GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

ELECTRICIANS WORK SG

FEB / MAR 2006

TIME: 3 hours

MARKS: 200

REQUIREMENTS:

- Drawing instruments and an approved calculator

INSTRUCTIONS:

- Answer ALL the questions.
- Rule off after each question in your answer book.
- Where applicable, formulae and calculations must be shown.
- A list of formulae appears on the last page of the question paper.

QUESTION 1
ELECTRICAL CURRENT THEORY

1.1 A series circuit consists of a coil, having a resistance of 8 ohms and inductance of 0,2 Henry, connected to a capacitor having a reactance of 12 ohms. The current flowing in the circuit is 1,2 amperes, and the frequency of the supply is 50 Hz.

Calculate:

1.1.1 The supply voltage (10)

1.1.2 The total power used by the circuit (5)

1.1.3 The capacity of the capacitor in microfarad (5)

1.2 The instantaneous values over half a cycle of an alternating voltage are given in the table below:

Voltage (in volts)	0	12	15	16	14	6	0
Angle (in degrees)	0	30	60	90	120	150	180

Using the scales 2 V = 1 cm and 30° = 2 cm draw the graph of the alternating voltage by connecting the points with straight lines. Draw SIX mid-ordinates. Determine the form factor of the wave. (20)

1.3 An alternating current is represented by the following equation:

$$i = 75 \sin 563\, t \text{ amperes}$$

Calculate the

1.3.1 effective value of the current. (3)

1.3.2 frequency of the supply. (3)

1.3.3 instantaneous value of the current 0,003 seconds after it has been switched on. (4)

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

1.5 Calculate the frequency of an alternating voltage which has a cycle time of 5 ms. (3)

1.6 What ideal phase angle must be aimed for in an installation? (2)

1.7 How many radials equal 180°? (2)
[60]

QUESTION 2
INSTRUMENTS AND THREE-PHASE ALTERNATING CURRENT SYSTEMS

2.1 Draw neat, labelled circuit diagrams of the following instrument transformers connected to a supply:

2.1.1 A current transformer (4)

2.1.2 A voltage transformer (5)

2.2 Discuss the vibrating-reed frequency meter under the following headings:

2.2.1 Construction (5)

2.2.2 Operation (5)

2.3 The supply to a 125 kW three-phase motor is 380 V. If the power factor is 0,9 and the efficiency of the motor is 85%, calculate the line current taken by the motor. (8)

2.4 In a star connected system the line voltage is 380 volt and the phase current is 25 amperes. Determine the phase voltage and line current. Draw the circuit diagram of the system, and show all given and calculated values. (10)

2.5 A three-phase delta connected motor draws 25 A from a 380 V supply at a power factor of 0,86 lagging. Calculate the input power. (3)
[40]

QUESTION 3
TRANSFORMERS

3.1 State FOUR conditions for the satisfactory parallel functioning of transformers. (8)

3.2 The supply voltage to a 120 kVA, 50 Hz, single-phase transformer is 2 000 volts and the output voltage is 380 volts. The transformer has 150 turns on the secondary winding.

Calculate the

3.2.1 primary current at full load. (4)

3.2.2 secondary current at full load. (4)

3.2.3 number of primary turns. (4)

3.3 Calculate the secondary current capacity of a three-phase 250 kVA transformer with an output voltage of 7 000 volts. (4)

3.4 Sketch the wiring diagram of a three-phase transformer, which consists of three single-phase transformers. The three-phase transformer is connected in delta-star. (8)

3.5 What is the function of a breather? (3)
[35]

QUESTION 4
ALTERNATING-CURRENT MOTORS

4.1 Explain briefly the difference between synchronous speed and rotor speed. (4)

4.2 A six-pole motor is fed by a 50 Hz supply. Determine the speed of the motor if the slip is 8%. (7)

4.3 Draw a labelled circuit diagram of a capacitor start-and-run motor. (8)

4.4 Mention the TWO factors which determine the speed of an induction type alternating current motor. (2)

4.5 What is the purpose of the no-volt coil in a motor starter? (4)

4.6 Draw the control circuit of a direct-on-line starter that will change the direction of rotation of the motor. (10)

[35]

QUESTION 5
ELECTRONICS AND OCCUPATIONAL SAFETY

5.1 Name the characteristics of a transistor amplifier with a common emitter configuration. (6)

5.2 Draw a fully labelled diagram of a rectifier circuit using a transformer and four junction diodes. (9)

5.3 Indicate, with the aid of diagrammatic sketches, what is understood by the terms **forward bias** and **reverse bias** for a diode. (10)

5.4 Explain what you would do if you noticed that a learner in the workshop was being shocked by an electrical supply. (5)

[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 = $\frac{\textbf{Output}}{\textbf{Input}}$ *Rendement* = $\frac{Afvoer}{Invoer}$

END / *EINDE*