



higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1520(E)(A5)T

NATIONAL CERTIFICATE

RADIO THEORY N3

(11040873)

5 August 2019 (X-Paper)

09:00–12:00

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

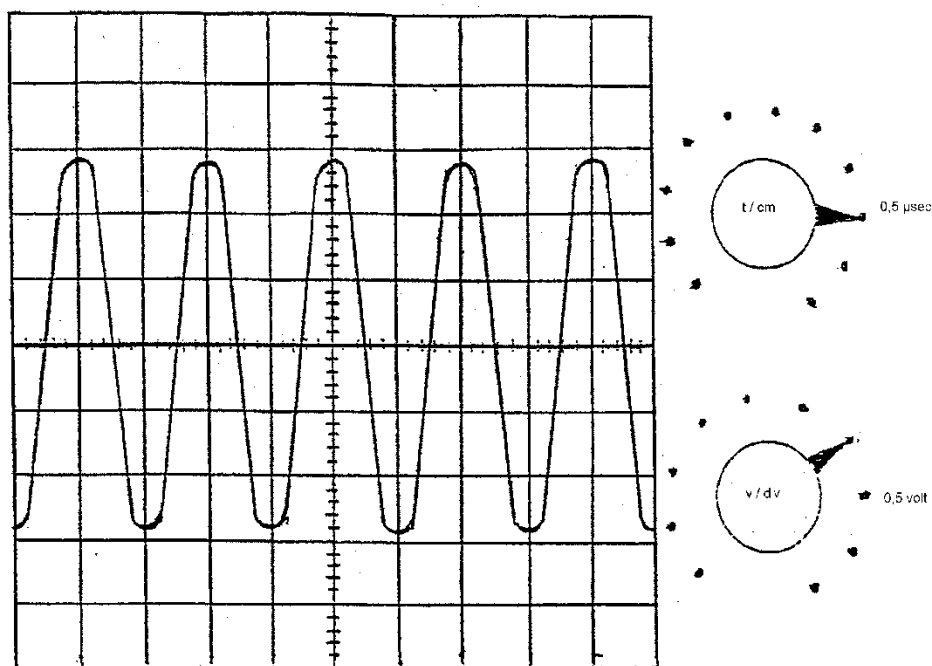
DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
RADIO THEORY N3
TIME: 3 HOURS
MARKS: 100

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. Write neatly and legibly.
-

QUESTION 1

The oscilloscope shown below displays the oscillator output of a superheterodyne receiver.



- 1.1 Determine the frequency to which the receiver is tuned if the frequency at the input of the intermediate frequency (IF) stage measures 455 kHz. (4)
 - 1.2 Determine the RMS and average values of the oscillator output. (6)
- [10]**

QUESTION 2

Show, with the aid of a block diagram of the stages concerned, how a sweep-signal generator and an oscilloscope are connected when aligning an FM intermediate-frequency stage.

[10]

QUESTION 3

- 3.1 Draw the circuit diagram of an inverting operational amplifier applied as an inverting audio amplifier stage with gain control, coupling capacitors and thermal compensation. (10)
- 3.2 Draw the circuit diagram of an inverting operational amplifier that has a constant gain. (2)
- 3.3 With reference to QUESTION 3.2, the input and feedback resistors are 200 k Ω and 400 k Ω respectively.

What is the output voltage for an input of 5 V?

(3)
[15]

QUESTION 4

Choose the correct answer from those given in brackets. Write only the answer next to the question number (4.1–4.15) in the ANSWER BOOK.

- 4.1 An operational amplifier used as an integrator uses a/an (inductor/capacitor/resistor) in the feedback path.
- 4.2 (Space/Ground/Short) waves are used at frequencies above 30 MHz.
- 4.3 The modulation (factor/index/reflex) is associated with FM.
- 4.4 With regard to the frequency-response curve of an IF amplifier, the narrower the bandwidth, the (less/more) selective the circuit. 
- 4.5 A de-emphasis network is normally inserted between the detector and the (IF/audio) amplifier.
- 4.6 The adjustment of the tuned circuits in the IF stage is done to obtain maximum (voltage/gain/current) for a given bandwidth.
- 4.7 The Yagi antenna has an (omnidirectional/unidirectional) radiation pattern.
- 4.8 A/An (even/slow/fast) recording speed results in a good frequency response of a magnetic tape.
- 4.9 Automatic gain control (AGC) is obtained from the output of the (IF/detector/audio) stage in the receiver. 
- 4.10 (Alpha/Beta/Delta) is an example of time-division multiplexing used for digital data communication.
- 4.11 The (oscilloscope/frequency counter/sweep generator) measures distortion.
- 4.12 Refraction is the (reflecting/bending/absorption) of an electromagnetic wave as it passes from one medium to another.
- 4.13 The angle between the E-fields and H-fields in an electromagnetic wave is (0°/90°/180°).
- 4.14 The (capstan/pinch roller) drives the tape in a tape recorder. 
- 4.15 The RF amplifier isolates the (local oscillator/IF amplifier/audio amplifier) signal from the antenna.

(15 × 1)

[15]

QUESTION 5

Explain, with the aid of simple sketches, each of the following forms of modulation:

- 5.1 Pulse-amplitude modulation (PAM) (2)
- 5.2 Pulse-width modulation (PWM)  (3)
- 5.3 Pulse-position modulation (PPM) (3)
- [8]**

QUESTION 6

- 6.1 Briefly explain why AGC is needed and how it is achieved. (4)
- 6.2  The purpose of an RF amplifier is to amplify a signal with a small amplitude to a usable level.
- Explain the terms *selectivity* and *sensitivity*. (3)
- [7]**

QUESTION 7

- 7.1 Draw a neat, labelled circuit diagram of a ratio detector. (8)
- 7.2 State the main purpose of a detector in a receiver.  (2)
- 7.3 What is the frequency of the IF signal in an AM receiver? (1)
- 7.4 Which section of the AM receiver produces the most gain and selectivity? (2)
- 7.5 Why does FM have a better signal-to-noise ratio than AM? (2)
- [15]**

QUESTION 8

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

- 8.1 Tropospheric ducting (5)
- 8.2 Tropospheric scatter  (5)
- [10]**

QUESTION 9

- 9.1 Explain how a capstan drive works with regard to tape recorders. (6)
- 9.2 Give the advantages of feeding the audio signal together with an alternating current bias signal to the recording head. (4)
- [10]**

TOTAL: 100

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 $R_1 = R_0$

4. then $N = 20 \log \frac{I_0}{I_1}$
5. $N = 20 \log \frac{V_0}{V_1}$