higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

RADIO THEORY N2

(11040862)

04 August 2021 (X-paper)
09:00–12:00

Scientific calculators and drawing instruments may be used.

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

179Q1G2104

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

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QUESTION 1

Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (1.1–1.15) in the ANSWER BOOK.

1.1 The distance between the plates of a capacitor plays no part in the capacitance of a capacitor.

1.2 In DC applications, capacitors readily allow current to flow.

1.3 The supply frequency generated by the power station is 50 Hz, thus the time to complete one cycle is 20 minutes.

1.4 The total impedance of a series RLC circuit is equal to the sum of the individual impedances.

1.5 The vacuum diode has a heater.

1.6 In a resonant circuit containing R, L and C in series, the phase angle θ is equal to 0°.

1.7 The output signal of the common collector amplifier is in phase with the input signal.

1.8 In radio wave communication, the information transmitted is in the form of an electrical wave.

1.9 The local oscillator in a radio receiver generates a constant frequency signal at variable amplitude.

1.10 The Colpitts oscillator uses tapped inductance for the feedback circuit.

1.11 To operate as a Class-A amplifier, the working point of the amplifier must be selected at the mid-point of the characteristic curve.

1.12 An internal bias oscillator feeds a low-frequency signal to the erase head.

1.13 The ceramic cartridge operates on the piezoelectric effect.

1.14 Field effect transistors are current-controlled devices.

1.15 An ohmmeter must always be connected in parallel with the load.

(15 × 1) **[15]**

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QUESTION 2

In a series RLC circuit, R = 500 Ω L = 10 mH C=10 nF.
The supply frequency is 12 kHz and the supply voltage is 20 V.

Calculate the following:

2.1 Total current flowing (9)

2.2 Voltage drop across the capacitor, resistor and inductor respectively (6)
[15]

QUESTION 3

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

3.2 Make a neat, labelled sketch of a half wave power supply. (4)

3.3 Give the term(s) used to indicate the electrons found in the outer orbit of an atom. (2)

3.4 Give the typical barrier potential for germanium diodes. (1)
[10]

QUESTION 4

Draw the circuit diagram of a common base amplifier that uses an NPN transistor. The diagram must show the input and output waveforms and the potential divider resistors. **[10]**

QUESTION 5

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

QUESTION 6

6.1 Draw a neat, fully labelled block diagram of an AM super heterodyne radio receiver. The diagram must clearly show the position of the AGC and gang tune. (10)

6.2 Explain *selectivity* and *sensitivity* with regard to radio receivers. (2 × 2) (4)
[14]

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QUESTION 7

7.1 Calculate the series multiplier resistor needed to enable a moving-coil meter with a full-scale deflection current of 120 mA and a coil resistance of 150 Ω to measure 100 V at full scale. (3)

7.2 Give a brief description of the function of the following controls as found in an oscilloscope:

7.2.1 Volts/division (2)

7.2.2 Time/division (2)

7.2.3 Brightness (1)

7.2.4 X-shift (1)

7.2.5 Y-shift (1)

[10]

QUESTION 8

One of the procedures in fault finding is to inspect the equipment and circuit boards.

Name and explain THREE conditions that can be found by doing the look test. **[6]**

QUESTION 9

9.1 Name and explain the THREE main regions of a transistor. (6)

9.2 Metal Oxide Semiconductor Field Effect Transistors are classified into two types.

Name the TWO different types of MOSFETS. (2)

9.3 Explain *negative feedback* as used in amplifiers. (2)

[10]

TOTAL: 100

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FORMULA SHEET

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

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

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

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

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

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

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

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

$$\tau = R \times C$$

$$Q = C \times V$$

$$V_C = V\left(1 - e^{\frac{-t}{RC}}\right)$$

$$i = \frac{V}{R} \times e^{\frac{-t}{RC}}$$

$$X_L = 2.\pi.F.L$$

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

$$Z = \sqrt{R^2 + X_L{}^2}:$$

$$Z = \sqrt{R^2 + X_C{}^2}:$$

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

$$I_T = \frac{V_T}{X_L}:$$

$$I_T = \frac{V_T}{X_C}:$$

$$I_T = \frac{V_T}{Z}$$

$$V_R = I \times R:$$

$$V_L = I \times X_L:$$

$$V_C = I \times X_C$$

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

$$f_r = \frac{1}{2.\pi.\sqrt{LC}}$$

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

$$Q = \frac{X_L}{R}$$

$$V = I \times R$$

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

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

RMS voltage = 0,707 × Peak

Average voltage = 0,637 × Peak

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