SENIOR CERTIFICATE EXAMINATION

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ELECTRICIANS WORK

SG

703-2/0 E

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6 pages

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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 across the page in your answer book upon completion of each question.
- Formulae and calculations, where applicable, must be shown.
- A list of formulae appears on the last page of the question paper.

QUESTION 1
ELECTRICAL CURRENT THEORY

1.1 A parallel circuit consists of a non-inductive resistance of 20 ohms, an inductor of 35 mH, and a capacitor of 180 microfarad. The supply voltage is 150 V / 50 Hz.

Calculate the

1.1.1 current through each component. (12)

1.1.2 total current. (3)

1.1.3 impedance. (3)

1.2 The following midordinate values are obtained from a graph which represents the instantaneous values of an alternating current over a half cycle.

Midordinate	i1	i2	i3	i4	i5	i6
Current in ampere	2	5	8	9	6	3

Use these midordinate values and calculate

1.2.1 the form factor. (10)

1.3 Of which TWO components does the current drawn from a supply consist? (2)

1.4 A series circuit consists of a resistor of 25 ohms, an inductor of 0,3 henry and a capacitor of 160 microfarad. If the supply voltage is 100 V / 100 Hz, calculate the

1.4.1 current in the circuit. (12)

1.4.2 phase angle between the current and the voltage. (3)

1.4.3 power factor. (2)

1.4.4 active current in the circuit. (3)
[50]

QUESTION 2
INSTRUMENTS

2.1 Draw a neat, labelled diagram of a power-factor meter and indicate how it is connected in a circuit. (10)

2.2 Explain the basic operating principle of a dynamometer type wattmeter. (8)

2.3 What type of meter will reflect the true power in a circuit? (1)

2.4 Why is an ammeter connected in series to a circuit? (1)
[20]

QUESTION 3
THREE-PHASE SYSTEMS

3.1 The full-load output of a 600 volt three-phase motor is 12 kW. If the input line current at full load is 20 amperes at a power factor of 0,9, what is the efficiency of the motor? (6)

3.2 A 200 kW three-phase, delta-connected motor is connected to a 500 V supply. The power factor is 0,9 and the efficiency is 90%.

Calculate the

3.2.1 line current of the motor. (8)

3.2.2 phase current of the motor. (3)

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

Calculate the

3.3.1 input power. (3)

3.3.2 apparent power. (3)

3.3.3 phase current of the motor winding. (4)

3.3.4 full-load efficiency of the motor if the input power is given as 12 kW. (3)
[30]

QUESTION 4
TRANSFORMERS

4.1 What safety precaution must be taken when an ammeter is removed from the current transformer, and why is it necessary to take this precaution? (3)

4.2 State TWO advantages and TWO disadvantages of an auto-transformer. (4)

4.3 A three-phase transformer is connected in delta-star to a 22 kV line. The transformer has 6 400 primary windings and takes a full-load line current of 8 amperes on the same side. The secondary line voltage is 380 volts with a lagging power factor of 0,8.

Calculate the

4.3.1 secondary phase voltage. (4)

4.3.2 transformation ratio. (4)

4.3.3 number of secondary windings. (3)

4.3.4 primary phase current. (3)

4.3.5 output power of the transformer. (3)

4.4 What is the function of a breather in a transformer? (4)

4.5 Name TWO tests which can be carried out on a transformer. (2)
[30]

QUESTION 5
ALTERNATING-CURRENT MOTORS

5.1 Draw a neat, labelled diagram of the starting circuit of the slip-ring induction motor. (15)

5.2 A four-pole, three-phase induction motor is connected to a 380 volt / 50 hertz supply. The slip of the motor is 5%.

Calculate the

5.2.1 synchronous speed. (4)

5.2.2 rotor speed. (4)

5.3 Name FOUR examples of safety devices that could be included in the safety circuit of a motor starter. (4)

5.4 Draw a neat, labelled diagram of a shaded-pole induction motor. (9)

5.5 Which TWO factors determine the efficiency of a machine? (2)

5.6 Explain the term **rotor speed**. (2)
[40]

QUESTION 6
ELECTRONICS

6.1 Name THREE advantages of semiconductor diodes, when compared with tube diodes. (3)

6.2 State TWO practical applications of an oscilloscope. (2)

6.3 Draw a neat, labelled circuit diagram of a 220/12 V power supply that makes use of a centre-tapped transformer with a secondary turn. (6)

6.4 Draw a labelled sketch of a cathode-ray tube. (9)
[20]

QUESTION 7
SAFETY

7.1 State the FIVE basic causes of accidents. (5)

7.2 Explain how Aids can be spread from one person to another. (5)
[10]

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*