higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# NATIONAL CERTIFICATE

# COMMUNICATION-ELECTRONICS N4

(8080224)

**19 November 2024 (X-paper)**
**09:00–12:00**

**Drawing instruments and nonprogrammable calculators may be used**

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

016Q1E2419

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# DEPARTMENT OF HIGHER EDUCATION AND TRAINING
# REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
COMMUNICATION-ELECTRONICS N4
TIME: 3 HOURS
MARKS: 100

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**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 black or blue pen.
6. 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 angle of refraction is an angle between a reflected ray and the norm to the surface of reflection.

1.2 A ground wave has a frequency of 30 kHz – 300 kHz.

1.3 The function of a limiter in the FM receiver is to remove unwanted amplitude variations of the FM signal.

1.4 A transmitter must provide sufficient power amplification to carry the modulated signal over a long distance.

1.5 A half-wave voltage detector provides more efficient filtering of the IF signal.

1.6 The modulator in communication is there to carry intelligence which can be in the form of video or audio.

1.7 The cut-off frequency of a high-pass filter is a point where the gain changes from low to high.

1.8 The resistors in an attenuator circuit may be connected in such a way that the input and output impedances are equal.

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

1.10 The 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 *Kirchhoff's voltage law*. (2)

2.2 Obtain Thevenin's equivalent circuit for FIGURE 1 below:

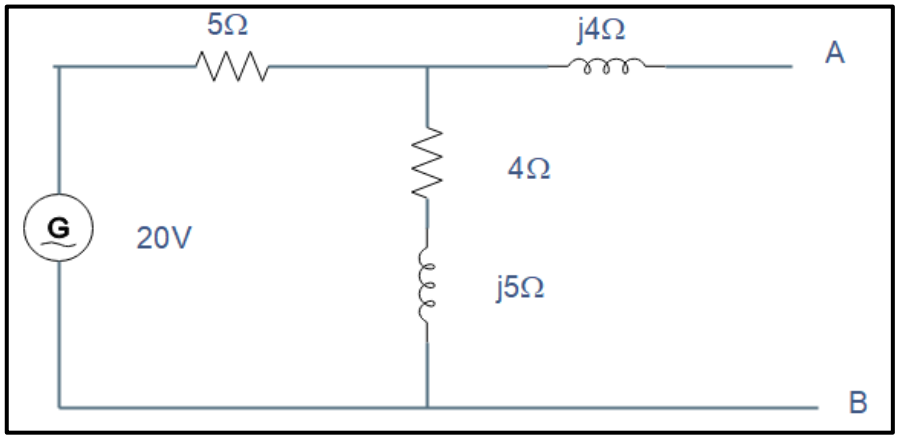


**FIGURE 1**

(9)
**[11]**

## QUESTION 3: VECTORS

3.1 With the aid of THREE labelled diagrams (circuit, waveform and phasor), explain the operation of a purely inductive circuit when an alternating voltage is applied across an inductor. (6)

3.2 Refer to the RLC circuit in FIGURE 2 below and calculate the following:

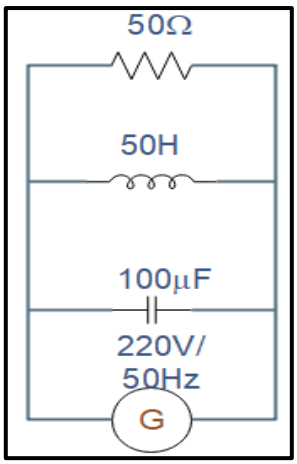


**FIGURE 2**

3.2.1 The current in each branch (5)

3.2.2 The total current flowing in the circuit (2)

3.2.3 The phase angle (1)
**[14]**

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## QUESTION 4: FILTER NETWORKS

4.1 Define the following:

4.1.1 Filter network

4.1.2 An attenuator network

(2 × 2) (4)

4.2 Draw a fully labelled frequency response curve of an ideal low-pass filter. (3)

4.3 Draw a circuit diagram of a basic band-stop filter. (4)

**[11]**

## QUESTION 5: MODULATION

5.1 Define *modulation* and also explain its importance. (4)

5.2 Briefly explain the following (NO sketches):

5.2.1 Pulse-position modulation (PPM)

5.2.2 Depth of modulation

(2 × 2) (4)

5.3 State THREE advantages of amplitude modulation. (3)

**[11]**

## QUESTION 6: DEMODULATION

6.1 Name the TWO methods of modulation. (2)

6.2 Draw a neat, labelled circuit diagram of an AM oscillator modulator with a base injection. (10)

**[12]**

## QUESTION 7: COMMUNICATION SYSTEMS

7.1 Draw a fully labelled block diagram of a tuned radio-frequency receiver. (9)

7.2 Explain the function of each block of the diagram in QUESTION 7.1. (6)

7.3 State THREE disadvantages of a tuned radio-frequency receiver. (3)

**[18]**

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## QUESTION 8: RADIO WAVE PROPAGATION

8.1 In your own words, briefly define the term *radio-wave propagation*. (2)

8.2 Draw a fully labelled diagram of a double-cavity klystron. (8)

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

**[13]**

**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. $Q = \frac{X_L}{R} = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{f_R}{band\ width/bandwydte}$
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. $f = \frac{v}{\lambda}$
22. $B - W = \frac{R}{2\pi L}$
23. $V_T = \sqrt{V_R^2 + (V_C - V_L)^2}$

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