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Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE

RADIO AND TELEVISION THEORY N2

(11040832)

9 April 2020 (X-paper)
09:00–12:00

This question paper consists of 5 pages and a formula sheet of 3 pages.

223Q1A2009

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
RADIO AND TELEVISION 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. Sketches must be large, neat and fully labelled.
5. Use only a black or blue pen.
6. Write neatly and legibly.

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 amount of charge stored in the capacitor.

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

1.3 In South Africa, the supply frequency generated by the power station is 50 Hz, thus the time to complete one cycle is 20 ms.

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

1.5 Circuits containing inductors and capacitors that are connected in parallel are known as rejector circuits.

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 amplitudes.

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

1.11 For an amplifier to operate as a class A amplifier the working point is selected at the midpoint of the characteristic curve.

1.12 A band-stop filter attenuates all frequencies below a certain cutoff frequency.

1.13 The EHT in a monochrome television receiver is higher than that found in a colour television receiver.

1.14 The time-base generator found in a CRO generates a sine wave.

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

(15 × 1) **[15]**

QUESTION 2

2.1 State THREE factors that influence the charge on capacitors. (3)

2.2 How many time constants does it take for a capacitor to fully charge or discharge? (1)

2.3 A 100 kΩ resistor is connected in series with a 100 µF capacitor across a 50 V DC supply.

Determine:

2.3.1 The first time constant (2)

2.3.2 The time taken in seconds for the capacitor to be fully charged. (3)

2.3.3 The potential difference across the capacitor when it has reached 63,2% of the maximum supplied voltage. (2)

2.3.4 The voltage across the resistor at the voltage you calculated in QUESTION 2.3.3. (2)

[13]

QUESTION 3

3.1 State and give the unit of each of the following parts of the equation: $e = E\sin 2\pi ft$

3.1.1 e

3.1.2 E

3.1.3 f

3.1.4 t

(4 × 2) (8)

3.2 A certain AC voltage is represented by $e = 100\sin 2\pi(50)t$.

Calculate:

3.2.1 The peak-to-peak value of the wave (2)

3.2.2 The angle in degrees after 0,015 seconds (3)

3.2.3 The voltage value at 270° (2)

[15]

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, as well as the potential divider resistors. **[10]**

QUESTION 5

5.1 Draw a neat, fully labelled block diagram of an AM superheterodyne radio receiver. The diagram should clearly show the position of the AGC and gang tune. (10)

5.2 Explain *selectivity* and *sensitivity* with regard to radio receivers. (3)

[13]

QUESTION 6

6.1 Draw a neat, fully labelled block diagram of a 625 line monochrome television receiver. Indicate all signal directions and interconnections. (14)

6.2 Fully explain the function of each of the following with regard to monochrome television receivers:

6.2.1 The coaxial cable

6.2.2 The video detector

6.2.3 The video amplifier

(3 × 2) (6)

[20]

QUESTION 7

Name and explain the FOUR basic parts that are found inside a cathode-ray tube (CRT) that are important for the successful operation of this tube. **[8]**

QUESTION 8

Before proceeding with a fault-finding process you may find that many problem-solving procedures can be eliminated just by looking at the circuit board.

Name and explain THREE conditions that can be found merely by looking for faults.

(3 × 2) **[6]**

TOTAL: 100

RADIO AND TELEVISION THEORY N2

FORMULA SHEET

CAPACITOR CALCULATIONS

Capacitors in series: $\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \cdots$

Capacitors in parallel: $C_T = C_1 + C_2 + \cdots$

Instantaneous voltage across a capacitor: $V_C = V(1 - e^{\frac{-t}{RC}})$

Initial charging current through a capacitor: $i = \frac{V}{R} \times e^{\frac{-t}{RC}}$

Time constant: $T = R \times C$

Charge of capacitor: $Q = C \times V$

AC THEORY

Inductive reactance: $X_L = 2 \bullet \pi \bullet F \bullet L$

Capacitive reactance: $X_C = \frac{1}{2 \bullet \pi \bullet F \bullet C}$

Impedance for RL, RC and RLC circuits:

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

Circuit current for RL, RC and RLC circuits:

$\mathrm{I}_T = \frac{V}{X_L}$ $\mathrm{I}_T = \frac{V}{X_C}$ $\mathrm{I}_T = \frac{V}{Z}$

Voltage drop across components:

$V_R = \mathrm{I} \times R$ $V_L = \mathrm{I} \times X_L$ $V_C = \mathrm{I} \times X_C$

Power factor: $Cos\ \theta = \frac{R}{Z}$

Phase angle: $\phi = Cos^{-1}\frac{R}{Z}$

Resonant frequency: $f_r = \frac{1}{2 \bullet \pi \bullet \sqrt{L \bullet C}}$

Q-factor: $Q = \frac{1}{R \bullet}\sqrt{\frac{L}{C}}$

OHM'S LAW

Resistors in series: $R_T = R_1 + R_2 + \cdots$

Resistors in parallel: $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2} + \cdots$

Voltage drop: $V = I \times R$

Circuit current: $\mathrm{I} = \frac{V}{R}$

OSCILLOSCOPE CALCULATIONS

Period = Time/Division × Horizontal divisions

Amplitude = Volts/Division × Vertical divisions

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

RMS voltage = 0,707 × Peak

Average voltage = 0,637 × Peak

Voltage (peak-to-peak) = 2 × Peak