higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

**NATIONAL CERTIFICATE**

# RADIO THEORY N2

(11040862)

**20 November 2020 (X-paper)**
**09:00–12:00**

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

203Q1E2020

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# DEPARTMENT OF HIGHER EDUCATION AND TRAINING
# REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
RADIO THEORY N2
TIME: 3 HOURS
MARKS: 100

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**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. Start each section on a new page.
5. Use only a black or blue pen.
6. Write neatly and legibly.

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## QUESTION 1

1.1 What are the THREE factors that determine the capacitance of a capacitor? (3)

1.2 Calculate the total inductance of the following TWO inductors connected in series: 0,1 H and 900 mH (3)

1.3 An alternating current has a maximum value of 100 A and a frequency of 50 Hz.

Calculate the value of the RMS current and the time period. (4)

1.4 An RC circuit consists of a 100-μF capacitor in series with a 10-Ω resistor, connected across a 12-V/50-Hz supply.

Calculate the following:

1.4.1 The capacitive reactance

1.4.2 The impedance of the circuit

1.4.3 The current flow in the circuit

1.4.4 The voltage drop across the resistor

1.4.5 The phase angle

(5 × 2) (10)
**[20]**

## QUESTION 2

2.1 Name THREE precautions when using a DC voltmeter. (3)

2.2 Calculate the series resistor needed to enable a moving-coil meter with a full-scale deflection current of 200 mA and coil resistance of 100 Ω to measure 50 V at full scale. (3)

2.3 An oscilloscope displays an AC signal (one cycle) that covers four vertical divisions and six horizontal divisions. The volts/division control is set to 2 V/division. The time/division control is set to 2 mSeconds/division.

Calculate the following:

2.3.1 Peak-to-peak voltage (2)

2.3.2 Frequency (3)

2.4 Name FOUR uses of an oscilloscope (4)
**[15]**

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## QUESTION 3

3.1 A diode can be used for rectification purposes. Draw a neat, labelled circuit diagram of a bridge rectifier. Include a transformer and a load resister. Your diagram must also show the input and output waveforms. (6)

3.2 Choose a term from COLUMN B that matches an item in COLUMN A. Write only the letter (A–D) next to the question number (3.2.1–3.2.4) in the ANSWER BOOK.

| COLUMN A | | COLUMN B | |
|---|---|---|---|
| 3.2.1 | Intrinsic | A | pentavalent |
| 3.2.2 | N-type semiconductor | B | blocks electric current flow |
| 3.2.3 | Protons | C | pure silicon |
| 3.2.4 | Insulator | D | positive charge |

(4)
**[10]**

## QUESTION 4

4.1 Name the THREE regions on the output characteristic curve of a transistor. (3)

4.2 Give FOUR advantages of negative feedback in amplifiers. (4)

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

4.4 Complete the comparison table of the characteristics of the amplifier configurations below. Write only the question number and answer 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)
**[15]**

## QUESTION 5

5.1 What is the main construction difference between a mains transformer and an autotransformer? (2)

5.2 With the aid of a neat, labelled diagram, explain the operation of a moving-coil microphone. (8)
**[10]**

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## QUESTION 6

6.1 Draw a neat, fully labelled block diagram of an AM superheterodyne radio receiver. (8)

6.2 Explain the purpose of automatic gain control (AGC) as used in an AM receiver. (2)

**[10]**

## QUESTION 7

7.1 Define *AM modulation*. (2)

7.2 Make a neat, labelled sketch of the construction of a record/playback head as used in tape recorders. (4)

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

**[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 time period of a 60-Hz frequency is 16,667 ms.

8.2 Capacitive reactance is inversely proportional to the frequency.

8.3 At resonance in an RLC circuit, the phase angle is 90°.

8.4 The voltage across the inductor of a RL circuit lags the current by 90°.

8.5 Capacitors block DC.

8.6 The cartridge converts the stylus' mechanical motion into an electrical signal.

8.7 The low-frequency speaker is called a tweeter.

8.8 The disadvantage of a carbon microphone is that it is very noisy.

8.9 The input of a transformer is called the secondary.

8.10 A Class A amplifier has a high efficiency.

(10 × 1) **[10]**

**TOTAL: 100**

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**FORMULA SHEET**

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

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

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

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

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

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

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

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

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

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

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

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

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

RMS voltage = 0,707 x Peak

Average voltage = 0,637 x Peak

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