higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T270**(E)**(N17)T

NOVEMBER EXAMINATION

NATIONAL CERTIFICATE

COMMUNICATION-ELECTRONICS N4

(8080224)

17 November 2016 (X-Paper)
09:00–12:00

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

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.

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 An AM signal with 75% modulation is over-modulated.

1.2 An AM modulator is an example of an attenuator.

1.3 A parabolic reflector is an example of an amplifier in radio communication.

1.4 Digital signals can be processed by digital circuit components, which are expensive and easily produced in many components on a single chip.

1.5 Permanent magnets in the travelling wave tube, holds the beam in the centre of the helix.

1.6 A bridged T-type attenuator is used to block high frequencies.

1.7 A reflex klystron oscillator produces an AC output.

1.8 A receiver antenna converts electrical currents into sound waves.

1.9 Satellite communication is effective because dishes focus signals onto a small pick-up unit.

1.10 Digital signals typically use less bandwidth.

(10 x 1) **[10]**

QUESTION 2

2.1 Define the following:

2.1.1 Kirchoff's voltage law

2.1.2 Thevenin's theorem

(2 x 2) (4)

2.2 Use Thevenin's theorem to find Thevenin's equivalent circuit for the network in FIGURE 1 on the attached DIAGRAM SHEET. Draw the equivalent circuit. (6)

[10]

QUESTION 3

A parallel circuit consists of a coil with a DC resistance of 10 Ω, an inductance of 0,1 H and a variable capacitor tuned to 250 nF.

Determine the following:

3.1 The frequency at which the circuit will resonate. Answer in Hz.

3.2 The dynamic impedance

3.3 The Q-factor of the circuit

3.4 The bandwidth

3.5 Prove the answer in QUESTION 3.3 using any alternative method.

(5 x 2) **[10]**

QUESTION 4

4.1 Draw the following attenuators:

4.1.1 T-type attenuator

4.1.2 O-type attenuator

(2 x 2) (4)

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

4.3 Draw the basic attenuation-versus-frequency graph of the filter in QUESTION 4.2. (3)

[10]

QUESTION 5

Make neat, fully labelled sketches of the following:

5.1 Multi-cavity magnetron

5.2 Reflex klystron amplifier

(2 x 5) **[10]**

QUESTION 6

6.1 Draw a block diagram of an AM-transmitter. (5)

6.2 Explain the function of each stage in the transmitter above. (10)

6.3 Name the TWO uses of a modem. (2)

6.4 Identify the circuit in FIGURE 2 on the attached diagram sheet. (3)
[20]

QUESTION 7

7.1 Draw a block diagram of an FM-receiver. (5)

7.2 Draw a circuit diagram of an FM-modulator. (5)

7.3 Define *frequency modulation.* (2)

7.4 Define *modulation index.* (2)

7.5 Choose the correct word from those given in brackets:

The function of a limiter is to prevent (amplitude/frequency) variations. (1)
[15]

QUESTION 8

8.1 Define the following:

8.1.1 Beamwidth

8.1.2 Polarisation

8.1.3 Refraction index

8.1.4 Critical angle

(4 x 2) (8)

8.2 Choose the correct term from those given in brackets:

The absence of a radio signal at a foot of a mountain is a result of a phenomenon called (silent zone/skip distance). (1)

8.3 Briefly explain what is meant by *sunspots* and how they have an influence on radio communication (2)

8.4 Make neat, fully labelled sketches of the following:

8.4.1 The rhombic antenna

8.4.2 The loop antenna

(2 x 2) (4)
[15]

TOTAL: 100

DIAGRAM SHEET

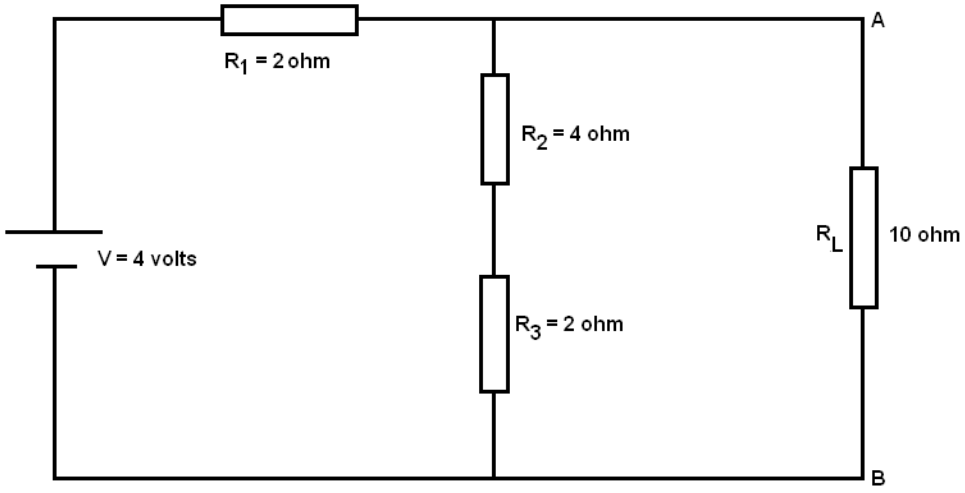

FIGURE 1

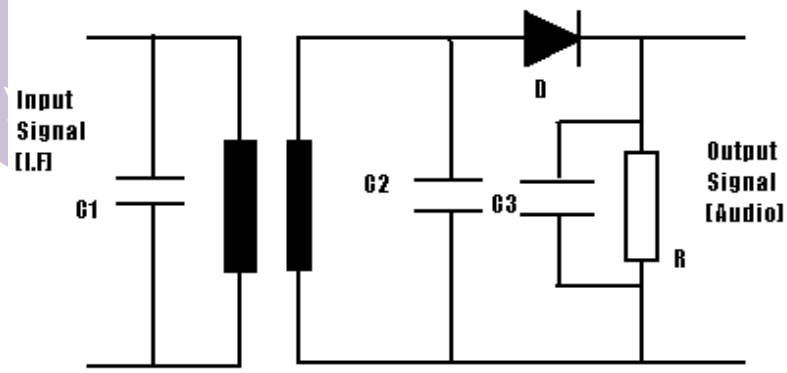

FIGURE 2

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. $Q = \frac{X_L}{R} = \frac{1}{R}\sqrt{\frac{L}{C}} = \frac{f_R}{bandwidth}$
17. $V_c = V \times Q \ and \ V_L = V \times Q$
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. $V_T = \sqrt{V_R{}^2 + (V_C - V_L)^2}$