higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N5

(8080175)

9 April 2021 (X-paper)
09:00–12:00

This question paper consists of 5 pages.

106Q1A2109

Copyright reserved

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N5
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. Start each question on a new page.
5. Use only black or blue pen.
6. Write neatly and legibly.

Copyright reserved

QUESTION 1: ALTERNATING CURRENT THEORY

1.1 Briefly explain why a square wave form is suitable for testing certain electronic circuits. (2)

1.2 A circuit has an impedance of $Z_1 = 15 - j3\ \Omega$ connected in parallel with another impedance $Z_2 = 10 + j4\ \Omega$. This circuit is connected in series to an impedance of $Z_3 = 6 + j7\ \Omega$. The combination is then connected in parallel to an impedance of $Z_4 = 7 + j8\ \Omega$. The current flowing through Z_2 is $20 \angle 0°$A.

Calculate the supply voltage and the total current. (14)
[16]

QUESTION 2: POWER SUPPLIES

2.1 Calculate the value of the load resistor R_L if the following values of a capacitor filter are known:

$V_M = 20$ V
f = 50 Hz after half-wave rectification
C = 470 µf
$I_{DC} = 15$ mA. (6)

2.2 Beskryf kortliks die werking van oorstroombeskerming. (3)

2.3 Show with the aid of a neat, labelled circuit diagram how a 5 V fixed voltage regulator can be used to produce a voltage lower than the fixed voltage regulator. (4)

2.4 Choose the correct term from those given in brackets. Write only the answer next to the question number (2.4.1–2.4.2) in the ANSWER BOOK.

2.4.1 The 7812-integrated voltage regulator is a (fixed/adjustable) voltage regulator.

2.4.2 An optional protective element in a series voltage regulator uses (control element/control network) for protection.

(2 × 1) (2)
[15]

Copyright reserved

QUESTION 3: TRANSISTOR AMPLIFIERS

3.1 The following values of a fixed voltage biased amplifier are known:

$^{+}V_{CC}$ = 13,2 V; V_{CE} = 6,8 V; β = 300;

$f_{(MIN)}$ = 50 Hz; $I_{C(MAX)}$ = 12,2 mA; V_{BE} = 0,68 V;

h_{ie} = 1,3 kΩ; h_{oe} = 20 µA/V; h_{re} = 2 x 10^{-4}; h_{fe} = 40

Calculate the following:

3.1.1 R_C (2)

3.1.2 R_B (3)

3.1.3 A_i (according to precise method; current divider rule may be used) (4)

3.1.4 A_V (according to precise method) (3)

3.2 Use the circuit in QUESTION 3.1 to calculate the input impedance Z_i and output impedance Z_O by means of approximate method. (5)

[17]

QUESTION 4: OPERATIONAL AMPLIFIERS

4.1 Explain the term *common mode rejection ratio* (CMRR) (2)

4.2 Indicate by means of a neat, labelled sketch how a zero-offset setting can be applied practically in an operational amplifier. (3)

4.3 Draw a neat, labelled circuit diagram of a practical operational amplifier as an integrator. (3)

4.4 The input signal to an operational amplifier in the inverting mode is (-2 V) and the input resistance is 20 k Ω. If the output voltage is 20 V.

Calculate the feedback resistance. (3)

[11]

QUESTION 5: INTEGRATED CIRCUITS

5.1 What is the output voltage of a 7 805-voltage regulator? (1)

5.2 Why are certain C-MOS integrated circuits sensitive to static charge? (2)

[3]

Copyright reserved

QUESTION 6: TRANSDUCERS

6.1 Draw a neat, labelled circuit diagram of a linear variable differential transformer (LVDT) used in a closed-loop servo system. (4)

6.2 Draw a neat, labelled circuit diagram of a precision switch that uses a light-dependent resistor and an operational amplifier. (5)

6.3 Briefly explain the operating principle of a closed-loop system that makes use of two potentiometers to control a cannon. (5)

[14]

QUESTION 7: ELECTRONIC PHASE CONTROL

Draw a neat, labelled circuit diagram of a phase control circuit that makes use of two silicon controller rectifiers for full wave AC control. Indicate also trigger and load waveforms for a phase angle of 90^0. **[6]**

QUESTION 8: TEST EQUIPMENT

8.1 Use a 4-bit binary code to illustrate how a successive approximation A/D converter would measure an initial unknown of 15 volts. (5)

8.2 Briefly explain the function of the A/D converter in a staircase voltmeter. (2)

[7]

QUESTION 9: OSCLLATORS

9.1 Show with the aid of a circuit diagram how the two-time constants of a-stable multi-vibrator can be adjusted equally by means of a potentiometer. (4)

9.2 Draw a neat, labelled circuit diagram of a bi-stable multivibrator which uses two NPN transistors. (4)

9.3 Calculate the oscillation frequency of an astable 555- timer with the following values: (3)

R_A = 80 kΩ
R_B = 70 kΩ
C = 1 µf

[11]

TOTAL: 100

Copyright reserved