higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

RADIO THEORY N3

(11040873)

23 November 2022 (X-paper)
09:00–12:00

Drawing instruments and scientific calculators may be used.

This question paper consists of 5 pages and 1 formula sheet.

175Q1E2223

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
RADIO THEORY N3
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. Use only a black or blue pen.
6. Write neatly and legibly.

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QUESTION 1

1.1 Why is the loss or gain in communication systems usually expressed as a power ratio? (2)

1.2 A certain amplifier with an input to output power ratio of 4:40 has an input impedance of 1 000 Ω. The output of this amplifier is then connected to the input of another amplifier. This amplifier produces a gain of 10 dB.

Determine:

1.2.1 The total gain of the system (2)

1.2.2 The output of the second amplifier when a sine wave with a maximum voltage of 1,414 V is applied to the input of the first (8)

[12]

QUESTION 2

A filter is a network with low attenuation in a certain band of frequencies and high attenuation at all other frequencies.

Using the above statement, draw an active band-pass filter that incorporates an operational amplifier. **[10]**

QUESTION 3

Draw a fully labelled block diagram that shows how to connect test instruments to an amplifier for plotting the frequency-response curves of this amplifier. Using the constructed diagram, provide a step-by-step explanation of how the response-curve measurements are performed. **[15]**

QUESTION 4

4.1 Draw a neat, labelled block diagram of a single-sideband (SSB) transmitter. (11)

4.2 The following information concerns an SSB transmitter:

- Audio spectrum: 300 Hz to 3 kHz
- IF carrier oscillator: 4 MHz
- Local oscillator frequency: 14 MHz

Calculate the transmitter frequency spectrum for the upper sideband. (6)

4.3 State the THREE properties that make a balanced modulator suitable for use in an SSB transmitter. (3)

[20]

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QUESTION 5

5.1 Draw the response curve of an FM discriminator with a centre frequency of 10,7 MHz and a bandwidth of 200 kHz. Clearly show all points of importance i.e. centre, lower and upper cut-off frequency, linear response and bandwidth as well as frequencies at these points. (10)

5.2 Briefly explain the use of automatic gain control (AGC) in a radio receiver. (2)

5.3 Give THREE advantages of AGC as used in radio receivers. (3)

5.4 Why must AGC be taken off the detector stage before the filtering of the detector waveform? (2)

5.5 Briefly explain the difference between *simple AGC* and *delayed AGC*. (3)

[20]

QUESTION 6

6.1 At which frequencies are parabolic reflectors used? (1)

6.2 How is the radiation from the feed, which is not reflected by the paraboloid, prevented? (2)

6.3 Make a neat, fully labelled sketch of a centre-fed parabolic reflector with a spherical shell. (5)

[8]

QUESTION 7

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (7.1–7.5) in the ANSWER BOOK.

7.1 Ground waves travel further over land than water.

7.2 Space waves give a range of approximate line of sight.

7.3 Very low frequency (VLF) has a frequency range of 30 kHz to 300 kHz.

7.4 The lower the critical angle, the further the skip distance extends.

7.5 The higher the electron diversity of the ionosphere, the higher the critical frequency.

(5 × 2) **[10]**

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QUESTION 8

8.1 Name THREE types of multiplexing used in transmission systems. Do not use abbreviations. (3)

8.2 Give TWO examples of time-division multiplexing used for digital data communication. (2)
[5]

TOTAL: 100

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FORMULA SHEET

DC THEORY

(i) $V = I \times R$

(ii) $R_T = R_1 + R_2$

(iii) $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

(iv) $P = V \times I$

(v) $P = I^2 \times R$

(vi) $P = \frac{V^2}{R}$

DECIBEL RELATIONS

(i) $N = 10\,log\ \frac{P_0}{P_1}$

(ii) $N = 20\,log\ \frac{I_0}{I_1} + 10\,log\ \frac{R_0}{R_1}$

(iii) $N = 20\,log\ \frac{V_0}{V_1} + 10\,log\ \frac{R_1}{R_0}$

If $R_1 = R_0$

———

(iv) then $N = 20\,log\ \frac{I_0}{I_1}$

(v) $N = 20\,log\ \frac{V_0}{V_1}$

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