higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

COMMUNICATION-ELECTRONICS N4

(8080224)

21 November 2023 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

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

016Q1E2321

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. Start each section on a new page.
5. Use only a blue or black pen.
6. Write neatly and legibly.

QUESTION 1

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

1.1 Kirchhoff's voltage law states that any linear, complex electrical circuit can be reduced into a simple electric circuit with one current and a resistance connected in parallel.

1.2 In radio communications, modulation is needed in the transmission systems to transfer the message to the available high-frequency radio channel.

1.3 One of the advantages of FM is that it offers smaller geographical interference between neighbouring stations than AM.

1.4 The process of recovering the original signal from the modulated wave is known as demodulation.

1.5 Ground wave propagation is when radio waves are not influenced by the earth or its atmosphere.

1.6 FM radio signals cannot be affected by fine weather, including high pressure.

1.7 In a Double Side Band (DSB) Transmission, both side bands and the carrier frequency is transmitted.

1.8 An antenna in an FM transmitter converts audio to sound.

1.9 The current flowing in a circuit containing capacitance depends on the rate at which the voltage changes.

1.10 Critical angle is the maximum frequency at which a radio-wave directed vertically is reflected by the layer of the ionosphere and above which it penetrates the layer.

(10 × 1) **[10]**

QUESTION 2: NETWORK THEOREMS

2.1 Define the following:

2.1.1 The superposition theorem

2.1.2 Thevenin's theorem

(2 × 2) (4)

2.2 Use Thevenin's theorem to find Thevenin's equivalent circuit for the network in FIGURE 1 below and draw the circuit. (10)

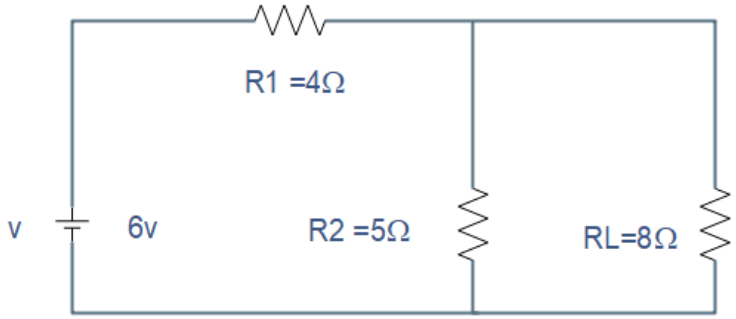


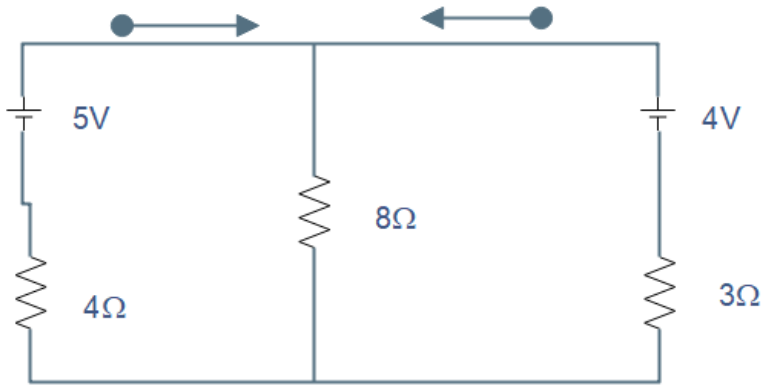
FIGURE 1

[14]

QUESTION 3: VECTORS

3.1 State THREE characteristics of a series resonance circuit. (3)

3.2 Calculate the current in the circuit below by making use of Kirchhoff's laws: (7)



[10]

QUESTION 4: FREQUENCY RESPONSE

4.1 Draw the following attenuators:

4.1.1 L-type attenuator

4.1.2 O-type attenuator

(2 × 2) (4)

4.2 Draw a circuit diagram of a band-pass filter. (3)

4.3 Draw the basic gain-versus-frequency graph of the filter in QUESTION 4.2. (3)
[10]

QUESTION 5: MODULATION

5.1 List THREE types of modulation. (3)

5.2 Briefly explain the following (NO sketches):

5.2.1 Depth of modulation.

5.2.2 Pulse Position Modulation (PPM)

5.2.3 Pulse Amplitude Modulation (PAM)

(3 × 2) (6)

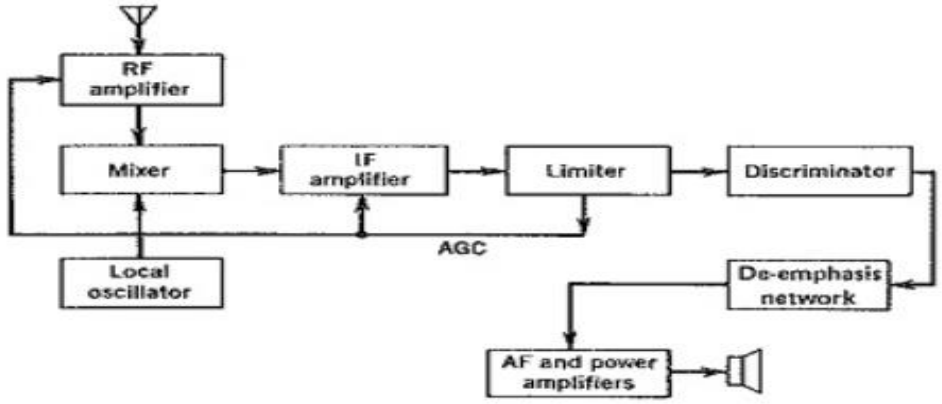
QUESTION 6: DEMODULATION

6.1 Briefly explain a frequency distortion in detectors. (2)

6.2 Draw a fully labelled circuit diagram showing a ratio detector. (8)
[10]

QUESTION 7: COMMUNICATION SYSTEMS

Study the diagram of an FM receiver below and explain the function of each stage.



[20]

QUESTION 8: RADIO WAVE PROPAGATION

8.1 Explain the following modes of radio wave propagation.

8.1.1 Free-space propagation

8.1.2 Ground wave propagation

8.1.3 Ionospheric propagation

(3 × 2) (6)

8.2 Determine the length of a standard half-wave dipole antenna used to receive a 60 MHz radio signal with the velocity of the electromagnetic wave in the antenna of 3×10^8 m/s. (2)

8.3 Make a neat, labelled sketch of a helix antenna. (3)

8.4 Make a neat, labelled sketch of a travelling-wave tube. (6)

[17]

TOTAL: 100

(8080224)

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