higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

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

NATIONAL CERTIFICATE

RADIO THEORY N2

(11040862)

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09:00–12:00

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

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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.

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QUESTION 1

Choose the correct words from those given in brackets. Write only the words next to the question number (1.1–1.10) in the ANSWER BOOK.

1.1 Capacitors can be either (polarised/magnetised).

1.2 The current is always shown with the letter (V/I).

1.3 In a series resonant circuit, the impedance is equal to (X_L/R).

1.4 The current gain for a transistor connected in the common emitter mode is (high/unity).

1.5 The local oscillator's frequency is always set to the (RF/IF) above the incoming frequency.

1.6 The output of a microphone is (RF/AF).

1.7 To maintain a relatively constant sound under varying reception conditions, we use (AGC/AVC) to alter the gain of the IF amplifiers.

1.8 Semiconductor material that has been doped is referred to as (extrinsic/intrinsic) material.

1.9 Crystal oscillators are popular because of their (high/low) sensitivity.

1.10 Class B amplifiers amplify only (a third/half) of the input signal.

(10 × 1) **[10]**

QUESTION 2

An alternating waveform has a peak-to-peak value of 200 V and a frequency of 50 Hz.

Calculate the following:

2.1 The maximum value (1)

2.2 The RMS value and average value (4)

2.3 The time period (2)

[7]

QUESTION 3

3.1 Give SIX conditions that exist when a circuit with R, L and C in series resonates. (6)

3.2 A coil with a resistance of 15 Ω and an inductance of 128 mH is connected in series with a 58 µF capacitor. The supply voltage to this circuit is 100 V.

Determine the following:

3.2.1 The resonant frequency (4)

3.2.2 The quality factor (Q) of the coil (3)
[13]

QUESTION 4

4.1 A transistor can be configured in three different ways to function as an amplifier, namely, common emitter, common base and common collector.

Make neat sketches of each of the THREE configurations.
Use NPN transistors. (11)

4.2 Tabulate the current gain, voltage gain and power gain of the THREE configurations in QUESTION 4.1. (9)
[20]

QUESTION 5

Name SIX factors that limit the accuracy of an analogue meter. **[6]**

QUESTION 6

With the aid of a neat labelled diagram, explain the operation of a moving coil microphone. **[10]**

QUESTION 7

7.1 Draw the symbol of a varactor diode. (2)

7.2 Draw the characteristic curve of a varactor diode. (3)

7.3 Name FIVE different instruments or equipment used in a radio repair shop. (5)
[10]

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QUESTION 8

With the aid of a neat labelled diagram, describe the functions of ALL the stages of the tuned radio frequency receiver (TRF). **[15]**

QUESTION 9

9.1 Name TWO basic types of cartridges found in record players. (2)

9.2 Draw a fully labelled circuit diagram of an AM detector. Your diagram must include the input wave and the output wave. (7)
[9]

TOTAL: 100

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FORMULA SHEET

RADIO THEORY N2

CAPACITORS, RESISTORS AND INDUCTORS

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

$$C_T = C_1 + C_2 + ...$$

$$R_T = R_1 + R_2 + ...$$

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

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

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

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

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

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

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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 $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$

OHM'S LAW

Voltage drop $V = I \times R$

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

OSCILLOSCOPE CALCULATIONS

Period = Time/Division x Horizontal divisions

Amplitude = Volts/Division x \Vertical divisions

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

RMS voltage = 0,707 x Peak

Average voltage = 0,637 x Peak

Voltage (Peak to Peak) = 2 x Peak

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