higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

ELECTRONIC CONTROL AND DIGITAL ELECTRONICS
NQF LEVEL 4

(12041024)

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

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

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ELECTRONIC CONTROL AND DIGITAL ELECTRONICS
NQF LEVEL 4
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 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 List FOUR applications for resonant circuits. (4)

1.2 With the aid of circuit diagrams, distinguish between the low- and high-pass filter circuits in an RL series circuit. (3 + 3) (6)

1.3 A series circuit consists of a resistor of 40 ohm, capacitive reactance of 60 ohm and a phase angle of -26,56 degrees (current leading). If the supply voltage is 220 V at a frequency of 50 Hz,

Calculate:

1.3.1 The inductive reactance. (3)

1.3.2 The inductance in mH. (3)

1.3.3 Draw the phasor diagram. (4)

[20]

QUESTION 2

2.1 List FIVE factors that affect the oscillation frequency. (5)

2.2 A 555 timer is an IC used in timers, pulse generation and oscillator applications. In astable mode, it can be used for flashing lamps and LEDs.

Draw fully labelled 555 timer in astable mode. (6)

2.3 Describe the principle of operation of a switched-mode power supply. (8)

2.4 Name and explain any THREE rating parameters found on the characteristic curve of an SCR. (3 × 2) (6)

2.5 Name THREE advantages of a transformer coupling. (3)

2.6 List TWO applications of UPSs. (2)

[30]

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QUESTION 3

3.1 If you cannot find the exact replacement for the transistor that you want to replace, you can always refer to one of the guidebooks for transistor substitutions.

List and explain FOUR important parameters that you have to know so that you will not have a problem finding substitutions for transistors. (4 × 2) (8)

3.2 Indicate whether the following statements are TRUE or FALSE by writing only 'True' or 'False' next to the question number (3.2.1–3.2.5) in the ANSWER BOOK.

3.2.1 A stripboard is a solderless board used when designing electronic circuits.

3.2.2 An optocoupler is a device used to electrically isolate one section of a circuit from another section and used in cases where a high-voltage power must be coupled to a high-voltage device.

3.2.3 A cold joint is a joint in which the solder does not make good contact with the component lead or PCB pad.

3.2.4 When testing an inductor with a multimeter, if the coil is good, the ohmmeter will show the winding resistance which depends on the wire size and the number of turns.

3.2.5 A PCB mechanically supports and electrically connects electronic components using conductive tracks.

(5 × 1) (5)

3.3 Explain THREE problems that might occur when using a stripboard for the first time. (3)

3.4 Name TWO types of measurements that you can take (with a diode tester) when testing a diode. (2)

3.5 What is *fault-finding*? (2)

[20]

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QUESTION 4

4.1 Define the following Boolean algebra laws:

4.1.1 Commutative laws

4.1.2 Associative laws

4.1.3 Distributive laws

(3 × 2) (6)

4.2 Convert the following decimal numbers to 2421 BCD code:

4.2.1 6_{10}

4.2.2 28_{10}

(2 × 1) (2)

4.3 Explain the difference between *encoders* and *decoders*. (4)

4.4 Explain THREE guidelines that have to be followed to prevent software problems before installation. (3)

[15]

QUESTION 5

5.1 Explain what you understand by the following terms and devices:

5.1.1 PLC

5.1.2 Latch

5.1.3 Rung

5.1.4 Relay

5.1.5 CPU

(5 × 1) (5)

5.2 The local can manufacturing company has requested you to write a program using ladder diagram logic, that will do the following task:

MOTOR A must start rotating immediately when you switch on the machine. After 5 minutes MOTOR B must start rotating automatically while MOTOR A is still running. Both motors must run together for 2 minutes and then after 2 minutes MOTOR B must stop automatically. (10)

[15]

TOTAL: 100

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FORMULA SHEET

C Theory

$$X_C = \frac{1}{2\pi fc}$$

$$X_L = 2\pi fL$$

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

$$\emptyset = \tan^{-1}\frac{X_L - X_C}{R}$$

$$I_T = \sqrt{{I_R}^2 + (I_C - I_L)^2}$$

$$f_c = \frac{1}{2\pi RC}$$

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

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

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

$$f_o = \frac{1}{2\pi RC\sqrt{2n}}$$

$$C_t = \frac{c_1 \times c_2}{c_1 + c_2}$$

$$f_o = \frac{1}{2\pi\sqrt{R_1 R_2 C_1 C_2}}$$

Fundamental of Electronics

$$B_W = \frac{f_r}{Q}$$

$$\beta = \frac{I_C}{I_B}$$

$$I_B = \frac{V_{BB} - V_{BE}}{R_B}$$

$$I_C = \frac{V_{CC}}{R_C}$$

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