higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T1510**(E)**(A1)T

NATIONAL CERTIFICATE

RADIO THEORY N2

(11040862)

1 August 2018 (X-Paper)
09:00–12:00

This question paper consists of 6 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

1.1 Draw a neat, labelled sine wave that represents a 720° spread. Indicate the peak value and time period on the drawing. (4)

1.2 An alternating voltage has an RMS value of 212,1 volts.

Calculate the maximum and average values. (4)

1.3 Calculate the total capacitance of two capacitors of 10 µF and 20 µF respectively that are connected in series. (3)

1.4 List THREE factors that determine the capacitance of a capacitor. (3)

1.5 A series circuit consists of a 10 Ω resistor, a 20 mH inductor and a 68 µF capacitor.

Calculate:

1.5.1 The resonance frequency

1.5.2 The inductive reactance at resonance

1.5.3 The Q-factor

(3 × 2) (6)

[20]

QUESTION 2

2.1 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 into an ammeter capable of measuring a maximum of 50 mA. (3)

2.2 List FOUR precautions when using a DC voltmeter. (4)

2.3 Name SIX uses of an oscilloscope. (6)

2.4 State the function of each of the following controls of an oscilloscope:

2.4.1 Focus control

2.4.2 Volts/Division control

(2 × 1) (2)

[15]

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QUESTION 3

3.1 Explain the operation of a half-wave rectifier using an AC-input voltage. (4)

3.2 Draw the characteristic curve of a silicon P-N junction diode. (5)

3.3 Name the component that changes its capacitance with a change of voltage across its terminals. (1)

[10]

QUESTION 4

4.1 Name THREE transistor amplifier configurations. (3)

4.2 Transistors have three terminals.

Draw the symbol for an NPN transistor, name the THREE terminals and give the function of each terminal. (4)

4.3 Name the TWO basic types of MOSFETS. (2)

4.4 Complete the comparison table of the characteristics of amplifier configurations below. Write only the answer next to the question number (4.4.1–4.4.6) in the ANSWER BOOK.

CIRCUIT	PHASE SHIFT	CURRENT AMPLIFICATION	VOLTAGE AMPLIFICATION
Common base	0 degrees	4.4.1	4.4.2
Common emitter	4.4.3	high	4.4.4
Common collector	4.4.5	4.4.6	none

(6 × 1) (6)

[15]

QUESTION 5

5.1 Give TWO advantages and TWO disadvantages of a capacitor microphone.

(2 + 2) (4)

5.2 Make TWO neat, labelled diagrams of TWO speakers connected to each other showing in-phase and out-of-phase movement. (4)

5.3 The erase head of a magnetic tape recording is used to remove recorded information from the tape.

What forces the magnetic particles on the tape out of alignment? (2)

[10]

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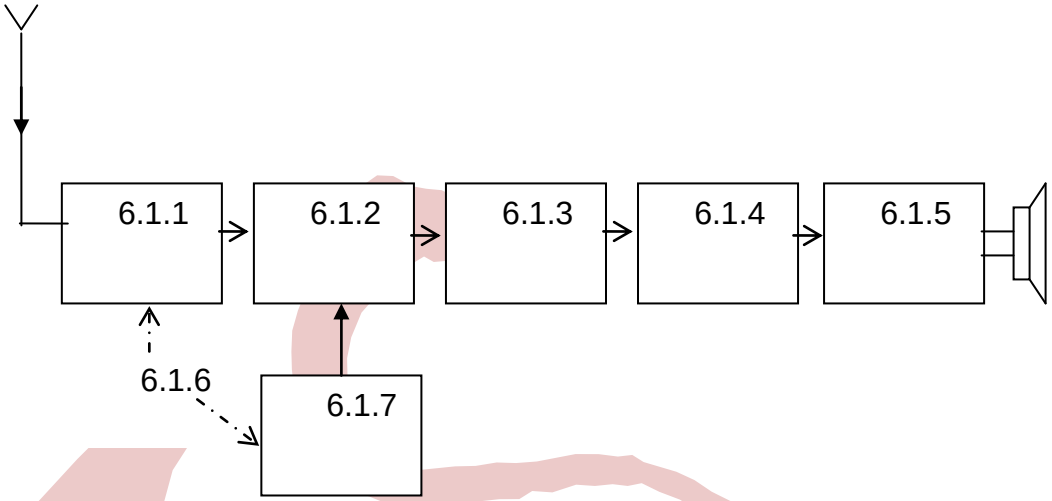
QUESTION 6

6.1 Name the components of an AM superheterodyne radio receiver below. Write only the name of the component next to the question number (6.1.1–6.1.7) in the ANSWER BOOK.



(7 × 1) (7)

6.2 Explain the operation of component in QUESTION 6.1.2. (3)
[10]

QUESTION 7

7.1 Name FOUR pieces of test equipment or instruments that can be used in testing an audio amplifier for correct functioning. (4)

7.2 Draw the circuit diagram of a Hartley oscillator. (6)
[10]

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QUESTION 8

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

8.1 A voltmeter is used to measure current.

8.2 Frequency is measured in hertz.

8.3 The unit of inductance is farads.

8.4 Oscilloscopes can measure DC voltage.

8.5 To measure current in a DC circuit, the amp meter is connected in parallel with the battery.

8.6 Valence electrons are found in the inner orbit of an atom.

8.7 Diodes change AC to pulsating DC.

8.8 A diode will destroy itself if the PIV of the diode is exceeded.

8.9 When inductors are connected in series, the total resistance decreases.

8.10 In a class-B amplifier the transistor is biased at cut-off.

(10 × 1) **[10]**

TOTAL: 100

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

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

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