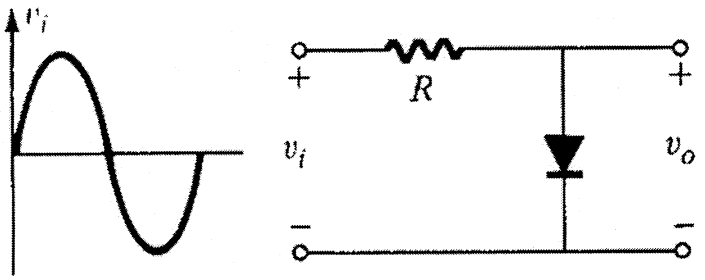


Figure 4.2: Automatic volume reducing circuit

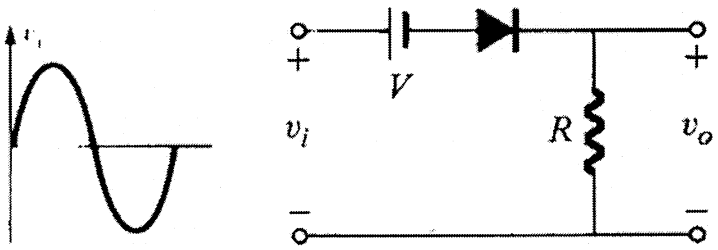
4.3 Vasklem en afkap-stroombane is diodegolfvormingskringe wat sekere gedeeltes van golwe deurlaat en ander dele weer tot sekere waardes beperk. Bepaal die uitset spanningsgolfvorm vir die insetgolwe in die kringe in **Figuur 4.3**. (Teken **slegs** die uitsetgolfvorm in jou antwoordboek.)

4.3.1



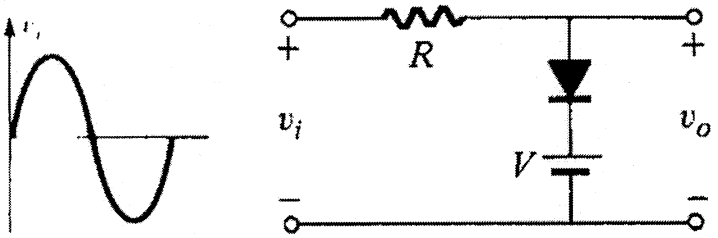
(2)

4.3.2



(3)

4.3.3



(3)

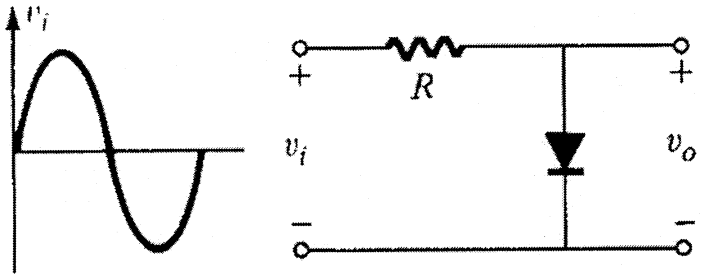
Figuur 4.3: Golfvormingskringe

4.4 Verduidelik die werksbeginsel van **ENIGE** elektroniese eksperiment **OF** model wat jy hierdie jaar gebou/ontwerp het. Neem kennis dat jou verduideliking 'n netjies benoemde kringdiagram of blokdiagram met 'n kort verduideliking moet insluit. Alle relevante golfvorms moet getoon word. Neem verder kennis dat die beskrywing verband moet hou met jou kringdiagram. Jy mag nie enige kringbane en vrae wat in hierdie vraestel voorkom, herhaal nie. (15)

[44]

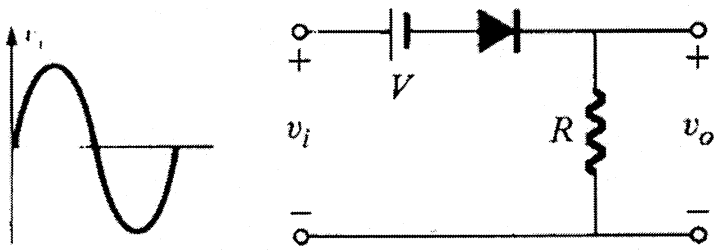
4.3 Clippers and clampers are diode wave shaping circuits transmitting parts of waveforms and suppressing others to a predetermined value. Find the output voltage wave shape for the inputs shown in **Figure 4.3**. (**Only** sketch the output voltage wave shape in your answer book.)

4.3.1



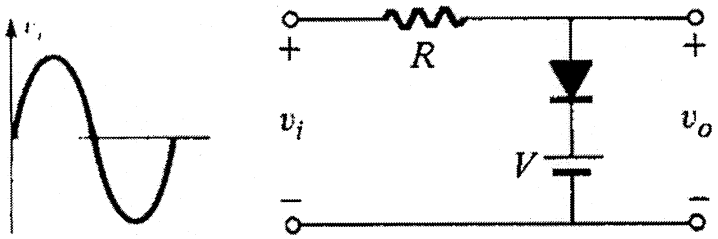
(2)

4.3.2



(3)

4.3.3



(3)

Figure 4.3: Wave shaping circuits

4.4 Explain the working principle of **ANY** electronic experiment **OR** model that you have built / designed this year. Take note that your explanation should include a neatly labelled circuit diagram or block diagram with a brief description. All relevant wave forms, where applicable should be included. Please note that the description should directly link to your circuit diagram. You are not allowed to replicate a question already covered in this question paper. (15)

[44]

VRAAG 5
OSSILLATORS

5.1 Verduidelik aan die hand van 'n netjies benoemde kringdiagram en 'n kort verduideliking die werksbeginsel van die Hartley-ossilator. (12)

5.2 Bereken die ossileringsfrekwensie (Fo) van die kring in Vraag 5.1 indien die volgende waardes met verwysing na die tenkstroomkring bekend is:

L1 = 750 µH

L2 = 750 µH

C = 150 pF

M = 150 µH (6)

[18]

VRAAG 6
REKENAARBEGINSELS

6.1 Ontwerp 'n NEN-heknetwerk vir die volgende Boole-vergelyking (A, B en C is direkte hekinsette.):

$F = A.B.C + A.B + A$ (6)

6.2 Bewys deur gebruik te maak van Boole-algebra dat:

$$\overline{AB} + \overline{\overline{A}} + B = \overline{AB}$$ (5)

6.3 Ontwerp 'n outomatiese waarskuwingstoestel vir 'n tweesitplek-motorvoertuig, wat 'n alarm sal aktiveer indien die aansitter aangeskakel is en enige van die passasiers versuim het om sy/haar veiligheidsgordel aan te sit.

6.3.1 Konstrueer 'n waarheidstabel vir hierdie situasie. (5)

6.3.2 Verteenwoordig die alarmfunksie F in terme van A, B en C. (3)

6.3.3 Vereenvoudig die funksie en ontwerp 'n praktiese logikakringbaan. (6)

6.4 Bereken die som van die volgende twee desimale nommers in binêr:

28,375

\+ 15

(4)

QUESTION 5
OSCILLATORS

5.1 Explain with the aid of a neatly, labelled circuit diagram and a brief description, the operating principle of a Hartley oscillator. (12)

5.2 Calculate the oscillating frequency (Fo) of the circuit in Question 5.1 if the following values, with reference to the tank circuit, are known:

L1 = 750 µH

L2 = 750 µH

C = 150 pF

M = 150 µH (6)

[18]

QUESTION 6
COMPUTER PRINCIPLES

6.1 Design a NAND gate network for the following Boolean expression (A, B and C are direct gate inputs.):

$F = A.B.C + A.B + A$ (6)

6.2 Prove by means of Boolean algebra that:

$$\overline{AB} + \overline{\overline{A}} + B = \overline{AB}$$ (5)

6.3 Design a two-passenger automatic seat-belt warning system for a motor vehicle that will sound an alarm if the ignition is on and there is a passenger with an unfastened seatbelt.

6.3.1 Construct a truth table for this situation. (5)

6.3.2 Represent the alarm function F in terms of A, B and C. (3)

6.3.3 Simplify the function and design a practical logic circuit. (6)

6.4 Add the following two decimal numbers in binary:

$$\begin{array}{rr} & 28{,}375 \\ + & 15 \\ \hline & \\ \hline \end{array}$$ (4)

6.5 Illustreer deur middel van 'n netjies benoemde blokdiagram van 'n voloptellerkring hoe die volgende binêre nommers bymekaar getel word:

1010

\+ 1111

(16)

6.6 Verduidelik die verskil tussen 'n LSG en 'n LAG met verwysing na rekenaars. (6)
[51]

VRAAG 7
INFORMASIE-OORDRAG

7.1 Frekwensies word volgens frekwensiebande geklassifiseer, wat elk hul onderskeie gebruike het. Verwys na **TABEL 7.1** en dui een gebruik vir elke spesifieke frekwensieband aan. Skryf die nommers onder mekaar in jou antwoordboek neer en skryf die gebruik teenoor die toepaslike vraagnommer neer. (6)

BAND	TERM	GEBRUIKE
30 kHz – 300 kHz	Lae Frekwensie (LF)	7.1.1
300 kHz – 3 MHz	Medium Frekwensie (MF)	7.1.2
3 MHz – 30 MHz	Hoë Frekwensie (HF)	7.1.3
30 MHz – 300 MHz	Baie Hoë Frekwensie (VHF)	7.1.4
300 MHz – 3 GHz	Ultra Hoë Frekwensie (UHF)	7.1.5
Bokant 3 GHz	Super Hoë Frekwensie (SHF)	7.1.6

TABEL 7.1

7.2 Verduidelik waarom optiese vesel kommunikasie-stelsels bo koperdraad-stelsels verkies word. (2)

7.3 Verduidelik waarom die las van optiese veselkabels baie belangrik is. (6)

7.4 Verduidelik deur middel van 'n netjiese benoemde blokdiagram die werkbeginsel van 'n tipiese mikrogolfkommunikasie-stelsel. (10)

7.5 Verduidelik die term **Puls Kode Modulasie** in terme van konvensionele telefoonstelsels. Verduidelik verder hoe dit moontlik is vir meer as een telefoonoproep om tergelykertyd plaas te vind op 'n tweekoperdraadstelsel sonder om steurnisse tussen die oproepe te veroorsaak. Maak gebruik van relevante golfvorme om jou antwoord beter te omskryf. (8)
[32]

6.5 Illustrate by means of a neatly labelled block diagram of a full adder circuit, how the following binary numbers will be added.

```
  1010
+ 1111
------
```

(16)

6.6 Explain the difference between a RAM and a ROM memory with reference to computers. (6)
[51]

QUESTION 7
INFORMATION TRANSFER

7.1 Frequencies fall into frequency bands, each with different uses. Refer to **TABLE 7.1** and indicate one use for a specific frequency band. Write the numbers below each other in your answer book and write the uses next to the appropriate question number. (6)

BAND	TERM	USES
30 kHz – 300 kHz	Low Frequency (LF)	7.1.1
300 kHz – 3 MHz	Medium Frequency (MF)	7.1.2
3 MHz – 30 MHz	High Frequency (HF)	7.1.3
30 MHz – 300 MHz	Very High Frequency (VHF)	7.1.4
300 MHz – 3 GHz	Ultra High Frequency (UHF)	7.1.5
Above 3 GHz	Super High Frequency (SHF)	7.1.6

TABLE 7.1

7.2 Discuss why fibre-optic communication systems are favoured above copper wire systems. (2)

7.3 Explain the importance of the correct joining of fibre-optic cables. (6)

7.4 Explain by means of a neatly labelled block diagram the working principle of a typical microwave communication system. (10)

7.5 Explain the term **Pulse Code Modulation** in terms of conventional telephone systems. Also explain how it is possible to have multiple telephone conversations on a two copper wire system without interference from each other. Make use of applicable waveforms to enhance your answer. (8)
[32]

VRAAG 8
MEETINSTRUMENTE

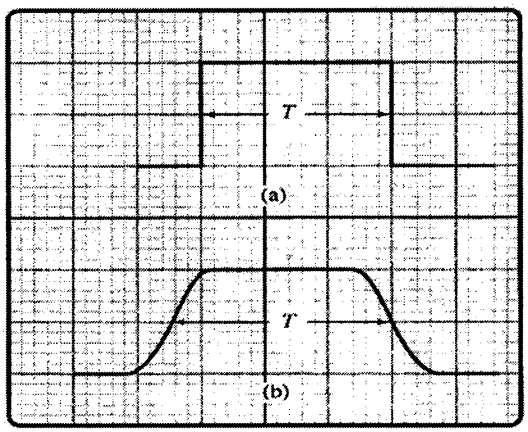
8.1 Teken 'n netjies benoemde blokdiagram van 'n katodestraalbuis-ossiloskoop. (10)

8.2 Noem DRIE voordele van 'n digitale multimeter bo 'n analoogmeter. (3)

8.3 Bestudeer **Figuur 8.1**. Twee pulse word tegelyk op die skerm van 'n ossilloskoop vertoon (KSO). Bepaal die volgende:

8.3.1 Die frekwensie van puls A indien die Tyd/Divisie-skakelaarverstelling van die ossiloskoop op 50 µsec/Div gestel is. (6)

8.3.2 Die maksimum waarde van puls B indien die Spanning/Divisie-verstelling op 2 V/Div gestel is. (3)



Figuur 8.1 **[22]**

VRAAG 9
VEILIGHEID

9.1 Noem VYF veiligheidsinspeksies wat jy sal doen voordat daar met draagbare elektriese toestelle gewerk word wat by 'n kontaksok ingeprop word. (5)

9.2 Noem TWEE voorsorgmaatreëls wat getref moet voordat 'n nuwe projek wat van elektrisiteit gebruik maak vir die eerste keer aangesit word. (2)

9.3 Verduidelik waarom skuimbrandblussers nie op elektriese brande gebruik behoort te word nie. (2)

9.4 'n Dertienjarige seun (Johan Stoop) van Bethal is in Oktober 2002 gedurende 'n bloedoortapping met die MIV-virus besmet. Verduidelik kortliks hoe dit moontlik was. (3)

QUESTION 8
MEASURING INSTRUMENTS

8.1 Draw a neatly labelled block diagram of a cathode ray oscilloscope. (10)

8.2 List THREE advantages a digital multi-meter has compared to an analogue meter. (3)

8.3 Examine **Figure 8.1**. Two pulses are displayed on the screen of an oscilloscope (CRO). Determine the following:

8.3.1 The frequency of pulse A if the Time/division setting of the oscilloscope is set at 50 µsec/Div. (6)

8.3.2 The peak value of pulse B if the Voltage / division setting of the oscilloscope is set at 2 V/Div. (3)

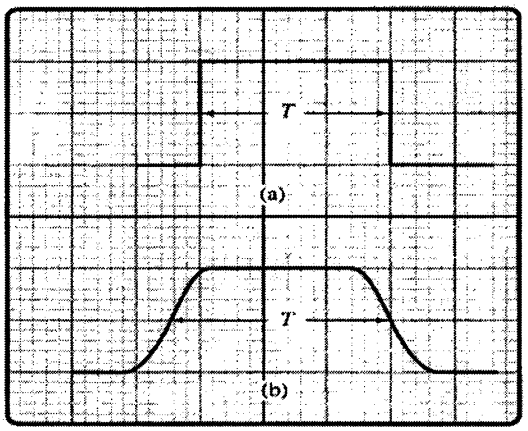


Figure 8.1 **[22]**

QUESTION 9
SAFETY PRECAUTIONS

9.1 Name FIVE safety checks that should be done before using portable electrical equipment from a socket outlet. (5)

9.2 When finishing a project that makes use of electricity, name TWO precautions to be taken before powering up your project for the first time. (2)

9.3 Explain why foam fire-extinguishers should not be used on electrical fires. (2)

9.4 A 13-year-old boy (Johan Stoop) from Bethal contracted HIV during a blood transfusion in October 2002. Briefly explain how this is possible. (3)

9.5 Beantwoord die volgende vrae. Skryf slegs WAAR of ONWAAR in jou antwoordboek teenoor die toepaslike vraagnommer.

'n Persoon Kan VIGS kry deur

9.5.1 'n persoon se hand te skud wat MIV-positief is. (1)

9.5.2 uit dieselfde glas te drink as 'n persoon wat MIV-positief is. (1)

9.6 Skryf die VIGS kontaknommer in jou antwoordboek neer. (1)
[15]

TOTAAL: 300

9.5 Answer the following questions. Only write TRUE or FALSE next to the appropriate question number in your answer book.

A person can get AIDS from

9.5.1 shaking hands with a person infected with HIV. (1)

9.5.2 drinking from the same glass as a person infected with HIV. (1)

9.6 Write down the AIDS hotline number in your answer book. (1)
[15]

TOTAL: 300

INFORMATION SHEET / *INLIGTINGSBLAD*

ELECTRIC CURRENT THEORY / *ELEKTRIESE STROOMTEORIE*

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

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

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

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

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

STAR / *STER*

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

$$I_L = I_P$$

DELTA

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

$$V_L = V_P$$

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

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

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

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

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

$$V_X = V_L - V_C$$

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

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

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

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

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

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

$V_C = I_T \times X_C$

$V_L = I_T \times X_L$

$V_R = I_T \times R$

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

$V_X = V_C - V_L$

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

$I_X = I_C - I_L$

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

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

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

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

$X_X = X_L - X_C$

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*

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

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

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

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

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

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

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

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*