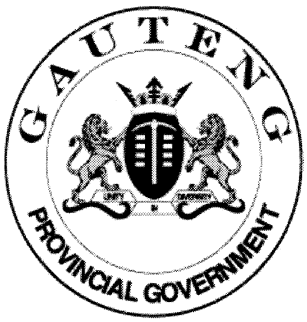
SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN



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ELECTRICIANS WORK

ELEKTRISIËNS-WERK

SG **703-2/0**

6 pages
6 bladsye

GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIORSERTIFIKAAT-EKSAMEN

ELEKTRISIËNSWERK SG

TYD: 3 uur

PUNTE: 200

BENODIGHEDE:

- Tekeninstrumente en 'n goedgekeurde nieprogrammeerbare sakrekenaar.

INSTRUKSIES:

- Beantwoord AL die vrae.
- Trek 'n lyn dwarsoor die bladsy na beantwoording van elke vraag.
- Formules en berekeninge moet, waar van toepassing, getoon word.
- 'n Lys van formules word verskaf.

VRAAG 1
ELEKTRIESE STROOMTEORIE

1.1 'n Sekere spoel is oor 'n 120 V gs-toevoer verbind, en die stroomvloei was 1,5 ampère. Dieselfde spoel is daarna oor 'n 220 V, 50 Hz ws-toevoer verbind en die stroom was 0,6 ampère. Bereken die induktansie van die spoel. (13)

1.2 Noem DRIE tipes belastings wat 'n nalopende arbeidsfaktor sal veroorsaak. (3)

1.3 Definieer die term **arbeidsfaktor**. (3)

1.4 Die onderstaande tabel toon die oombliklike waardes van 'n wisselstroom oor 'n halwe siklus:

Hoek in grade	0	30	60	90	120	150	180
Stroom in ampère	0	4	6	12	6	2	0

1.4.1 Teken 'n grafiek van hierdie waardes waar 40 mm gelyk is aan 30 grade op die X-as en 10 mm gelyk is aan 1 ampère op die Y-as. Verbind hierdie punte met reguit lyne en dui die middel-ordinate aan. (8)

1.4.2 Bepaal die vormfaktor. (9)

GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

ELECTRICIANS WORK SG

TIME: 3 hours

MARKS: 200

REQUIREMENTS:

- Drawing instruments and an approved non-programmable calculator.

INSTRUCTIONS:

- Answer ALL the questions.
- Draw a line after answering each question.
- Formulae and calculations, where applicable, must be shown.
- A list of formulae is provided.

QUESTION 1
ELECTRICAL CURRENT THEORY

1.1 When a certain coil was connected to a 120 d.c. supply, a current of 1,5 amperes was drawn. The same coil was then connected to a 220 V, 50 Hz supply and the current drawn was 0,6 amperes. Determine the inductance of the coil. (13)

1.2 Name THREE types of loads that will cause a lagging power factor. (3)

1.3 Define the term **power factor**. (3)

1.4 The table below shows the instantaneous values of an alternating current over half a cycle:

Angle in degrees	0	30	60	90	120	150	180
Current in amperes	0	4	6	12	6	2	0

1.4.1 Draw a graph of these values where 40 mm is equal to 30 degrees on the x-axis and 10 mm is equal to 1 ampere on the Y-axis. Join these values with straight lines and indicate the mid-ordinates. (8)

1.4.2 Determine the form factor. (9)

1.5 'n Seriekring bestaan uit 'n resistor van 25 ohm, 'n induktor van 0,3 henry en 'n kapasitor van 160 mikrofarad. As die toevoerspanning 100 V, 100 Hz is

1.5.1 bereken die stroom in die kring. (9)

1.5.2 bereken die fasehoek tussen die stroom en die spanning. (3)

1.5.3 bereken die drywingsfaktor. (2)

1.5.4 bereken die aktiewe stroom in die kring. (3)

1.5.5 bereken die totale drywing van die kring. (3)

1.5.6 Skets die fasordiagram met al die inligting aangedui (nie volgens skaal nie). (4)

[60]

VRAAG 2
INSTRUMENTE EN DRIEFASE-STELSELS

2.1 Teken 'n netjiese benoemde skets van 'n dinamometer-tipe wattmeter. (10)

2.2 Teken 'n kringdiagram om aan te toon hoe drie wattmeters gekoppel moet word om die totale drywing in 'n driefasige vierdraad-stelsel te meet. (8)

2.3 'n Driefasige delta-verbinde motor trek 30 A vanaf 'n 380V-toevoer teen 'n arbeidsfaktor van 0,9 nalopend.

Bereken

2.3.1 die insetdrywing. (3)

2.3.2 die skyndrywing. (3)

2.3.3 die fasestroom van die motorwikkeling. (3)

2.3.4 die vollas-rendement van die motor, as die kraglewering as 12 kW aangegee word. (3)

2.4 Noem DRIE instrumente waarmee die arbeidsfaktor in 'n enkelfase-kring bepaal kan word. (3)

2.5 As die fasespanning van 'n driefase-ster-verbinde generator 220 V is, wat sal die lynspanning wees? (3)

2.6 'n Enkelfase-motor gebruik 'n stroom van 5 A wanneer dit aan 'n 220 V-toevoer verbind word. Die wattmeter wat in die stroombaan verbind is, lees 0,85 kW. Bereken die drywingsfaktor van die kring. (4)

[40]

1.5 A series circuit consists of a resistor of 25 ohms, an inductor of 0,3 henry and a capacitor of 160 micro-farads. The supply voltage is 100 V, 100 Hz.

1.5.1 Calculate the current in the circuit. (9)

1.5.2 Calculate the phase angle between the current and the voltage. (3)

1.5.3 Calculate the power factor. (2)

1.5.4 Calculate the active current in the circuit. (3)

1.5.5 Calculate the total power of the circuit. (3)

1.5.6 Draw (not to scale) a phasor diagram with all the information given. (4)

[60]

QUESTION 2
INSTRUMENTS AND THREE-PHASE SYSTEMS

2.1 Make a neat, labelled sketch of a dynamometer-type wattmeter. (10)

2.2 Draw a circuit diagram to illustrate how three wattmeters should be connected to measure the power in a three-phase four-wire system. (8)

2.3 A three-phase delta-connected motor draws 30 A from a 380 V supply at a power factor of 0,9 lagging.

Calculate

2.3.1 the input power. (3)

2.3.2 the apparent power. (3)

2.3.3 the phase current of the motor winding. (3)

2.3.4 the full load efficiency of the motor if the output power is given as 12 kW. (3)

2.4 Name THREE instruments with which to determine the power factor of a single-phase circuit. (3)

2.5 If the phase voltage of a three-phase star-connected generator is 220 V, what will the line voltage be? (3)

2.6 A single-phase motor takes up a current of 5A when connected to 220 V supply. The wattmeter connected in the circuit reads 0,85 kW. Calculate the power factor of the circuit. (4)

[40]

VRAAG 3
TRANSFORMATORS

3.1 'n Eenfasige 140 kVA-transformator met 'n toevoer van 2 000 volt, 50 hertz het 'n uitset van 250 volt. Die sekondêre wikkeling het 100 windings. Bereken die

3.1.1 getal primêre windings. (3)

3.1.2 primêre stroom. (3)

3.2 'n Driefase-transformator het 400 primêre en 30 sekondêre windings. Die toevoerspanning is 3 300 volt. Bereken in elke geval die waarde van die sekondêre lynspanning wanneer die transformator verbind word in

3.2.1 ster-delta. (7)

3.2.2 delta-ster. (7)

3.3 Teken 'n netjiese, benoemde diagram om te wys hoe drie enkelfase-transformators aan 'n driefase-toevoer gekoppel kan word, met die primêre wikkeling in delta en die sekondêre wikkeling in ster gekonnekteer. (9)

3.4 Noem die verskillende toetse wat op 'n transformator uitgevoer kan word. (4)

3.5 Noem TWEE verliese wat in die ysterkern van transformators plaasvind. (2)
[35]

VRAAG 4
WISSELSTROOM-MOTORE

4.1 Skets 'n netjiese benoemde diagram van 'n kapasitor-induksie-motor. (8)

4.2 Noem VIER nadele van sinchrone motors, wanneer dit met gewone induksie-motors vergelyk word. (8)

4.3 Skets 'n netjiese, benoemde kringdiagram van 'n driefase handbediende ster-delta-aansitter. (12)

4.4 'n Tweepool-driefase-induksiemotor word aan 'n 380 volt, 50 Hz-toevoer verbind. Die glip van die motor is 3%. Bereken die rotorspoed. (7)
[35]

QUESTION 3
TRANSFORMERS

3.1 A single-phase 140 kVA transformer with a supply of 2 000 volt, 50 hertz has an output of 250 volt. The secondary winding has 100 turns. Calculate the

3.1.1 number of primary turns. (3)

3.1.2 primary current. (3)

3.2 A three-phase transformer has 400 primary and 30 secondary turns. The supply voltage is 3 300 volts. Calculate, in each case, the value of the secondary line voltage when the transformer is connected in

3.2.1 star-delta. (7)

3.2.2 delta-star. (7)

3.3 Make a neat diagrammatic sketch to show how three single-phase transformers may be connected to a three-phase supply, with the primary side in delta and the secondary side in star connection. (9)

3.4 Name the different tests which can be carried out on a transformer. (4)

3.5 Name the TWO losses which occur in the iron core in transformers. (2)
[35]

QUESTION 4
ALTERNATING-CURRENT MOTORS

4.1 Draw a neat, labelled circuit diagram of a capacitor-induction motor. (8)

4.2 Name FOUR disadvantages of synchronous motors, when compared to ordinary induction motors. (8)

4.3 Draw a neat, labelled circuit diagram of a three-phase manual star-delta starter. (12)

4.4 A 2-pole, three-phase induction motor is connected to a 380 volt, 50 Hz supply. The slip of the motor is 3%. Calculate the rotor speed. (7)
[35]

VRAAG 5
ELEKTRONIKA EN VEILIGHEID

5.1 Wat is die kenmerke van 'n transistorkring in 'n gemeenskaplike kollektor-konfigurasie? (8)

5.2 Teken 'n kringdiagram van 'n transistor in 'n eenvoudige versterker-kring. Toon die inset- en uitsetgolf-vorms. (8)

5.3 Noem VIER voordele van halfgeleier-diodes, wanneer hulle vergelyk word met buisdiodes. (8)

5.4 Verduidelik hoe Vigs van een persoon na 'n ander oorgedra kan word. (6)
[30]

TOTAAL: 200

QUESTION 5
ELECTRONICS AND SAFETY

5.1 What are the characteristics of a transistor circuit in a common collector configuration? (8)

5.2 Draw a circuit diagram of a transistor in a simple amplifier circuit. Show the input and output waveforms. (8)

5.3 Name FOUR advantages of semiconductor diodes, when compared to tube diodes. (8)

5.4 Explain how Aids can be spread from one person to another. (6)
[30]

TOTAL: 200

FORMULA SHEET ***FORMULEBLAD***

$Z = \sqrt{R^2 + (X_L \approx X_c)^2}$ $V_R = I_T \times R$ $I_T = \frac{V_T}{Z}$

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

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

$V_L = I_T \times X_L$ $V_c = I_T \times X_c$

$I_T = \sqrt{I_R^{\ 2} + (I_c \approx I_L)^2}$ $I_R = \frac{V_R}{R};$ $I_L = \frac{V_L}{X_L};$ $I_C = \frac{V_c}{X_c};$ $Cos\theta = \frac{I_R}{I_T}$

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

$P = V \times I \times \cos\theta$ $\cos\theta = \frac{R}{Z}$ $\tan\theta = \frac{X_L - X_c}{R};$ $\cos\theta = \frac{P}{VA}$

$P = I^2R$

$I_{act} = I \times \cos\theta$ $I_{react} = I \times \sin\theta$

Star/*ster*	Delta/*delta*
$I_L = I_{ph}$	$I_L = \sqrt{3} \times I_{ph}$
$V_L = \sqrt{3} \times V_{ph}$	$V_L = V_{ph}$

$F = \frac{pN}{60}$ $S = \frac{N_s - N_R}{N_S} \times 100\%$ $N_R = \frac{f}{p}(1-s)$

$P = \sqrt{3} \times V_L \times I_L \times \cos\theta$

$S = \sqrt{3} \times V_L \times I_L;$ $\frac{V_p}{V_s} = \frac{N_P}{N_s} = \frac{I_s}{I_p}$ or / of $\frac{V_1}{V_2} = \frac{N_1}{N_2} = \frac{I_2}{I_1}$

Efficiency = $\frac{\text{Output}}{\text{Input}}$ *Rendement* = $\frac{Afvoer}{Invoer}$

END / *EINDE*