higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

RADIO THEORY N2

(11040862)

30 November 2023 (X-paper)
09:00–12:00

Scientific calculators and drawing instruments may be used.

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

171Q1E2330

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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. Use only a black or blue pen.
5. Write neatly and legibly.

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QUESTION 1

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

1.1 In an NPN transistor the base is … with respect to the emitter and the collector. (negative/positive).

1.2 When measuring resistance, we place the meter in … with the component under test. (series/parallel)

1.3 The limiter's function is to … the amplifier variation by "clipping" the top and bottom interference. (add/remove)

1.4 The loudspeaker is a device that converts electric energy into … energy. (graphic/sound)

1.5 A microphone can change pressure on the surface and convert it into … waves. (electrical/sound)

1.6 A Zener diode can operate in both the … and … bias modes. (no bias/reverse/forward)

1.7 When an alternating potential is applied to a capacitor, it appears to pass a … through it. (resistance/current)

1.8 A half-wave rectifier circuit changes an alternating quantity into … quantity. (full-wave/direct)

1.9 A varactor diode is use in the … bias area of a characteristic curve. (reverse/ forward)

1.10 Amplitude modulation is the process by which the … of the carrier wave varies in accordance with the amplitude of modulating signal. (frequency/amplitude)

(10 × 1) **[10]**

QUESTION 2: AC THEORY

2.1 The equation e = 150 sin 314,159 t voltage represents a certain alternating current.

Calculate the following for the given voltage expression:

2.1.1 The peak-to-peak value of the wave. (2)

2.1.2 The frequency of the wave. (2)

2.1.3 The angle in degrees, after 0,015 seconds. (2)

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2.1.4 The voltage value at 90º. (2)

2.1.5 The instantaneous voltage value after 16,5 milliseconds. (4)

2.2 Certain circuit conditions exist when a RLC circuit resonates.

List any FOUR conditions for resonance to occur. (4)
[16]

QUESTION 3: MEASURING INSTRUMENTS

3.1 Name any FIVE factors that limit the accuracy of an analogue meter in the repair of a radio receiver. (5)

3.2 When repairing a radio, you will need instruments and equipment. Name any THREE instruments you will need to do the work. (3)

3.3 The oscilloscope can be used to show a graphic representation of a sine wave.

Give any FIVE applications of the oscilloscope (5)
[13]

QUESTION 4: AMPLIFIER (TRANSISTORS)

4.1 Draw the following circuit symbols you find in a radio amplifier:

4.1.1 PNP Transistor

4.1.2 NPN Transistor

4.1.3 MOSFET P-Channel Transistor

4.1.4 J FET N-Channel Transistor

(4 × 2) (8)

4.2 Draw a neat, labelled circuit diagram of a common collector amplifier. (8)
[16]

QUESTION 5: RADIO COMMUNICATION FM SUPERHETERODYNE

5.1 The limiter stage is only used in FM superheterodyne radio receivers. Provide the function of the limiter. (2)

5.2 The superheterodyne receiver is the most popular receiver used in radios.

Draw a neat, labelled block diagram of an AM superheterodyne receiver and show all interconnections between stages. (10)

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5.3 Complete the following sentences by filling in the missing word or words. Write only the word or words next to the question number (5.3) in the ANSWER BOOK.

Modulation is the process of combining … onto a … . (2)
[14]

QUESTION 6: MICROPHONES

A cell phone converts mechanical sound into electrical waves.

Draw a neat, labelled sketch of a capacitor microphone as used in a cell phone. **[11]**

QUESTION 7: SPEAKERS

7.1 Sound in a cell phone is heard through the speakers.

Draw a neat, labelled sketch of a moving coil loudspeaker. (8)

7.2 Give the threshold voltage needed to overcome the barrier potential for germanium and a silicon diode respectively. (2)
[10]

QUESTION 8: FAULTS FINDING

8.1 The selection of the bias point on a transistor determines the classes of amplification. Name FOUR classes of amplification. (4)

8.2 Explain what the fault is when the audio stage amp in a superheterodyne receiver is faulty. (3)

8.3 Name any THREE transformers found in a radio receiver. (3)
[10]

TOTAL: 100

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FORMULA SHEET

RADIO THEORY N2

Capacitors Resistors and Inductors

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

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

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

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

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

$L_T = L_1 + L_2 + \ldots$

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

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

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

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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 × 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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