higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

COMMUNICATION-ELECTRONICS N4

(8080224)

1 April 2021 (X-paper)
09:00–12:00

Nonprogrammable calculators and drawing instruments may be used.

This question paper consists of 6 pages and 1 formula sheet.

003Q1A2101

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
COMMUNICATION-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.

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QUESTION 1

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.1–1.10) in the ANSWER BOOK.

1.1 The impedance of a series circuit at resonance is a maximum.

1.2 Radio waves travel at the speed of sound.

1.3 A radio antenna is omnidirectional.

1.4 The output of a travelling-wave tube increases exponentially.

1.5 A parabolic reflector is a converter in radio communication.

1.6 The function of a ratio detector is to convert IF to audio.

1.7 A speaker converts audio to electromagnetic waves.

1.8 A network designed to stop a certain band of frequencies is known as a filter.

1.9 The impedance in any antenna will set up magnetic and electric fields.

1.10 Ultrasonic vibration from the sun is the main cause of ionisation.

(10 × 1) **[10]**

QUESTION 2: NETWORK THEOREMS

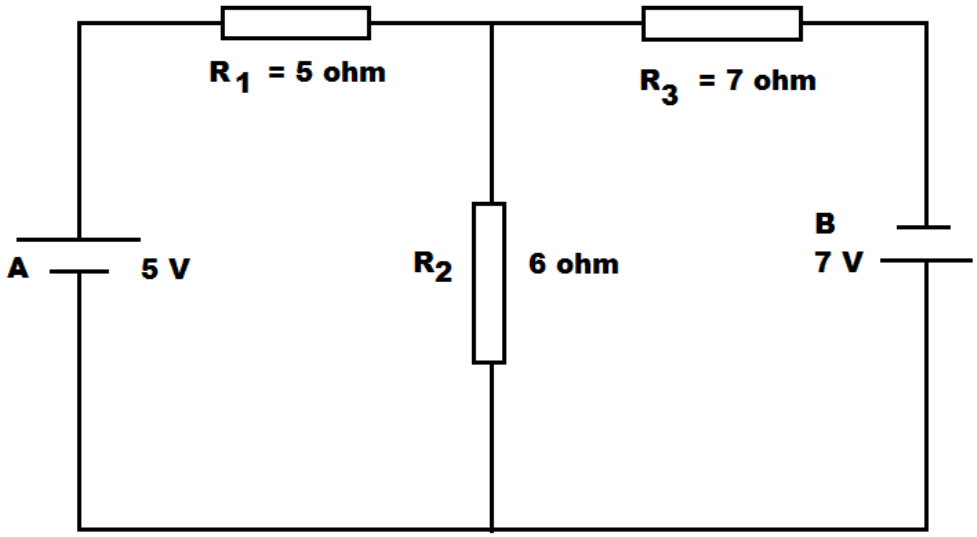
2.1 Define each of the following:

2.1.1 Norton's theorem

2.1.2 Superposition theorem

(2 × 2) (4)

2.2 Use the superposition theorem to find current flowing through resistor R_2 in the network below.



(7)
[11]

QUESTION 3: ALTERNATING-CURRENT THEORY

A series circuit consists of a coil with a DC resistance of 5 Ω and an inductance of 12 mH in series with a 220 nF capacitor.

3.1 Calculate each of the following:

3.1.1 Frequency at resonance

3.1.2 Bandwidth

3.1.3 Q-factor

3.1.4 Impedance of circuit at resonance

(4 × 2) (8)

3.2 Prove the answer in QUESTION 3.1.3 using any alternative method (2)
[10]

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QUESTION 4: ATTENUATORS AND FILTERS

4.1 Make neat sketches of each of the following attenuators:

4.1.1 Bridge T-type

4.1.2 H-type

(2 × 2) (4)

4.2 Name the advantages of a ceramic filter over other filters. (2)

4.3 4.3.1 Draw a circuit diagram of a low-pass filter. (1)

4.3.2 Draw the basic gain versus frequency graph for the filter in QUESTION 4.3.1 (1)
[8]

QUESTION 5: MODULATION

5.1 Name FOUR different modulation types used in communication networks. (4)

5.2 Explain THREE advantages and THREE disadvantages of amplitude modulation. (6)
[10]

QUESTION 6: DEMODULATION

6.1 Draw a fully labelled block diagram of an AM receiver. (9)

6.2 A 540 kHz carrier wave with an amplitude of 10 V is modulated by a 9 kHz audio signal with an amplitude of 5 V (AM transmitter).

6.2.1 Determine the TWO main frequencies which will show up in a spectrum analysis of the modulated wave. (2)

6.2.2 Draw the audio signal. (2)

6.2.3 Draw the carrier signal. (2)

6.2.4 Construct the modulated wave. (2)

6.3 Draw the circuit diagram of an AM full-wave detector. (2)
[19]

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QUESTION 7: COMMUNICATION SYSTEMS

7.1 Explain how electromagnetic waves are radiated from an antenna. (2)

7.2 Draw a block diagram of an FM transmitter and briefly explain the function of each stage. (16)
[18]

QUESTION 8: RADIO-WAVE PROPAGATION

8.1 Explain the difference between a directional and an omnidirectional antenna. (2)

8.2 Define *silent zone* as applicable to radio-wave propagation. (2)

8.3 Briefly explain sunspots and the influence they have on radio communication. (2)

8.4 Define *refraction in the ionosphere*. (2)

8.5 Describe what is meant by beam width regarding antennae. (2)

8.6 Make neat, labelled diagrams of each of the following antennae:

8.6.1 Loop antenna

8.6.2 Folded-dipole antenna

(2 × 2) (4)
[14]

TOTAL : 100

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COMMUNICATION-ELECTRONICS N4

FORMULA SHEET

1. $I = \frac{V}{R}$

2. $X_L = 2\pi fL$

3. $X_C = \frac{1}{2\pi fc}$

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

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

6. $V_R = I \,.\, R$

   $V_L = I \,.\, X_L$

   $V_C = I \,.\, X_C$

7. $Cos\phi = \frac{R}{Z}$

8. $I = \sqrt{I_R + I_C^2}$

9. $\theta = Tan^{-1}\frac{I_C}{I_R}$

10. $I = \sqrt{I_R^2 + I_L^2}$

11. $I = \sqrt{I_R^2 \ + (I_L - L_C)^2}$

12. $\theta = Tan^{-1}\frac{(I_L - I_C)}{I_R}$

13. $f_r = \frac{1}{2\pi\sqrt{LC}}$

14. $C = \frac{1}{4\,.\,\pi^2\,.\,f_r^2\,.\,L}$

15. $L = \frac{1}{4\,.\,\pi^2\,.\,f_r^2\,.\,C}$

16, $Q = \frac{X_L}{R} = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{f_R}{bandwidth/bandwydte}$

17. $V_c = V \times Q$ *and/en* $V_L = V \times Q$

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

19. $I_c = I \times Q$

20. $I_L = I \times Q$

21. $f = \frac{\nu}{\lambda}$

22. $B - W = \frac{R}{2\pi L}$

23. $V_T = \sqrt{V_R{}^2 + (V_C - V_L)^2}$

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