higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

ENGINEERING

T1360(E)(M25)T
APRIL EXAMINATION

NATIONAL CERTIFICATE

RADIO AND TELEVISION THEORY N2

(11040832)

25 March 2014 (Y-Paper)
13:00–16:00

Calculators may be used.

This question paper consists of 4 pages and 2 formula sheets.

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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 the questions carefully.
3. ALL the sketches and diagrams must be large, clear and neat.
4. Keep questions and subsections of questions together.
5. Answers must be numbered according to the numbering system used in the question paper.
6. Show ALL the steps and calculations.
7. Write neatly and legibly.

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QUESTION 1

1.1 Three resistors of 15 Ω, 10 Ω and 15 Ω are connected in series to a 100 V supply and this is then connected to a DC supply.

1.1.1 Draw the circuit. (4)

Determine the following:

1.1.2 The total resistance of the circuit (2)

1.1.3 The total current flow (2)

1.1.4 The voltage drop across each resistor (6)

1.2 Give the THREE main functions of capacitors. (3)

1.3 Name the THREE types of non-polarised capacitors. (3)
[20]

QUESTION 2

A battery is connected to a 100 kΩ resistor in series with a capacitor of 0,01 µF.

Calculate the following:

2.1 The time constant. (3)

2.2 The voltage across the capacitor. (5)

2.3 The voltage across the resistor after 2 m/s (2)

2.4 The instantaneous current after 001 seconds. (2)

2.5 The instantaneous current after 0,002 seconds (2)
[14]

QUESTION 3

A series RLC circuit consists of 47 µF capacitor, a resistor of 100 Ω and an inductor of 25 mH connected to a 120 V 100 Hz supply.

Determine the following:

3.1 The inductive reactance. (2)

3.2 The capacitive reactance. (2)

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3.3 The impedance of the circuit. (2)

3.4 The total current. (2)

3.5 The phase angle. (2)

3.6 The voltage across each component. (6)
[16]

QUESTION 4

Draw a fully labelled block diagram of an AM superheterodyne radio receiver. **[10]**

QUESTION 5

5.1 Define the following terms:

5.1.1 Impedance

5.1.2 Amplitude modulation

5.1.3 Superheterodyne

5.1.4 Name THREE measurements that can be done with an oscilloscope.

(3 x 4) (12)

5.2 The medium waveband of a supersonic radio receiver is marked 500 kHz to 1 600 kHz.

Determine the equivalent wavelength range. (6)
[18]

QUESTION 6

6.1 Draw a fully labelled block diagram of an oscilloscope. (10)

6.2 Name SIX controls of an oscilloscope and their functions. (12)
[22]

TOTAL: 100

REFERENCES

1. Elskie, J.J.V. 2011. Radio and Television theory. Revised edition. Pretoria: Hercules.
2. Johnson, J.J. Fletcher, B.D. 1997. Introductory Radio and Television Electronics. London: Macmillan.

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RADIO AND TELEVISION THEORY N2

FORMULA SHEET

CAPACITOR CALCULATIONS

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

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:

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

Circuit current for RL, RC and RLC circuits:

$$I_T = \frac{V}{X_L} \qquad I_T = \frac{V}{X_C} \qquad I_T = \frac{V}{Z}$$

Voltage drop across components:

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

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

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

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