higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

RADIO THEORY N3

(11040873)

4 August 2021 (X-paper)
09:00–12:00

Scientific calculators and drawing instruments may be used.

This question paper consists of 4 pages and 1 formula sheet.

181Q1G2104

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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 Prove that the loss or gain of a network is $N = 20\log\frac{E_2}{E_1}$ given that E_2 and E_1 are the output and input voltages respectively. R_2 and R_1 are the output and input resistances respectively and are equal to each other. (6)

1.2 Calculate the radiated power of an antenna that has a gain of 8,5 dB. The cable connected to this antenna has a loss of 2,25 dB when fed by a 30 W transmitter. (6)

[12]

QUESTION 2

2.1 Briefly explain *common-mode rejection ratio* with regards to operational amplifiers (op-amps). (2)

2.2 Give the typical gain and frequency values of an op-amp. (2)

2.3 Give FIVE ideal characteristics of an op-amp when operated in the open-loop mode. (5)

2.4 An op-amp can perform a wide variety of operations.

Do these include both analogue and digital operations? (1)

[10]

QUESTION 3

Draw a fully labelled block diagram to show how instruments are connected for alignment of the intermediate stages of an AM superheterodyne receiver. Clearly show all signal directions. **[15]**

QUESTION 4

4.1 Draw a neat, labelled block diagram of an FM transmitter. (10)

4.2 With respect to a transmitter, explain in detail why it is essential that the centre frequency around which the deviation occurs remains constant. (10)

[20]

QUESTION 5

5.1 Draw a neat, fully labelled block diagram of a Single Sideband Receiver (SSB). Clearly show all signal directions. (15)

5.2 State THREE advantages and TWO disadvantages of SSB reception. (5)

[20]

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QUESTION 6

6.1 What is the most important property of an antenna? (2)

6.2 Make a neat sketch of a folded dipole and its radiation pattern. (3)

6.3 Give THREE improved characteristics of the folded dipole over a half-wave dipole. (3)

[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 The ground wave has a frequency of 300 kHz to 3 000 kHz.

7.2 Space waves are used in satellite communications.

7.3 The wavelength of any radiated wave can be determined by multiplying the velocity of the wave by the time taken for one full cycle of the wave.

7.4 Skip distance does not depend on the critical angle at which the sky wave penetrates the ionosphere.

7.5 The refractive index of air is an approximate unity.

(5 × 2) **[10]**

QUESTION 8

Explain the preference of digital data to analogue data for the transmission of information. **[5]**

TOTAL: 100

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FORMULA SHEET

DC THEORY

1. $V = I \times R$

2. $R_T = R_1 + R_2$

3. $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$

4. $P = V \times I$

5. $P = I^2 \times R$

6. $P = \frac{V^2}{R}$

DECIBEL RELATIONS

1. $N = 10\log \frac{P_0}{P_1}$

2. $N = 20\log \frac{I_0}{I_1} + 10\log \frac{R_0}{R_1}$

3. $N = 20\log \frac{V_0}{V_1} + 10\log \frac{R_1}{R_0}$

If $R_1 = R_0$ then

4. $N = 20\log \frac{I_0}{I_1}$

5. $N = 20\log \frac{V_0}{V_1}$

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