higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1520**(E)**(A5)T

NATIONAL CERTIFICATE

RADIO THEORY N3

(11040873)

5 April 2018 (X-Paper)
09:00–12:00

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

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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. Write neatly and legibly.

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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 A directional antenna is obtained by decreasing the radiation in the direction of the director.

1.2 The best protection for the radio equipment against lightning is to connect a transformer between the antenna and the radio equipment.

1.3 The vertical amplitude selector is used for selecting a suitable voltage scale.

1.4 A sweep signal generator produces a marker signal.

1.5 To simplify calculations a logarithmic unit, the Bel, was introduced.

1.6 An operational amplifier used as a differentiator uses resistors in both the input and feedback loop (path).

1.7 The amplitude of the modulation signal determines the percentage modulation.

1.8 The RF amplifier contains a tuned circuit which is electrically ganged to the tuned circuit of the local oscillator.

1.9 In a receiver with a ratio detector, a limiter capacitor is provided across the two ratio detector diode outputs.

1.10 The capstan drive makes use of a spindle to control the length of tape per second and ensure a very constant drive.

(10 × 1) **[10]**

QUESTION 2

An amplifier has an input impedance of 6 ohms and an output impedance of 10 ohms. A 10 mA input current provides a 1 V output voltage.

Calculate the gain in dB of the amplifier. **[10]**

QUESTION 3

Draw TWO basic circuit diagrams of an integrated differential operational amplifier applied:

3.1 With unity gain and non-inverting output

3.2 As an inverting amplifier with gain control

(2 × 5) **[10]**

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QUESTION 4

Draw a neat, labelled block diagram showing how instruments are connected for displaying the band-pass curve of an IF stage. **[10]**

QUESTION 5

5.1 Explain, with the aid of a neat, labelled circuit diagram how frequency modulation (reactance modulation) is obtained using a varactor modulator. (13)

5.2 Name ONE other method of achieving reactance modulation. (1)

5.3 Show, by using two comparative sketches, the difference between pulse-width modulation (PWM) and pulse-position modulation (PPM). (6)
[20]

QUESTION 6

6.1 Draw a neat, fully labelled block diagram of an FM superheterodyne receiver. (8)

6.2 What is the purpose of the discriminator and the IF amplifier in QUESTION 6.1? (4)

6.3 Why does FM have a better signal-to-noise ratio than AM? (2)

6.4 What is the frequency of the IF signal in the receiver mentioned in QUESTION 6.1? (1)
[15]

QUESTION 7

7.1 State the definition of an *antenna*. (2)

7.2 Explain, with the aid of a simple sketch, the term *polarisation* with reference to an electromagnetic wave. (4)

7.3 State the angle between the E and H fields in an electromagnetic wave. (2)

7.4 Briefly explain the following:

7.4.1 Ground waves (2)

7.4.2 Direct waves (2)

7.4.3 Skip distance (3)
[15]

QUESTION 8

Draw a neat, labelled block diagram of the electrical section of a tape recorder. **[10]**

TOTAL: 100

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RADIO THEORY N3

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 $R_1 = R_0$ *then:*

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

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

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