higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

COMMUNICATION-ELECTRONICS N4

(8080224)

15 August 2022 (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.

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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. 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 Kirchhoff's current law states that if several conductors meet at a point, the total current flowing away from it, i.e. the algebraic sum of the current, is zero.

1.2 The strategy used in the superposition theorem is to eliminate all sources of power at the same time.

1.3 The reactance of capacitors and inductors is determined by their physical construction and the applied frequency.

1.4 The impedance of a series resonant circuit is equal to the circuit's total resistance.

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

1.6 A filter is a network consisting of transformers and diodes.

1.7 Carrier waves in telecommunications are used to convey voltage signal.

1.8 Communication by radio is made possible by electrical energy that travels from the transmitter to the receiver in the form of electromagnetic waves.

1.9 One of the advantages of amplitude modulation is that it uses a narrower bandwidth than frequency modulation.

1.10 Frequency modulation overcomes the interference of static better than amplitude modulation.

(10 × 1) **[10]**

QUESTION 2: NETWORK THEOREMS

2.1 Define the following:

2.1.1 Thevenin's theorem.

2.1.2 Norton's theorem.

(2 × 2) (4)

2.2 Use the superposition theorem to calculate the current through the 15 Ω resistor in FIGURE 1 below.

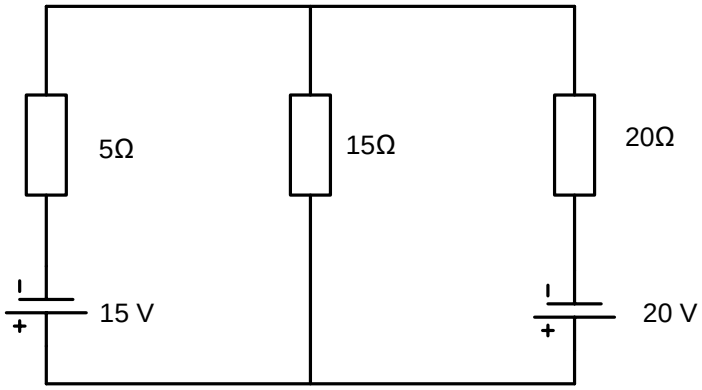

FIGURE 1

(8)
[12]

QUESTION 3: ALTERNATING CURRENT THEORY

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

3.2 A resistor with a value of 8 Ω is connected in series with an inductor of 100 µH and a capacitor of 60 µF.

Calculate the following:

3.2.1 Frequency at resonance (2)

3.2.2 Total impedance of the circuit (1)

3.2.3 Bandwidth (2)

3.2.4 Q-factor using THREE different methods (3 × 2) (6)
[14]

QUESTION 4: FILTERS

4.1	Define a *filter.*	(2)
4.2	Show, with the aid of a typical low-pass filter graph, the representation of a pass band, cut-off frequency and an attenuation band.	(4)
4.3	What is an attenuator?	(2)
4.4	Draw a circuit diagram showing a T-type attenuator.	(4)
		[12]

QUESTION 5: MODULATION

5.1	Define *phase modulation*.		(3)
5.2	Give TWO advantages of phase modulation.	(2 × 2)	(4)
5.3	Explain the THREE main reasons for using single-sideband (reduced carrier) working for point-to-point communication.	(3 × 2)	(6)
			[13]

QUESTION 6: DEMODULATION

6.1	Define the term *demodulation*.	(2)
6.2	What is the function of a ratio detector?	(2)
6.3	Draw a fully labelled circuit diagram of a ratio detector.	(5)
		[9]

QUESTION 7: COMMUNICATION SYSTEMS

7.1	Draw a fully labelled block diagram of an FM receiver.	(5)
7.2	Briefly explain the function of each stage of the receiver in QUESTION 7.1.	(10)
7.3	Draw a fully labelled block diagram of an FM transmitter.	(5)
		[20]

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QUESTION 8: RADIO WAVE PROPAGATION

Explain the following:

8.1 Ground wave

8.2 Space wave

8.3 Sky wave

8.4 Angle of arrival

8.5 Angle of refraction

(5 × 2) **[10]**

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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