SENIOR CERTIFICATE EXAMINATION
SENIORSERTIFIKAAT-EKSAMEN

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TECHNIKA (ELECTRICAL)
TECHNIKA (ELEKTRIES)

SG 713-2/0

5 pages
5 *bladsye*

TECHNIKA ELECTRICAL SG

713 2 0 SG

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GAUTENGSE DEPARTEMENT VAN ONDERWYS

SENIORSERTIFIKAAT-EKSAMEN

TECHNIKA (ELEKTRIES) SG

TYD: 3 ure

PUNTE: 200

BENODIGDHEDE:

- 'n Goedgekeurde sakrekenaar en tekeninstrumente

INSTRUKSIES:

- Beantwoord ALLE vrae.
- Sketse en diagramme moet duidelik en netjies wees.
- Formules en berekeninge moet duidelik wees.
- Formules en berekeninge moet, waar van toepassing, getoon word.
- 'n Lys formules, wat gebruik mag word waar van toepassing, word op die laaste bladsy van hierdie eksamenvraestel verskaf.

VRAAG 1
WISSELSTROOMTEORIE

1.1 'n WS-toevoer van 200V teen 100 Hz word oor 'n seriekring toegepas. Die kring bevat 'n resistor van 5 ohm, 'n induktansie van 0,01H en 'n 75 mikrofarad kapasitor.

Bereken:

1.1.1 Die totale stroom deur die kring (12)
1.1.2 Die fasehoek (3)
1.1.3 Die potensiaalverskil oor elke komponent (9)
1.1.4 Teken die fasordiagram (nie volgens skaal nie) (6)

1.2 'n Kring bestaan uit 'n nie-induktiewe weerstand van 40 ohm, 'n suiwer induktor van 0,5 henry en 'n kapasitor van 100 mikrofarad wat almal in parallel gekoppel is aan 'n toevoer van 110V, 50 Hz.

1.2.1 Bereken die stroom deur elke komponent. (10)

[40]

VRAAG 2
EEN- EN DRIEFASESTELSELS

Teken TWEE diagramme wat ster- en deltaverbindings sal illustreer. Die lyn- en fasewaardes van die strome en spannings moet aangedui word, as die toevoerspanning 380V en die stroom 10 Ampère is. (10)

[10]

GAUTENG DEPARTMENT OF EDUCATION

SENIOR CERTIFICATE EXAMINATION

TECHNIKA (ELECTRICAL) SG

TIME: 3 hours

MARKS: 200

REQUIREMENTS:

- An approved calculator and drawing instruments

INSTRUCTIONS:

- Answer ALL the questions.
- Sketches and diagrams should be clear and neat.
- Formulae and calculations must be clear.
- Where applicable, formulae and calculations must be shown.
- A list of formulae, which could be used where appropriate, is provided on the last page of the question paper.

QUESTION 1
ALTERNATING CURRENT THEORY

1.1 An AC supply of 200V at 100 Hz is connected across a series circuit. The circuit consists of a resistor of 5 ohm, an inductance of 0,01H and a 75 microfarad capacitor.

Calculate:

1.1.1 The total current of the circuit (12)
1.1.2 The phase angle (3)
1.1.3 The potential difference across each component (9)
1.1.4 Draw the phasor diagram (not to scale) (6)

1.2 A circuit consists of a non-inductive resistance of 40 ohm, a pure inductor of 0,5 henry and a capacitor of 100 microfarads, which are all connected in parallel to a supply of 110V, 50 Hz.

1.2.1 Calculate the current through each component. (10)
[40]

QUESTION 2
SINGLE AND THREE-PHASE SYSTEMS

Draw TWO diagrams that would illustrate star and delta connections. The line and phase values of the currents and voltages must be shown, if the supply voltage is 380V and the current is 10 Ampère. (10)
[10]

VRAAG 3
TRANSFORMATORS

3.1 'n 300 kVA ster-delta transformator met 'n windingsverhouding van 10:1, het 'n sekondêre lynspanning van 2,2 kV.

Bereken:

3.1.1 Die primêre fase- en lynspanning (7)
3.1.2 Die primêre lynstroom (4)
3.1.3 Die kraglewering teen vollas met 'n arbeidsfaktor van 0,85 nalopend (3)

3.2 Met verwysing na transformators, verduidelik die volgende:

3.2.1 Werwelstroomverliese (3)
3.2.2 Histereseverliese (3)
[20]

VRAAG 4
WISSELSTROOMMOTORS

4.1 Wanneer WS-motors met GS-motors vergelyk word, het hulle sekere voordele. Noem VYF voordele van WS-motors. (10)

4.2 Verduidelik hoe jy die volgende toetse op die stator van 'n driefasemotor sal uitvoer:

4.2.1 'n Isolasietoets tussen die wikkelings (3)
4.2.2 'n Isolasietoets tussen die wikkelings en aard (3)

4.3 Bespreek kortliks die TWEE funksies van die nulspanningspoel in 'n motoraansitter. (4)

4.4 Gee 'n kort beskrywing van die konstruksie en beginsel van werking van 'n split-fase-induksiemotor. (10)
[30]

VRAAG 5
HALFGELEIERS

Verduidelik volledig die werking van 'n TRIAK. Jou verduideliking moet sketse en kringdiagramme insluit. (10)
[10]

VRAAG 6
VERSTERKERS

6.1 Verduidelik, met behulp van netjies benoemde kurwes **en** 'n kort beskrywing, die werkbeginsel van 'n klas B-versterker. (10)

6.2 Teken die kringdiagram van 'n resistor-kapasitorgekoppelde versterker. Beskryf ook die doel van elke komponent van die versterker. (12)
[22]

QUESTION 3
TRANSFORMERS

3.1 A 300 kVA star-delta transformer with a winding ratio of 10:1 has a secondary line voltage of 2,2 kV.

Calculate:

3.1.1 The primary phase and line voltage (7)
3.1.2 The primary line current (4)
3.1.3 The outpower at full load with a power factor of 0,85 lagging (3)

3.2 With reference to transformers, explain the following:

3.2.1 Eddy current losses (3)
3.2.2 Hysteresis losses (3)
[20]

QUESTION 4
ALTERNATING CURRENT MOTORS

4.1 When AC motors are compared to DC motors, they have certain advantages. Name FIVE advantages of AC motors. (10)

4.2 Explain how you will perform the following tests on a stator of a three-phase motor:

4.2.1 An insulation test between the windings (3)
4.2.2 An insulation test between the windings and earth (3)

4.3 Briefly describe the TWO functions of the no-volt coil in a motor starter. (4)

4.4 Give a brief description of the construction and principle of operation of a split-phase induction motor. (10)
[30]

QUESTION 5
SEMI-CONDUCTORS

Explain fully the working principle of a TRIAC. Your explanation must include sketches and circuit diagrams. (10)
[10]

QUESTION 6
AMPLIFIERS

6.1 Explain, with the aid of neatly labelled curves **and** a brief description, the working principle of a class B amplifier. (10)

6.2 Draw the circuit diagram of a resistor-capacitor coupled amplifier. Describe also the purpose of each component in the amplifier. (12)
[22]

VRAAG 7
SKAKEL- EN BEHEERKRINGE

Verduidelik volledig die werking van Zenerdioderegulering in kragbronne. Jou verduideliking moet sketse en kringdiagramme insluit. (15)
[15]

VRAAG 8
OPERASIONELE VERSTERKERS

8.1 Teken 'n netjies benoemde kringdiagram wat gebruik maak van 'n operasionele versterker om as 'n omkeerversterker te werk. (5)

8.2 Teken 'n netjies benoemde kringdiagram van 'n omkeerversterker. (5)
[10]

VRAAG 9
OSSILATORS

Teken die kringbaan en verduidelik die werkbeginsel van die Colpitts-ossilator. (10)
[10]

VRAAG 10
REKENAARBEGINSELS

10.1 Teken 'n netjies benoemde logikakring vir die volgende Boole-algebraïse uitdrukking en teken ook die waarheidstabel in jou antwoordboek.

$$F = (\overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,B\,\overline{C} + ABC + \overline{A}\,\overline{B}\,C)$$ (8)

10.2 Verduidelik, met behulp van 'n netjies benoemde logikakring die werkbeginsel van 'n volopteller. (10)
[18]

VRAAG 11
MEETINSTRUMENTE

Teken 'n netjies benoemde blokdiagram van 'n ossiloskoop. (15)
[15]

TOTAAL: 200

QUESTION 7
SWITCHING AND CONTROL CIRCUITS

Fully explain the working principle of Zener diode regulation of power sources. Your explanation must include sketches and circuit diagrams. (15)
[15]

QUESTION 8
OPERATIONAL AMPLIFIERS

8.1 Draw a neatly labelled circuit diagram that uses an operational amplifier that serves as an inverting amplifier. (5)

8.2 Draw a neatly labelled circuit diagram of an inverting amplifier. (5)
[10]

QUESTION 9
OSCILLATORS

Draw the circuit diagram and explain the working principle of the Colpitts oscillator. (10)
[10]

QUESTION 10
COMPUTER PRINCIPLES

10.1 Draw a neatly labelled logic circuit using the Boolean expression below and also draw the truth table in your answer book.

$$F = (\overline{A}\,\overline{B}\,\overline{C} + \overline{A}\,B\,\overline{C} + ABC + \overline{A}\,\overline{B}\,C)$$ (8)

10.2 Explain, with the aid of a neatly labelled logic circuit, the working principle of a full adder. (10)
[18]

QUESTION 11
MEASURING INSTRUMENTS

Draw a neatly labelled block diagram of an oscilloscope. (15)
[15]

TOTAL: 200

FORMULAE/*FORMULES*

$$X_L = 2\pi fL$$

$$f_r = \frac{1}{2\pi\sqrt{LC}} \text{ and/}en \text{ Fr} = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}$$

Time constant/*Tydkonstant* t = RC

$$Z = \frac{V}{I}$$

$$I_E = I_B + I_C$$

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

$$I_r = I \sin \Phi; I_2 = 1 \cos \Phi$$

$$Cos\ \Phi = \frac{P}{P_{apparent/skynbaar}}$$

Star/*Ster*

$$R = Z \cos \Phi$$

$$V_p = \frac{V_L}{\sqrt{3}}; I_P = I_L$$

Delta

$$V_p = V_L; I_P = \frac{I_L}{\sqrt{3}}$$

$$P = \sqrt{3}\, V_L I_L \cos \Phi$$

$$I = \frac{V}{Z}$$

$$Z = \frac{L}{CR}$$

$$\frac{V_P}{V_S} = \frac{N_P}{N_S} = \frac{I_S}{I_P}$$

$$f = \frac{1}{t}$$

$$f = \frac{W}{2\pi}$$

$$f = \frac{_P N}{60}$$

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

$$I_C = \frac{V_{CE}}{R_L}$$

$$\text{Cos}\ \Phi = \frac{R}{Z}$$

$$\text{Efficiency/}Rendement = \frac{Output\ /\ Uitset}{Input\ /\ Inset}$$

$$S = \frac{N_s - N_r}{N_s}$$

$$\beta = \frac{I_C}{I_B}$$

END/EINDE