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Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T390(**A**)(J26)T

# NASIONALE SERTIFIKAAT

# KOMMUNIKASIE-ELEKTRONIKA N5

(8080235)

**26 Julie 2019 (X-Vraestel)**
**09:00–12:00**

**Hierdie vraestel bestaan uit 7 bladsye en 'n formuleblad van 5 bladsye.**

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# DEPARTEMENT VAN HOËR ONDERWYS EN OPLEIDING
# REPUBLIEK VAN SUID-AFRIKA

NASIONALE SERTIFIKAAT
KOMMUNIKASIE-ELEKTRONIKA N5
TYD: 3 UUR
PUNTE: 100

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**INSTRUKSIES EN INLIGTING**

1. Beantwoord AL die vrae.
2. Lees AL die vrae aandagtig deur.
3. Nommer die antwoorde volgens die nommeringstelsel wat in hierdie vraestel gebruik is.
4. Begin elke afdeling op 'n NUWE bladsy.
5. Gebruik slegs 'n blou of swart pen.
6. Skryf netjies en leesbaar.

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## VRAAG 1: ALGEMEEN

Voltooi die volgende sinne deur die woorde in die lys hier onder te gebruik. Skryf slegs die ontbrekende woord of woorde langs die vraagnommer (1.1–1.5) in die ANTWOORDBOEK neer.

| invoegingsverlies; bandwydte; teen te staan; mikrofoon; prototipe; elektriese; gelykstroom; wanaanpassing; netwerke; kontroleerders |
|---|

1.1 In 'n ... stroombaan is die enigste komponent wat beskikbaar is om stroomvloei in die stroombaan ... weerstand.

1.2 ... is die totale verlies van die ...verliese tesame met die verswakkingsverliese wanneer 'n netwerk ingevoeg word.

1.3 As ...filters ontwerp word, moet sowel T- as π-netwerke ontwerp word.

1.4 Die ... sit meganiese klankgolwe in ... strome om vir versterking deur die oudio-versterker.

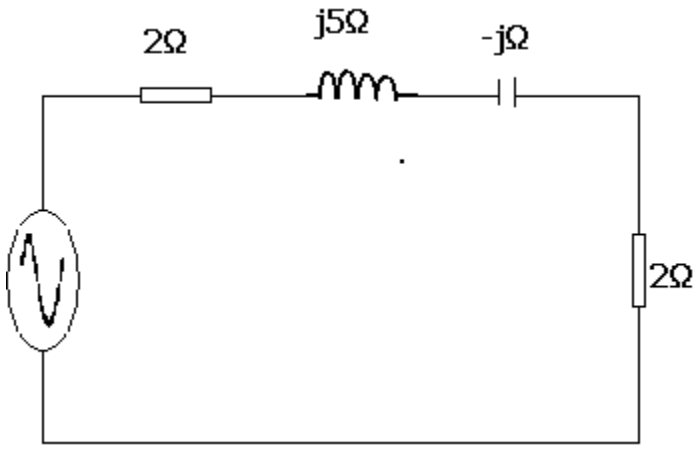
1.5 Fasevoorloop- en -naloopnetwerk... word hoofsaaklik gebruik om die akkuraatheid van die stabiliteit van die ... en versterker te verbeter.

(5 × 2) **[10]**

## VRAAG 2: WS-NETWERKE

2.1 Bestudeer FIGUUR 1 en beantwoord die afvrae.

E = 100L0°
ω = 377 rad/s




**FIGUUR 1**

2.1.1 Bepaal die totale stroom. (3)

2.1.2 Skryf die uitdrukking vir die stroom as 'n funksie van tyd. (3)

2.1.3 Teken die fasordiagram. (2)

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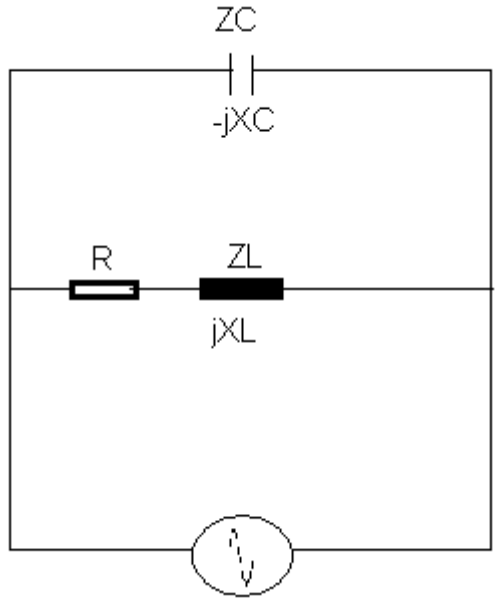
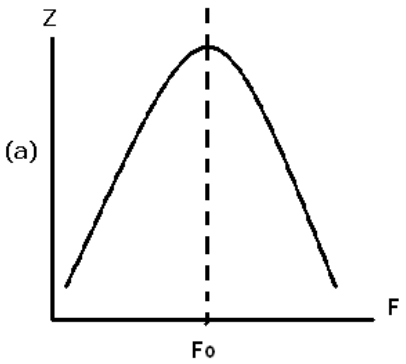
2.2 Bestudeer FIGUUR 2 en lei die formule af vir RLC- parallelle impedansie. (10)



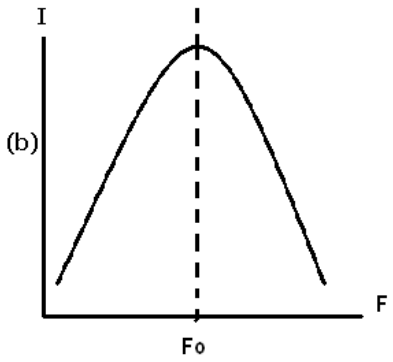

**FIGUUR 2**

2.3 Identifiseer die VIER basiese grafieke vir ingestemde kringe by resonansie.

2.3.1




2.3.2

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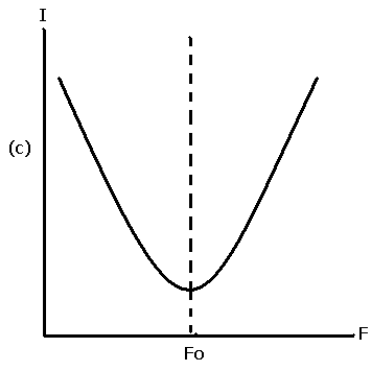
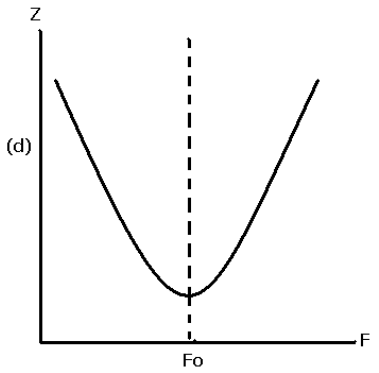
2.3.3




2.3.4




(4 × 3) (12)
**[30]**

## VRAAG 3: VIERTERMINAALNETWERKE

3. Definieer 'n *simmetriese tweepoortnetwerk.* (3)

3.2 Die waardes van suiwer weerstande van 'n tipiese simmetriese T-netwerk is:

Oop kring (ZOC) = 800 ∟0° Ω

Kortsluiting (ZSC) = 600 ∟0° Ω

3.2.1 Bereken Z1 en Z2. (5)

3.2.2 Teken die netwerk. (2)
**[10]**

## VRAAG 4: FILTERS

4.1 Definieer 'n *K-konstante filter* volledig. (4)

4.2 Ontwerp 'n prototipe onderdeurlaatfilter met 'n impedansie van 600 Ω en 'n afsnyfrekwensie van 1 000 Hz. (6)
**[10]**

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## VRAAG 5: ONTVANGERS EN SENDERS

5.1 Die stadiums wat hier onder getoon word is dié van 'n AM-sender.

- RF-ossilator
- Bufferversterker
- Frekwensievermenigvuldiger
- Modulator
- Mikrofoon
- OF- ('AF') versterker
- RF-kragversterker
- Antenna

Verduidelik funksie van elke stadium volledig. (8 × 2) (16)

5.2 Noem die DRIE komponente wat volgens die AM-spektrum deur die AM-RF-dragolf bevat word. (3)
**[19]**

## VRAAG 6: ANTENNAS

6.1 Toon met behulp van sketse hoe die DRIE dele van die Yagi-Uda-antenna verbind is. (4)

6.2 Definieer die volgende DRIE elemente van 'n antenna:

6.2.1 Gerigte wins

6.2.2 Stralingsweerstand ('radiation resistance')

6.2.3 Polarisering

(3 × 3) (9)
**[13]**

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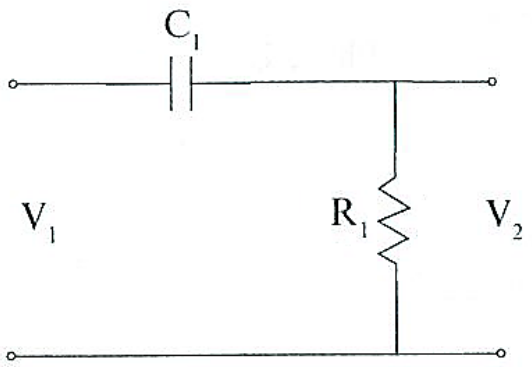
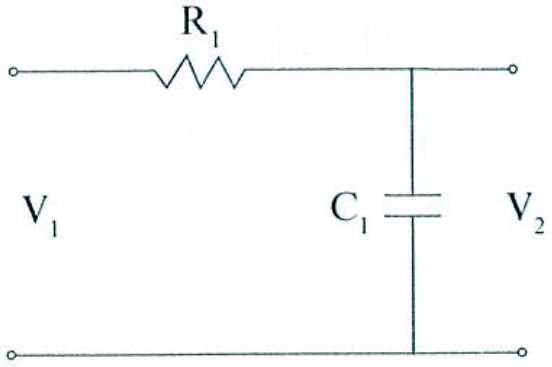
## VRAAG 7: BODE-PLOTTE

7.1 Definieer *Bode-diagramme.* (2)

7.2 Identifiseer die volgende stroombane:




7.2.1




7.2.2 (2 × 3) (6)

**[8]**

**TOTAAL: 100**

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# FORMULEBLAD

Enige ander toepaslike formule mag gebruik word.

## Induktiewe reaktansie

$$X_L = 2\pi fL$$

## Kapasitiewe reaktansie

$$X_c = \frac{1}{2\pi\ fC}$$

## Serieformules

$$Z_T = \sqrt{R^2 + (X_L - X_c)^2}$$

$$\tan\theta = \frac{X_L - X_c}{R}$$

$$BW = \frac{f_o}{Q} = \frac{R}{2\pi\ L}$$

$$p.f = \cos\phi$$

$$P = VI\cos\phi$$

$$Y = \frac{1}{Z} = G \pm jB$$

## Parallelformules

$$I_T = \sqrt{I_R^2 + (I_C - I_L)^2}$$

$$\tan\theta = \frac{I_C - I_L}{I_R}$$

$$I_X = I_C - I_L$$

$$p.f = \cos\phi$$

$$P = VI\cos\phi$$

$$Y_T = Y_1 + Y_2$$

## Serieresonansie

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

$$Z = R$$

$$\phi = 0^\circ$$

$$p.f = \cos\phi = 1$$

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

$$BW = \frac{f_o}{Q} = \frac{R}{2\pi\ L}$$

## Parallelresonansie

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

$$Z_D = \frac{L}{RC}$$

$$\phi = 0^\circ$$

$$p.f = \cos\phi = 1$$

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

$$BW = \frac{f_o}{Q} = \frac{R}{2\pi\ L}$$

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## FILTERS

### Onderdeurlaat

$$R_o = \sqrt{\frac{L}{C}}$$

$$f_c = \frac{1}{\pi\sqrt{LC}}$$

$$C = \frac{1}{\pi\ R_o\ f_c}$$

$$L = \frac{R_o}{\pi\ f_c}$$

$$Z_{OT} = \sqrt{\frac{L}{C}} \times \sqrt{1 - \frac{\omega^2 LC}{4}}$$

$$Z_{o\pi} = \frac{R_o}{\sqrt{1 - \frac{\omega^2 LC}{4}}}$$

### Bodeurlaat

$$R_o = \sqrt{\frac{L}{C}}$$

$$f_c = \frac{1}{4\pi\sqrt{LC}}$$

$$C = \frac{1}{4\pi\ R_o\ f_c}$$

$$L = \frac{R_o}{4\pi\ f_c}$$

$$Z_{OT} = \sqrt{\frac{L}{C}} \times \sqrt{1 - \frac{1}{4\omega^2 LC}}$$

$$Z_{o\pi} = \frac{R_o}{\sqrt{1 - \frac{1}{4\omega^2 LC}}}$$

## SIMMETRIESE VIERTERMINAALNETWERKE

### T- netwerk

$$Z_{in} = Z_{out}$$

$$Z_{OT} = \sqrt{Z_{oc} Z_{sc}}$$

$$Z_{OT} = \sqrt{\frac{Z_1^{\ 2}}{4} + Z_1 Z_2} = \frac{Z_1 Z_2}{Z_{O\pi}}$$

$$Z_1 = 2\left[Z_{oc} - \sqrt{Z_{oc}(Z_{oc} - Z_{sc})}\right]$$

$$Z_2 = \sqrt{Z_{oc}(Z_{oc} - Z_{sc})}$$

### π-netwerk

$$Z_{in} = Z_{out}$$

$$Z_{O\pi} = \sqrt{Z_{oc} Z_{sc}}$$

$$Z_{O\pi} = \frac{Z_1 Z_2}{\sqrt{\frac{Z_1^{\ 2}}{4} + Z_1 Z_2}} = \frac{Z_1 Z_2}{Z_{OT}}$$

$$Z_1 = \frac{Z_{sc}\left[Z_{oc} \pm \sqrt{Z_{oc}\ (Z_{oc} - Z_{sc})}\right]}{Z_{oc} + \sqrt{Z_{oc}(Z_{oc} - Z_{sc})} - Z_{sc}}$$

$$Z_2 = \frac{1}{2}\left[Z_{oc} \pm \sqrt{Z_{oc}(Z_{oc} - Z_{sc})}\right]$$

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## ASIMMETRIESE VIERTERMINAALNETWERKE

### L-seksie beeldimpedansie

$$Z_{o_1} = \sqrt{Z_1^2 + Z_1 Z_2}$$

$$Z_{o_2} = \frac{Z_1 Z_2}{\sqrt{Z_1^2 + Z_1 Z_2}}$$

### L-seksie iteratiewe impedansie

$$Z'O_1 = \sqrt{\frac{Z_1^2}{4} + Z_1 Z_2} + \frac{Z_1}{2}$$

$$Z'O_2 = \sqrt{\frac{Z_1^2}{4} + Z_1 Z_2} - \frac{Z_1}{2}$$

## NETWERKOMSETTING

### T → π-omsetting

$$ZA = \frac{Z_1 Z_2 + Z_2 Z_3 + Z_1 Z_3}{Z_2}$$

$$ZB = \frac{Z_1 Z_2 + Z_2 Z_3 + Z_1 Z_3}{Z_3}$$

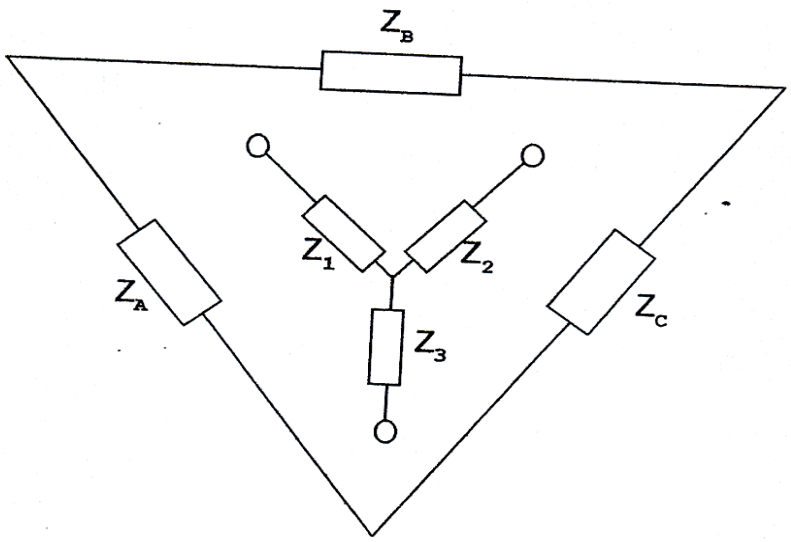
$$ZC = \frac{Z_1 Z_2 + Z_2 Z_3 + Z_1 Z_3}{Z_1}$$

### π→T-omsetting

$$Z_1 = \frac{Z_A Z_B}{Z_A + Z_B + Z_C}$$

$$Z_2 = \frac{Z_B Z_C}{Z_A + Z_B + Z_C}$$

$$Z_3 = \frac{Z_A \,.\, Z_C}{Z_A + Z_B + Z_C}$$

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## VERSWAKKERS IN DIE ALGEMEEN

$$dB = 8{,}686 \times \text{Neper}$$

$$dB = 10 \log \left( \frac{P_{in}}{P_{out}} \right)$$

$$dB = 20 \log \text{N}$$

$$Insertion\ loss = 10 \log \frac{P_1}{P_2} = 20 \log \frac{I_1}{I_2}$$

### Simmetriese verswakkers

$$N = \frac{I_{in}}{I_{out}} = \sqrt{\frac{P_{in}}{P_{out}}}$$

### Asimmetriese verswakkers

$$N = \sqrt{\frac{P_{in}}{P_{out}}}$$

### T-tipe

$$R_a = \frac{R\ (N-1)}{N+1}$$

$$R_b = \frac{2RN}{N^2-1}$$

### L-tipe

$$R_a = \sqrt{R_1(R_1 - R_2)}$$

$$R_b = \sqrt{\frac{R_1 R_2^2}{R_1 - R_2}}$$

### $\pi$-tipe

$$R_a = \frac{R\ (N+1)}{N-1}$$

$$R_b = \frac{R(N^2-1)}{2N}$$

### Oorbrugde T

$$R_a = R = Z_o$$

$$R_b = R\ (N-1)$$

$$R_c = \frac{R}{N-1}$$

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## WEDERSYDSE INDUKTANSIE

$$M = \sqrt{L_p \times L_s} \times k$$

$$k = \frac{M}{\sqrt{L_p P_s}}$$

$$k_c = \frac{1}{\sqrt{Q_p Q_s}}$$

$$Z_c = \frac{(\omega M)^2}{Z_s}$$

$$f_1 = \frac{f_o}{\sqrt{1+k}}$$

$$f_2 = \frac{f_o}{\sqrt{1-k}}$$

$$Q_p = \frac{X_{LP}}{R_p}$$

$$Q_s = \frac{X_{LS}}{R_s}$$

## Dot-reël

$$L_T = L_1 + L_2 + 2M$$
$$L_T = L_1 + L_2 - 2M$$

## AM

$$m = \frac{V_m}{V_c}$$

$$P_{DSB} = \frac{m^2 Pc}{2}$$

$$P_T = P_c\left(1 + \frac{m^2}{2}\right)$$

$$m_T = \sqrt{m_1^2 + m_2^2}$$

$$v_c = V_C \sin \omega_C t + \frac{mV_C}{2}\cos(\omega_C - \omega_m)t - \frac{mV_C}{2}\cos(\omega_C + \omega m_m)t$$

## FM

$$v_c = V_c \sin(\omega_{\cos} t - m\cos\omega_M t)$$

$$BW = f_{\text{mod}} \text{ x (aantal sybande) x } 2$$

## SHANNON-HARTLEY

$$C = \Delta f \log_2\left(1 + \frac{S}{N}\right)$$

$$dB = 10\log\left(\frac{\text{signal power}}{\text{noise power}}\right)$$

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