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Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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APRIL EXAMINATION

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONCS N4

(8080164)

8 April 2016 (X-Paper)
09:00–12:00

This question paper consists of 7 pages, 1 formula sheet of 2 pages.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N4
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Write neatly and legibly.

QUESTION 1

Use Kirchhoff's laws to calculate the current flowing through the 30 Ω resistor in FIGURE 1 below.

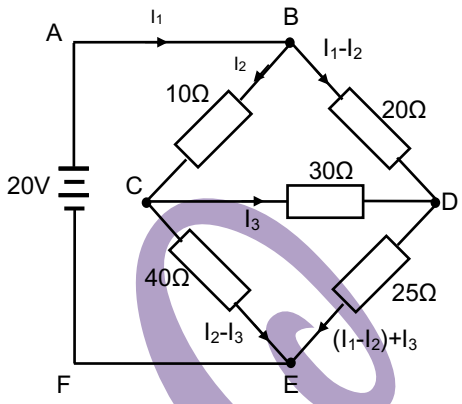

FIGURE 1 **[10]**

QUESTION 2

A circuit consists of a resistor with resistance of 50 Ω, an inductor with inductance of 0,2 H and a capacitor with capacitance of 100 μF respectively, connected in parallel across a 100 V, 60 Hz supply.

Calculate the following:

2.1 The current through the resistor (1)

2.2 The current through the inductor (2)

2.3 The current through the capacitor (2)

2.4 The resultant current (2)

2.5 The total power of the circuit (3)

[10]

QUESTION 3

3.1 Draw a neat symbol of a zener diode. Also explain its characteristic curve using a diagram. (5)

3.2 A 150kVA transformer has an input voltage of 2 200 V, and an output voltage of 400 V, at a frequency of 50 Hz. It has 100 turns on the secondary winding.

Calculate the following:

3.2.1 The primary current

3.2.2 The secondary current

3.2.3 The number of primary turns

(3 x 2) (6)

3.3 Explain the term *voltage regulation.* (2)

3.4 What is the purpose of a filter circuit in a power supply? (2)
[15]

QUESTION 4

4.1 A common base amplifier produces an output of 6 mA with an input current of 5 μA. The output voltage changes with 8 V by means of 4 V input voltage.

Calculate the following dynamic values:

4.1.1 The input impedance

4.1.2 The output conductance

4.1.3 The forward current gain

(3 x 2) (6)

4.2 Use a graph to illustrate what is meant by cross-over distortion and explain how it can be minimised. (4)

4.3 A field effect transistor is a voltage controlled device. (True/False) (1)

4.4 Draw a neat block diagram of negative feedback. (4)
[15]

QUESTION 5

5.1 Calculate the gain and the output voltage of an amplifier whose output voltage is 180° out of phase with the input voltage if the following information is available:

- Input voltage = 0,4 V
- Feedback resistance = 10 kΩ
- Input resistance = 1 kΩ (4)

5.2 Consider FIGURE 2 below and answer the following questions.

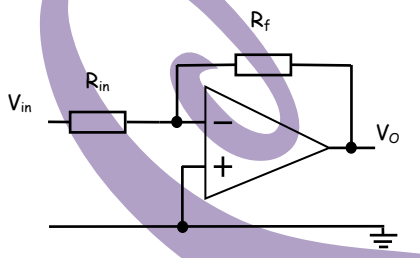

FIGURE 2

5.2.1 Identify the operational amplifier. (1)

5.2.2 Draw a 720° input square wave form and the expected output wave-form. (3)

5.2.3 Calculate the input resistance if Vin = 2 V, Vout = 5 V and feedback resistance is 1 kΩ. (3)

5.3 Name FOUR main characteristics of an ideal operational amplifier. (4 x 1) (4)
[15]

QUESTION 6

6.1 Various options are given as possible answers to the following questions. Choose the answer and write only the letter (A–C) next to the question number (6.1.1–6.1.5) in the ANSWER BOOK.

6.1.1 For normal SCR switching turn on depends on …

A cathode current.
B anode current.
C gate current.

6.1.2 Holding current of a thyristor is …

A less than the line current.equal to the line current.
B equal to the line current.
C more than the line current.

6.1.3 ONE of the applications of the LASCR is in …

A optical light controls.
B regulated power suppliers.
C relay control.

6.1.4 A triac is a(n) …

A unidirectional switch.
B bidirectional switch.
C four-directional switch.

6.1.5 A diac can be termed as …

A diode AC switch.
B triode AC switch.
C diode DC switch.

(5 x 1) (5)

6.2

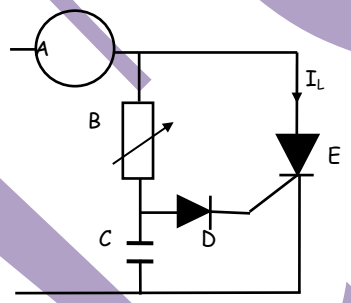

FIGURE 3

FIGURE 3 above shows a circuit application of a certain thyristor.

Consider the circuit and answer the following questions:

6.2.1 Label the parts marked A–E in the figure. Write the name next to the letter (A–E) in the ANSWER BOOK.

6.2.2 Explain the operation.

(2 x 5) (10)
[15]

QUESTION 7

7.1 State THREE important requirements for the design of a transducer to ensure reliable operation of a control system. (3 x 1) (3)

7.2 Briefly explain the principle of operation and give a construction of an LVDT. (7)
[10]

QUESTION 8

8.1 Draw a neat, labelled construction of an electrostatic cathode ray tube. (7)

8.2 Name the THREE uses of a triangular wave form. (3)
[10]

TOTAL: 100

INDUSTRIAL ELECTRONICS N4

FORMULA SHEET

$$\frac{1}{R_T}=\left(\frac{1}{R_1}+\frac{1}{R_2}+\ldots\frac{1}{R_n}\right) \qquad R_T=\frac{R_1R_2}{R_1+R_2} \qquad V_2=\frac{R_2}{R_1+R_2}\times\frac{V_T}{1}$$

$$Z=\sqrt{R^2+(X_L-X_c)^2} \qquad Cos\ \theta°=\frac{R}{Z} \qquad P=I^2R \qquad P=\frac{V^2}{R} \qquad P=VI\text{Cos}\theta$$

$$P=V\ .\ I \qquad F_r=\frac{1}{2\pi\sqrt{LC}} \qquad Q=\frac{X_L}{R} \qquad OF \quad \frac{1}{R}\sqrt{\frac{L}{C}}$$

$$I_t=\sqrt{I_R^2+(I_c-I_L)^2} \qquad Z=\frac{1}{\sqrt{\left(\frac{1}{R}\right)^2+\left(\frac{1}{X_c}-\frac{1}{X_L}\right)^2}} \qquad \frac{N_1}{N_2}=\frac{V_1}{V_2}=\frac{I_2}{I_1}$$

$$V_{rms\,/\,wgk}=0{,}707\,V_m \qquad i=I_s\left(e^{\frac{gv}{kT}}-1\right) \qquad R=\frac{kT}{qi} \qquad V.R=\frac{V_{NL}-V_{FL}}{V_{FL}}$$

$$V_{ave\,/\,gem}=0{,}637\,V_m$$

$$f=\frac{1}{t} \qquad \textit{Rate of change/Tempo van verandering} = -\frac{V_{in}}{CR_{in}}$$

$$V_{dc}\,/\,V_{gs}=0{,}318\,V_m \qquad V_{dc}\,/\,V_{gs}=0{,}637\,V_m$$

$$V_{r_{rms}}/V_{r\,wgk}=0{,}385\,V_m$$

$$PIV=V_m \quad or/of \quad 2\,V_m$$

$$V_{r_{rms}}/V_{r_{wgk}}=\frac{V_r\ (p-p)}{2\sqrt{3}} \qquad V_{dc}\,/\,V_{gs}=V_m-\frac{V_r\ (p-p)}{2}$$

$$r=\frac{V_{r_{rms}}\,/\,V_{r_{wgk}}}{V_{dc}\,/\,V_{gs}} \qquad V_{r_{rms}}/V_{r_{wgk}}=\frac{V_{dc}\,/\,V_{gs}}{R_L\ 2\sqrt{3}\ FC}$$

$$V_{dc}\,/\,V_{gs}=V_m \quad \frac{I_{dc}\,/\,I_{gs}}{2FC} \qquad r=\frac{I_{dc}\,/\,I_{gs}}{V_{dc}\,/\,V_{gs}\ 2\sqrt{3}\ FC}$$

$$V_{r'_{rms}}\,/\,V_{r'_{wgk}}=\frac{X_c}{\sqrt{R^2+X_c^2}}\times\frac{V_{r_{rms}}\,/\,V_{r_{wgk}}}{1}$$

$$V'_{dc}\,/\,V'_{gs}=\frac{R_L}{R_L+R_S}\times\frac{V_{dc}\,/\,V_{gs}}{1} \qquad V_{r'_{rms}}\,/\,V_{r'_{wgk}}=\frac{V_{r_{rms}}\,/\,V_{r_{wgk}}}{(2\pi f)^2\ LC}$$

$$R_{in} = \frac{V_{be}}{I_b} \qquad R_{out} / R_{uit} = \frac{V_{ce}}{I_c} \qquad R_c = \frac{V_{cc}}{I_c} \qquad V_{out} / V_{uit} = R_1 C \frac{dv_i}{dt}$$

Static current gain/Statiese stroomwins $= \frac{I_{out/uit}}{I_{in}}$

Dynamic current gain/Dinamiese stroomwins $= \frac{\Delta I_{out/uit}}{\Delta I_{in}}$

$$V_{cc} = V_{RC} + V_{ce} \qquad V_{ce} = V_{cc} - V_{RC} \qquad R = \frac{p\ell}{a}$$

$$A_p = 10 \log \frac{P_{out/uit}}{P_{in}} \qquad A_v = 20 \log \frac{V_{out/uit}}{V_{in}} \qquad A_i = 20 \log \frac{I_{out/uit}}{I_{in}}$$

Static voltage gain/Statiese spanningswins $= \frac{V_{out}/V_{uit}}{V_{in}}$

Dynamic voltage gain/Dinamiese spanningswins $= \frac{\Delta V_{out/uit}}{\Delta V_{in}}$

$hie = \frac{\Delta V_{in}}{\Delta I_{in}} = \frac{\Delta V_{be}}{\Delta I_b}$ $\quad V_{ce}$ = *constant/konstant*

$hre = \frac{\Delta V_{in}}{\Delta V_{out/uit}} = \frac{\Delta V_{be}}{\Delta V_{ce}}$ $\quad I_b$ = *constant/konstant*

$hfe = \frac{\Delta I_{out/uit}}{\Delta I_{in}} = \frac{\Delta I_c}{\Delta I_b}$ $\quad V_{ce}$ = *constant/konstant*

$hoe = \frac{\Delta I_{out/uit}}{\Delta V_{out/uit}} = \frac{\Delta I_c}{\Delta V_{ce}}$ $\quad I_b$ = *constant/konstant*

$V_{out/uit} = \frac{R_f}{R_{in}} \times V_{in}$ $\qquad V_{out/uit} = -\left(\frac{R_f V_1}{R_1} + \frac{R_f V_2}{R_2} + \ldots \frac{V_n R_f}{R_n}\right)$

$V_{out/uit} = \left(1 + \frac{R_f}{R_{in}}\right)$ V_{in} $\qquad V_{out/uit} = -\frac{1}{CR_{in}} \int V_{in}\,(t)\,dt$

Boltzmann's constant/
Boltzmann se konstante $= 1{,}38 \times 10^{-23}$ *J/k*

Electron charge/
Elektronlading $= 1{,}6 \times 10^{-19}$ *C*

NB: Any applicable formula may be used.
Enige toepaslike formule mag gebruik word.