higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

RADIO THEORY N2

(11040862)

14 April 2021 (X-paper)
09:00–12:00

Nonprogrammable calculators and drawing instruments may be used.

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

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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

1.1 Explain *time period* with reference to alternating current waveforms. (2)

1.2 Calculate the total capacitance of the following TWO capacitors connected in parallel:

0,2 µF and 800 nF (3)

1.3 Define *inductive reactance.* (2)

1.4 Calculate the maximum voltage value of an alternating voltage with an average value of 191,1V. (3)

1.5 A series RLC circuit consists of a 220 µF capacitor, a 20 mH inductor and a 10 Ω resistor connected across a 12 V/50 Hz supply.

Calculate each of the following:

1.5.1 Inductive reactance

1.5.2 Capacitive reactance

1.5.3 Impedance of circuit

1.5.4 Current flow in circuit

1.5.5 Phase angle

(5 × 2) (10)

[20]

QUESTION 2

2.1 Name SIX advantages of a digital multimeter compared to an analogue multimeter. (6)

2.2 A moving-coil meter has a full-scale deflection of 1 mA and an internal resistance of 200 Ω.

Calculate the shunt resistor needed to convert the meter to an ammeter capable of measuring a maximum of 50 mA. (3)

2.3 State the function of the intensity control on an oscilloscope. (2)

2.4 A signal occupies 5 horizontal divisions from the start of a cycle to the end of the cycle on an oscilloscope screen. The time/div sweep switch is set to 3 µs.

Calculate the time period and the frequency. (4)

[15]

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QUESTION 3

3.1 Draw a circuit diagram to show a half-wave rectification. The diagram must include a transformer, a capacitor and a load resister.

Draw the input and output waveforms of the circuit with a capacitor and without a capacitor. (7)

3.2 Explain the operation of a varactor diode. (3)

[10]

QUESTION 4

4.1 Two or more amplifier stages are coupled to increase the overall gain.

Draw a circuit diagram of an RC coupling amplifier. (6)

4.2 Name THREE transistor amplifier configurations. (3)

4.3 State TWO functions of a transistor. (2)

4.4 Draw a fully labelled electronic symbol of a P-channel depletion-type MOSFET. (4)

[15]

QUESTION 5

5.1 Show, by means of a fully labelled sketch, the construction of a moving-coil speaker. (6)

5.2 Name TWO advantages and TWO disadvantages of a capacitor microphone. (4)

[10]

QUESTION 6

Briefly describe each of the following terms as used in super-heterodyne radio-receiver communication:

6.1 Antenna

6.2 Selectivity

6.3 AM modulation

6.4 Mixer

6.5 Detector

(5 × 2) **[10]**

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QUESTION 7

7.1 Explain how you would locate the faulty stage of an audio amplifier by using a signal generator and an oscilloscope. (4)

7.2 Draw a fully labelled circuit diagram of a Hartley oscillator using an NPN transistor. (6)

[10]

QUESTION 8

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (8.1–8.10) in the ANSWER BOOK.

8.1 The inductive reactance at resonance in a series RLC circuit is equal to the capacitive reactance.

8.2 Current divides in a parallel circuit.

8.3 The average value of a 10 V peak-to-peak sine wave after rectification is 6,37 V.

8.4 The vertical shift on an oscilloscope changes the amplitude of the wave displayed.

8.5 Valence electrons are found in the outer band of an atom.

8.6 The dielectric of a capacitor is a conductor.

8.7 Current flows in a circuit when a diode is forward biased.

8.8 Field-effect transistors are voltage-controlled devices.

8.9 Transformers change AC to DC.

8.10 The detector in a radio removes the AF from the RF carrier wave.

(10 × 1) **[10]**

TOTAL: 100

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RADIO THEORY N2

FORMULA SHEET

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

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

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

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

$$\tau = R \times C \qquad Q = C \times V$$

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

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

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

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

$$\cos\theta = \frac{R}{Z}$$

$$f_r = \frac{1}{2.\pi.\sqrt{LC}} \qquad Q = \frac{1}{R}\sqrt{\frac{L}{C}} \qquad Q = \frac{X_L}{R}$$

$$V = I \times R \qquad I = \frac{V}{R}$$

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

RMS voltage = 0,707 × peak

Average voltage = 0,637 × peak

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