higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

COMMUNICATION ELECTRONICS N4

(8080224)

26 July 2021 (X-paper)
09:00–12:00

Drawing instruments and nonprogrammable calculators may be used.

This question paper consists of 7 pages and 1 formula sheet.

020Q1G2126

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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 question on a new page.
5. Only use 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 Network theorems are useful in simplifying analysis of more complex circuits.

1.2 Kirchhoff's first law states that 'if several conductors meet at a point, the total current flowing away from the same point is zero.'

1.3 Ohm's law determines the current flowing through the circuit.

1.4 The reactance of capacitors is determined by the applied voltage.

1.5 The filter is used to separate capacitance at different frequencies.

1.6 Carrier waves are used to convey either video or audio signals.

1.7 The advantage of FM as compared to AM is that it overcomes the interference of static.

1.8 An FM detector changes frequency variations into voltage variations.

1.9 Ground waves travel along the surface of the earth while following the curvature of the earth's surface.

1.10 The folded dipole antenna is used for point-to-point communication.

(10 × 1) **[10]**

QUESTION 2: NETWORK THEOREMS

2.1 Define the following:

2.1.1 Kirchhoff's voltage law (3)

2.1.2 Thevenin's theorem (3)

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2.2 Use Thevenin's theorem to find the equivalent circuit of the network in FIGURE 1.

Draw the equivalent network.

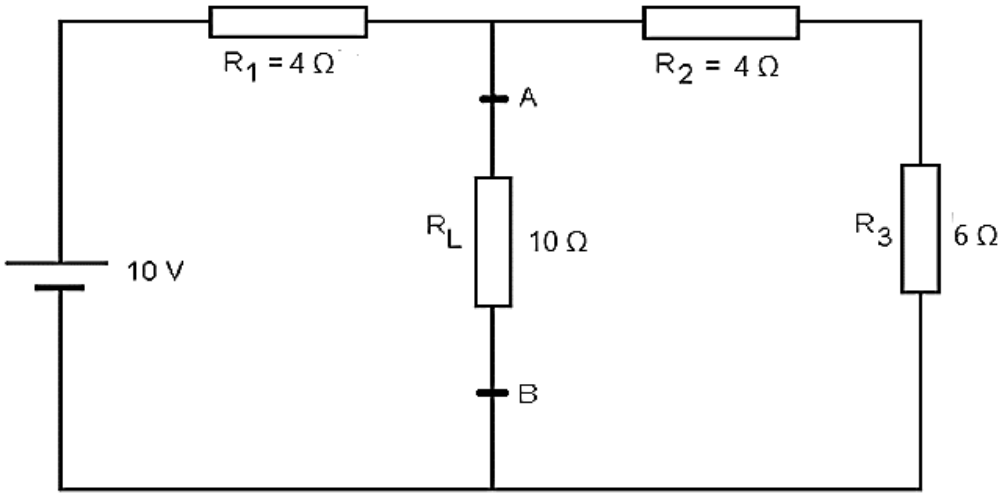

FIGURE 1 (8)

[14]

QUESTION 3: ALTERNATING CURRENT THEORY

3.1 Derive a formula for series resonance in an LC circuit. (2)

3.2 A series circuit consists of a resistance of 4 Ω, an inductance of 0,5 H and a variable capacitor, all connected across a 100 V, 50 Hz AC supply.

Calculate the following:

3.2.1 The capacitance required for resonance (2)

3.2.2 The current at resonance (1)

3.2.3 The voltage across the inductor at resonance (2)

3.2.4 The voltage across the capacitor at resonance (2)

3.2.5 The Q factor of the circuit (2)

[11]

QUESTION 4: ATTENUATORS AND FILTERS

4.1 Differentiate between the following attenuators:

4.1.1 Fixed attenuator pad

4.1.2 Variable attenuator pad

(2 × 1) (2)

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4.2 Make neat sketches of the following attenuator networks:

4.2.1 Balanced type

4.2.2 Bridged T-type

(2 × 1) (2)

4.3 Explain in detail how the composite filter is designed. (4)

4.4

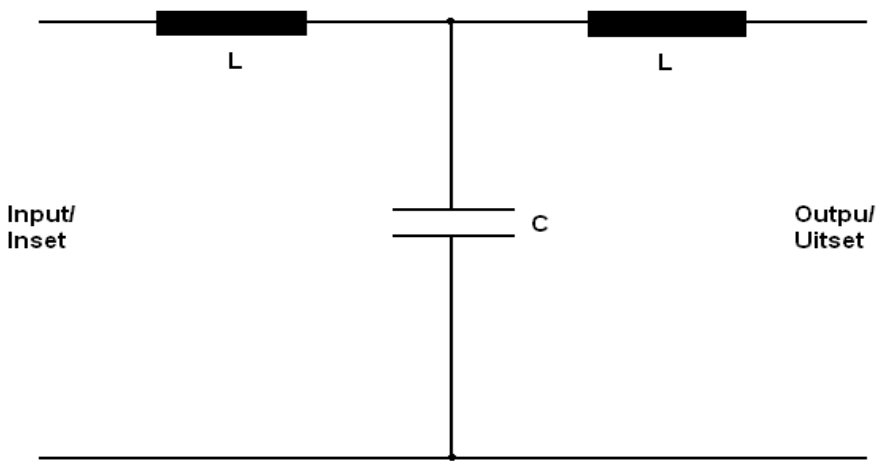

FIGURE 2

4.4.1 Identify the circuit diagram in FIGURE 2 above. (1)

4.4.2 Briefly explain what happens when the material of a ceramic filter is placed under mechanical strain, such as compression, bending and/or twisting. (2)

[11]

QUESTION 5: MODULATION

Explain exactly what happens at the receiving ends of the TWO types of AM transmissions mentioned below during the modulation process.

5.1 Double sideband (5)

5.2 Independent sideband (5)

[10]

QUESTION 6: DEMODULATION

6.1 With a neat, labelled circuit diagram, explain the operation of an amplifier modulator with base injection. (7)

6.2 Draw a neat, labelled circuit diagram of a full-wave voltage detector. (2)

6.3 Explain THREE types of distortion in detectors and state their occurrences. (6)

[15]

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QUESTION 7: COMMUNICATION SYSTEMS

7.1 Identify the block diagram in FIGURE 3 below. (1)

7.2 Explain the function of each stage in FIGURE 3 below.

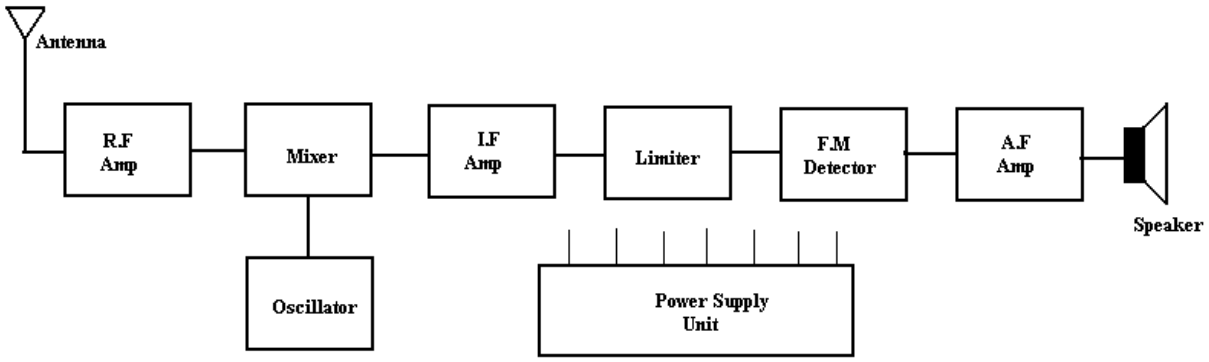

FIGURE 3 (10)
[11]

QUESTION 8: RADIO WAVE PROPAGATION

8.1 Identify the diagram in FIGURE 4. (1)

8.2 Label the diagram in FIGURE 4 by naming parts A to I.

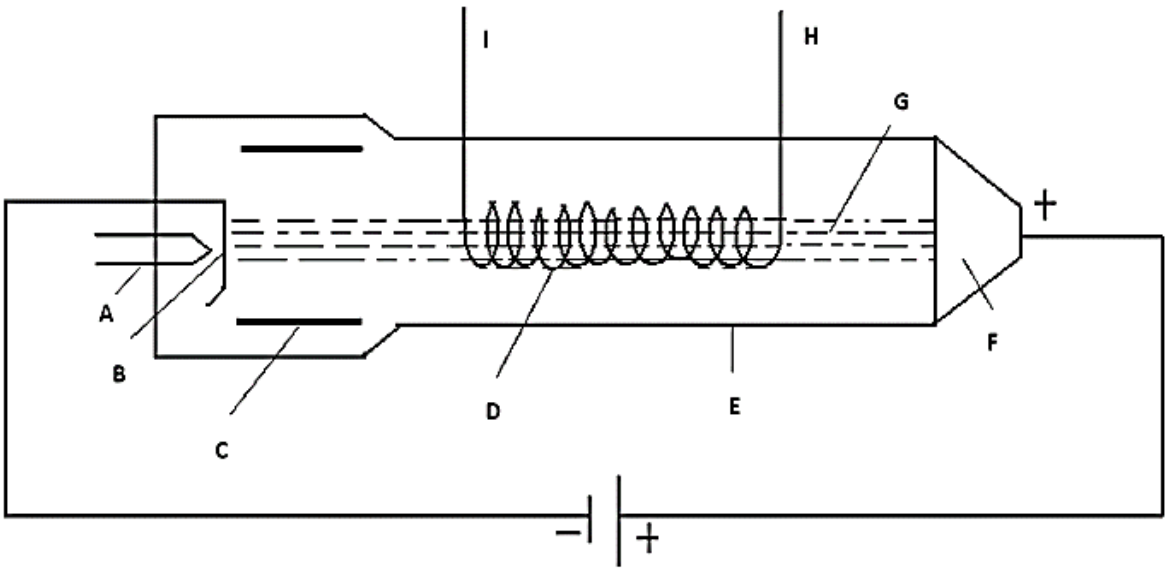

FIGURE 4 (9)

8.3 Identify the diagram in FIGURE 5. (1)

8.4 Label the diagram in FIGURE 5 by naming parts J to P.

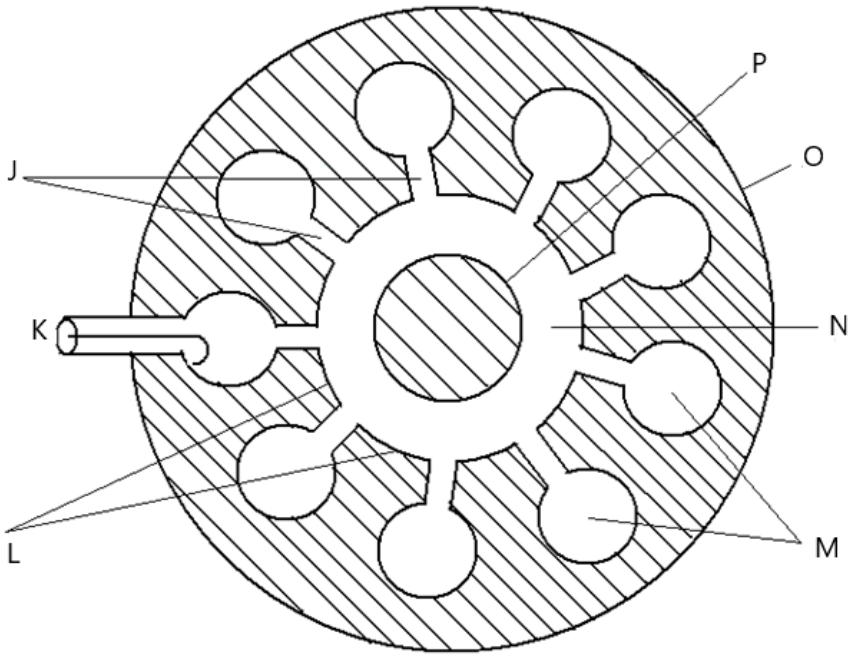

FIGURE 5

(7)
[18]

TOTAL : 100

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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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