higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

RADIO THEORY N3

(11040873)

30 November 2023 (X-paper)
09:00–12:00

Scientific calculators and drawing instruments may be used.

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

173Q1E2330

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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

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 Skip distance is also called the silent zone.

1.2 Antenna gain determines whether an antenna is omnidirectional or directional.

1.3 A time-base selector is used for selecting the amplitude at which the time-base generator must operate.

1.4 A sweep signal generator is used for oscillator alignment in a radio receiver.

1.5 *Wow* is caused by slow variations in tape speed.

1.6 An operational amplifier used as an integrator uses resistors in the input as well as the feedback paths.

1.7 The frequency of a modulation signal determines the rate of change of the carrier wave.

1.8 A loudspeaker is used to convert radio waves into sound waves.

1.9 Automatic gain control is associated with AM receivers.

1.10 The function of a record oscillator is to produce a constant DC bias onto which the audio signal is modulated.

(10 × 1) **[10]**

QUESTION 2

2.1 Name the SIX basic parts of a cathode-ray oscilloscope. (6)

2.2 Draw a fully labelled block diagram showing test instruments connected to an amplifier for plotting the frequency response curves of the amplifier. (4)

2.3 Briefly explain, with reference to a sweep signal generator, the function of an audio tone. (2)

2.4 An oscilloscope displays an AC signal for one cycle with four horizontal divisions. The time/division control is set to 5 ms/division.

Calculate the frequency of the AC signal. (3)

[15]

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QUESTION 3

An amplifier has an input impedance of 150 Ω and an output impedance of 8 Ω. An 800 mV input voltage provides a 2 A output current.

Calculate the:

3.1 Input power (3)

3.2 Output power (3)

3.3 Gain of the amplifier in decibels (4)

[10]

QUESTION 4

Draw a circuit diagram of a transistor push-pull audio-output amplifier coupled to a single integrated preamplifier. Show all components and include negative feedback. **[10]**

QUESTION 5

5.1 Draw a labelled circuit diagram of an AM detector. Include the input and output waveforms. (7)

5.2 What is the purpose of the discriminator in an FM radio receiver? (3)

5.3 What is the purpose of the IF amplifier in an FM radio receiver? (3)

5.4 What is the function of the limiter in an FM radio receiver? (2)

[15]

QUESTION 6

6.1 Draw the circuit diagram of an amplitude modulated transistor amplifier with base injection that is used in an AM radio transmitter. Label the two inputs. (7)

6.2 Give the THREE main uses of single-sideband transmission. (3)

[10]

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QUESTION 7

7.1 Explain time-division multiplexing as employed in data communication. (2)

7.2 Define the term *pulse position modulation* (PPM). (2)

7.3 Explain the function of the *modulator* and *demodulator* in a modem. (2 + 2) (4)

7.4 Which type of code is the CCITT-2 code? (2)

[10]

QUESTION 8

8.1 Give ONE advantage and ONE disadvantage of a log-periodic antenna over a Yagi-antenna. (2)

8.2 Explain, with reference to the ionosphere, what is meant by *critical frequency*. (4)

8.3 Briefly explain, with reference to radio wave propagation, each of the following radio waves:

8.3.1 Ground waves

8.3.2 Direct waves

(2 × 2) (4)

[10]

QUESTION 9

9.1 List FIVE possible faults that will result in a variation of speed and resultant distortion of sound in a tape recorder. (5)

9.2 Give THREE advantages of using AC bias over DC bias in a tape recorder. (3)

9.3 Explain, with reference to a magnetic tape recorder, *wow* and *flutter*. (2)

[10]

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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