SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

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TECHNIKA (ELECTRONICS)

TECHNIKA (ELEKTRONIES)

SG 714-2/0

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TECHNIKA ELECTRONICS SG

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GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIORSERTIFIKAAT-EKSAMEN

TECHNIKA (ELEKTRONIES) SG

TYD: 3 uur

PUNTE: 200

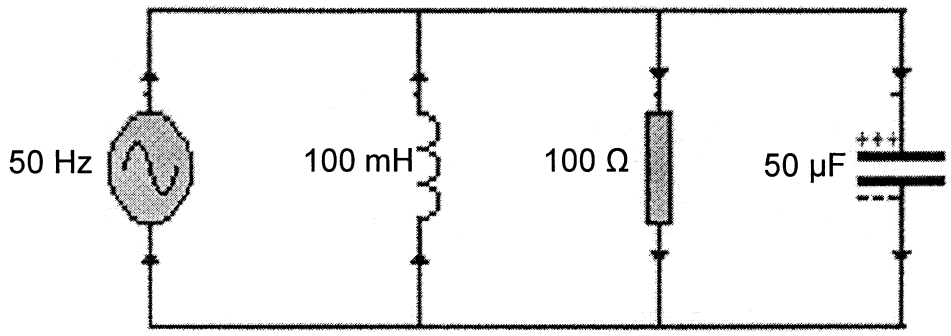
INSTRUKSIES:

- Beantwoord AL die vrae.
- Sketse en diagramme moet groot, netjies en benoem wees.
- Alle berekeninge moet getoon word.
- 'n Goedgekeurde sakrekenaar mag gebruik word.
- Antwoorde moet korrek genommer wees.
- Formuleblaaie is aan die einde van die vraestel ingesluit.

VRAAG 1
ELEKTRIESE STROOMTEORIE

1.1 Bestudeer die parallelkring in **Figuur 1** en bepaal die volgende:
(Toevoerspanning = 100 V)

1.1.1 Die stroomvloei deur elke tak (17)
1.1.2 Die totale stroomvloei deur die kring (3)
1.1.3 Die impedansie van die kring (3)



Figuur 1
RLC-kring

1.2 Bepaal die strek ("range") van die instemkapasitor vereis om 'n 0,15 µH-spoel deur die totale frekwensieband van (88 - 98 Khz) te laat resoneer. (6)
[29]

GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

TECHNIKA (ELECTRONICS) SG

TIME: 3 hours

MARKS: 200

INSTRUCTIONS:

- Answer ALL the questions.
- Sketches and diagrams must be large, neat and labelled.
- All calculations must be shown.
- An approved pocket calculator may be used.
- Answers must be clearly numbered.
- Formulae sheets are enclosed at the end of the paper.

QUESTION 1
ELECTRIC CURRENT THEORY

1.1 Study the parallel circuit in **Figure 1** and determine the following:
(Supply Voltage = 100 V)

1.1.1 The current through each branch (17)
1.1.2 The total current through the circuit (3)
1.1.3 The impendance of the circuit (3)

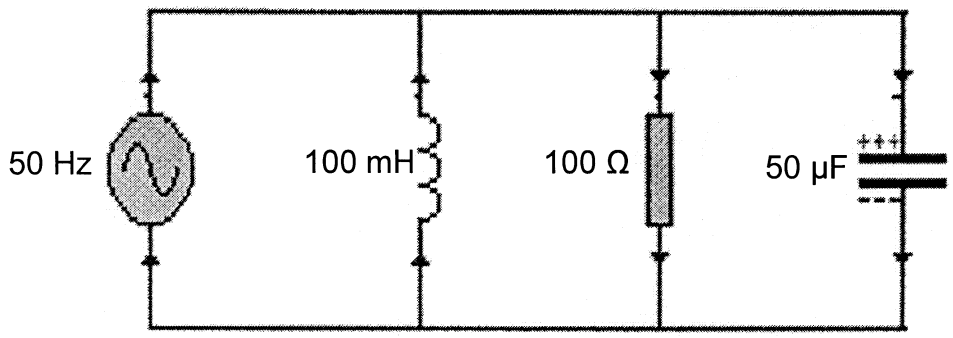
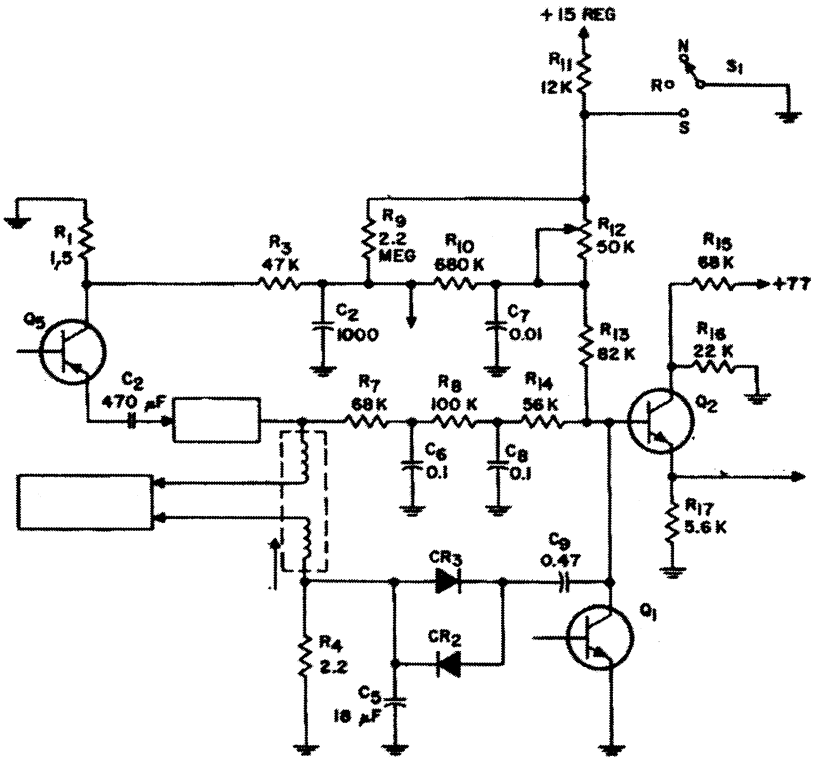


Figure 1
RLC-Circuit

1.2 Determine the range of the tuning capacitor that is needed to let a 0,15 µH coil resonate through a frequency band of (88 - 98 Khz). (6)
[29]

VRAAG 2
HALFGELEIER-TOESTELLE

2.1 Identifiseer die volgende elektroniese komponente met verwysing na die elektroniese kringdiagram in **Figuur 2**. Byvoorbeeld: R_8 is 'n 100 000-ohm-resistor.



Figuur 2
Vertikale voorversterker met insette

2.1.1 R_{10} (3)
2.1.2 Q_2 (2)
2.1.3 C_7 (2)
2.1.4 CR_2 (2)
2.1.5 Q_5 (2)

2.2 Verduidelik die basiese werkbeginsel van 'n eenvoegvlak-transistor (EVT/UJT) aan die hand van netjiese, benoemde sketse. (15)

2.3 Noem TWEE gebruike van die **BSG** in die praktyk. (2)
[28]

QUESTION 2
SEMICONDUCTOR DEVICES

2.1 Identify the following electronic components with reference to the electronic circuit diagram in **Figure 2**. For example: R_8 is a 100 000-ohm resistor.

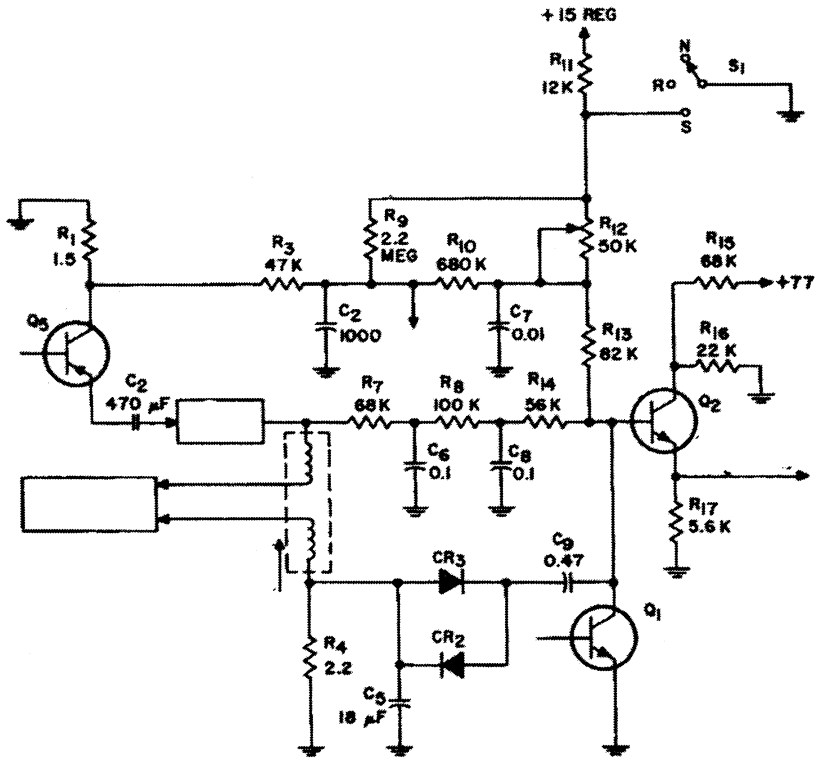


Figure 2
Vertical predriver with its inputs

2.1.1 R_{10} (3)
2.1.2 Q_2 (2)
2.1.3 C_7 (2)
2.1.4 CR_2 (2)
2.1.5 Q_5 (2)

2.2 Explain with the aid of sketches, the basic working principle of the unijunction transistor (UJT). (15)

2.3 State TWO uses of an **SCR** in practice. (2)
[28]

VRAAG 3
VERSTERKERS

3.1 Transistors word in verskillende stadiums met versterkers gekoppel om die vereiste wins te verkry. Verduidelik aan die hand van 'n netjiese, benoemde skets die basiese werkbeginsel van **óf** die balansversterker **óf** die radiofrekwensie-versterker. (20)

3.2 Dui aan die hand van netjiese, benoemde grafieke die verskille tussen Klas A- en Klas B-versterkers aan. Dui die posisie van die statiese werkpunt (Q-punt) en alle in- en uitset-golfvorms duidelik op elke grafiek aan. (10)

3.3 Verduidelik kortliks wat jy onder **negatiewe terugvoering** verstaan. (4)

3.4 Noem VYF kenmerke van 'n ideale operasionele versterker (op amp). (5)

3.5 Teken die penuitleg van die 741 operasionele versterker (op amp). (5)

3.6 Bereken die uitsetspanning van 'n nie-omkerende operasionele versterker vir die volgende waardes:

$V = 4$ Volt
$R_F = 250\ k\Omega$
$R_{in} = 50\ k\Omega$ (4)

[48]

VRAAG 4
SKAKEL- EN BEHEERKRINGE

4.1 Dui die verskille tussen 'n **serie- en sjunt-spanningsregulering-kring** met TWEE netjiese, benoemde kringdiagramme aan. (10)

4.2 Verduidelik kortliks, aan die hand van netjiese, benoemde ligverdof-kringdiagramme, hoe 'n transistor tesame met ander relevante elektroniese komponente vir ligdemping ingespan kan word. (12)

[22]

VRAAG 5
REKENAARBEGINSELS

5.1 Teken die IEC-simbool en waarheidstabel vir elk van die volgende:

5.1.1 NIE-hek (4)
5.1.2 OF-hek (6)
5.1.3 EN-hek (6)
5.1.4 NOF-hek (6)

5.2 Bewys met Boole-algebra dat die volgende stelling waar is.

$$A + B(A.\overline{B}) = A$$ (10)

[32]

QUESTION 3
AMPLIFIERS

3.1 Transistors are connected in different stages in amplifiers to obtain higher gain. Explain with the aid of a neatly labelled sketch the working principle of **either** the push-pull amplifier **or** radio frequency amplifier. (20)

3.2 Show by means of neat, labelled graphs the differences between Class A and Class B amplifiers. The position of the static working point (the Q-point) must be shown on each graph. (10)

3.3 Explain briefly what is meant by **negative feedback**. (4)

3.4 State FIVE characteristics of an ideal operational amplifier. (5)

3.5 Draw the pin layout of the 741 operational amplifier (op Amp). (5)

3.6 Determine the output voltage of a non-inverting operational amplifier for the following values:

$V = 4$ Volts
$R_F = 250\ k\Omega$
$R_{in} - 50\ k\Omega$ (4)

[48]

QUESTION 4
SWITCHING AND CONTROL CIRCUITS

4.1 Show the difference between a **series and sjunt voltage-regulating** circuit with the aid of TWO neat, labelled circuit diagrams. (10)

4.2 Briefly explain, by means of a neat labelled light-dimmer circuit diagrams, how a transistor in conjunction with other relevant electronic components, can be employed for dimming lights. (12)

[22]

QUESTION 5
COMPUTER PRINCIPLES

5.1 Draw the IEC-symbol and the truth table for each of the following:

5.1.1 NOT gate (4)
5.1.2 OR gate (6)
5.1.3 AND gate (6)
5.1.4 NOR gate (6)

5.2 By using Boolean algebra show that the following statement is true.

$$A + B(A.\overline{B}) = A \quad (10)$$

[32]

VRAAG 6
OSSILLATORS

6.1 Teken 'n netjies, benoemde kringdiagram van 'n Hartley-ossillator. **[15]**

VRAAG 7
MEETINSTRUMENTE

7.1 'n Vierkantgolf word op die skerm van 'n ossilloskoop waargeneem. Een siklus strek oor 'n afstand van 5 cm. Bereken die frekwensie van die golf, indien die horisontaleveeg-generator (tyd / divisie) op 100 µsec / cm gestel is. (7)

7.2 'n Sinusvormige golfvorm met 'n piekwaarde van 3.2 cm word op die skerm van 'n ossilloskoop waargeneem. Indien die amplitude-verswakker (volt / divisie) op 10V/cm gestel is, bereken die WGK-waarde van die sinusvormige golf. (6)
[13]

VRAAG 8
VEILIGHEIDSMAATREËLS

8.1 Noem VYF aspekte wat in ag geneem moet word wanneer draagbare elektriese apparaat gekoppel moet word. (5)

8.2 Noem VYF veiligheidsmaatreëls wat nagekom moet word in 'n werkswinkel. (5)

8.3 Noem DRIE plekke waar brandblussers geplaas behoort te word. (3)
[13]

TOTAAL: 200

QUESTION 6
OSCILLATORS

6.1 Draw a neatly labelled circuit diagram of a Hartley oscillator. **[15]**

QUESTION 7
MEASURING INSTRUMENTS

7.1 A square-wave signal is observed on an oscilloscope. One cycle measures 5 cm. Calculate the signal frequency if the horizontal sweep generator (time / division) setting is 100 µsec / cm. (7)

7.2 A sinusoidal-type waveform is displayed on the screen of an oscilloscope and is measured as having a peak amplitude of 3.2 cm. If the amplitude attenuator (voltage / division) setting is 10V/ cm, calculate the RMS-value of the sinusoidal wave. (6)
[13]

QUESTION 8
SAFETY PRECAUTIONS

8.1 State FIVE aspects that must be taken into consideration when connecting portable electrical apparatus. (5)

8.2 State any FIVE safety precautions that one must adhere to in a workshop. (5)

8.3 Name THREE places where fire extinguishers should be placed. (3)
[13]

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

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

$$V_L = V_P$$

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

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

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

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

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

$$V_X = V_L - V_C$$

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

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

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

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

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

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

$V_C = I_T \times X_C$

$V_L = I_T \times X_L$

$V_R = I_T \times R$

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

$V_X = V_C \sim V_L$

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

$I_X = I_C \sim I_L$

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

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

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

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

$X_X = X_L \sim X_C$

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 / *BEWERKINGSVERSTERKERS*

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

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

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

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

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

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

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

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*