higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1510**(E)**(A5)T

NATIONAL CERTIFICATE

RADIO THEORY N2

(11040862)

5 August 2019 (X-Paper)
09:00–12:00

This question paper consists of 5 pages and a formula sheet of 2 pages.

Copyright reserved

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
RADIO THEORY N2
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.

Copyright reserved

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 The input of a transformer is called the secondary.

1.2 A low-frequency speaker is called a tweeter.

1.3 The current gain for a transistor connected in the common emitter mode is unity.

1.4 Crystal oscillators are popular because of their low sensitivity.

1.5 The total capacitance of three capacitors in parallel is $C_T = C_1 + C_2 + C_3$.

1.6 In a series resonant circuit consisting of R, L and C the impedance is equal to $X_C + X_L$.

1.7 The frequency of the local oscillator in a receiver is set to the IF above the incoming frequency.

1.8 The time constant of a circuit containing a resistor and capacitor in series can be derived from the formula $R = \frac{T}{C}$.

1.9 A transistor has only three terminals.

1.10 Capacitors provide high impedance to high frequencies.

(10 × 1) **[10]**

QUESTION 2

Two capacitors, each with a value of 200 nF and 75 µF are connected in series across a 100 V DC supply.

Determine:

2.1 The total charge (3)

2.2 The voltage drop across each capacitor (2)

[5]

Copyright reserved

QUESTION 3

A resistor of 15 Ω, an inductor with an inductance of 0,15 H and a capacitor with a capacitance of 150 µF are all connected in series across a 100/50 Hz supply.

Calculate:

3.1 The impedance of the circuit (6)

3.2 The total current flowing in the circuit (2)

3.3 The voltage dropped across the resistor, capacitor and the inductor (3)

3.4 The power factor (2)

3.5 The total power of the circuit (2)
[15]

QUESTION 4

4.1 Make a neat, labelled sketch of a half-wave power supply. (4)

4.2 Draw TWO cycles of the input and output waveforms of a half-wave rectifier. (4)

4.3 Name the TWO basic types of MOSFETs. (2)
[10]

QUESTION 5

5.1 Draw a neat, labelled circuit diagram of a stabilised common emitter amplifier. Use an NPN transistor. (12)

5.2 Name the components that supply each of the following functions for the circuit in QUESTION 5.1.

5.2.1 Voltage divider

5.2.2 Stabilising circuit

5.2.3 Load resistor

5.2.4 Coupling capacitor

(4 × 2) (8)
[20]

Copyright reserved

QUESTION 6

6.1 Name FOUR types of microphones. (4)

6.2 Show, by means of a fully labelled sketch, the construction of a moving coil speaker. (6)
[10]

QUESTION 7

7.1 Define *AM modulation.* (3)

7.2 Draw the input and output waveforms of a modulator. (6)

7.3 What is the difference between sensitivity and selectivity, as associated with receivers? (2 + 2) (4)

7.4 What is the function of a speaker? (2)
[15]

QUESTION 8

8.1 List FIVE steps to find a fault in a radio receiver. (5)

8.2 Give a brief description of the function of each of the following controls in an oscilloscope:

8.2.1 Volts/division

8.2.2 Time/division

8.2.3 Brightness

8.2.4 X-shift

8.2.5 Y-shift

(5 × 2) (10)
[15]

TOTAL: 100

Copyright reserved

FORMULA SHEET

Capacitors resistors and inductors

$$\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots$$

$$C_T = C_1 + C_2 + \ldots$$

$$R_T = R_1 + R_2 + \ldots$$

$$\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots$$

$$\frac{1}{L_T} = \frac{1}{L_1} + \frac{1}{L_2} + \ldots$$

$$L_T = L_1 + L_2 + \ldots$$

$$R_{SH} = \frac{I_m \times R_m}{I_T - I_m}$$

$$R_S = \frac{V}{I_m} - R_m$$

Instantaneous voltage across a capacitor: $V_C = V\left(1 - e^{\frac{-t}{RC}}\right)$

Initial charging current through a capacitor: $i = \frac{V}{R} \times e^{\frac{-t}{RC}}$

Time constant: $\tau = R \times C$

Charge of capacitor: $Q = C \times V$

AC theory

Inductive reactance: $X_L = 2.\pi.F.L$

Capacitive reactance: $X_C = \frac{1}{2.\pi.F.C}$

Copyright reserved

Impedance for RL, RC and RLC circuits:

$$Z = \sqrt{R^2 + X_L{}^2} : Z = \sqrt{R^2 + X_C{}^2} : Z = \sqrt{R^2 + (X_L \approx X_C)^2}$$

Circuit current for RL, RC and RLC circuits:

$$I_T = \frac{V_T}{X_L} : \qquad I_T = \frac{V_T}{X_C} : \qquad I_T = \frac{V_T}{Z}$$

Voltage drop across components:

$$V_R = I \times R : V_L = I \times X_L : V_C = I \times X_C$$

Power factor: $\cos\theta = \frac{R}{Z}$

Phase angle: $\phi = \cos^{-1}\frac{R}{Z}$

Resonant frequency: $f_r = \frac{1}{2.\pi.\sqrt{LC}}$

Q-factor: $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$ or $Q = \frac{X_L}{R}$

Ohm's law

Voltage drop: $V = I \times R$

Circuit current: $I = \frac{V}{R}$

Oscilloscope calculations

Period = Time/division × Horizontal divisions

Amplitude = Volts/division × Vertical divisions

Frequency $= \frac{1}{\text{Period}}$

RMS voltage = 0,707 × peak

Average voltage = 0,637 × peak

Voltage (peak-to-peak) = 2 × peak

Copyright reserved