T791(E)(M28)T
APRIL 2011

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N1
(8080641)

28 March (X-Paper)
09:00 – 12:00

Calculators may be used.

This question paper consists of 5 pages and 1 formula sheet.
DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N1
TIME: 3 HOURS
MARKS: 100

INSTRUCTIONS AND INFORMATION
1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers correctly according to the numbering system used in this question paper.
4. ALL diagrams must be neat and in good proportion.
5. Use the value of \( \pi \) as 3.142.
6. Write neatly and legibly.

QUESTION 1

1.1 State the laws of magnetism. (2)
1.2 State Faraday's Law. (3)
1.3 Define polarisation of cells. (2)
1.4 Explain what you understand by electromagnet. (1)
1.5 State TWO disadvantages of primary cells. (2)
1.6 1.6.1 Sketch the circuit diagram of THREE cells connected in series with an EMF of 3 V each and an internal resistance of 0.12 \( \Omega \). (2)
1.6.2 Calculate the total current flow in the circuit of QUESTION 1.6.1 when a 6.8 ohm resistor is connected across the cells. (4)
1.7 Wave forms are classified according to their shapes. Give TWO types of these wave forms. (2)

1.8 State TWO characteristics of the magnetic lines of force. (2)

1.9 Sketch the IEC symbol of the following:

1.9.1 A transformer (1)
1.9.2 An electrolytic capacitor (1)
1.9.3 A NPN transistor (1)
1.9.4 An inductor (1)
1.9.5 A pre-set resistor (1)

[25]

QUESTION 2

2.1 Three capacitors with values of 1.4 μF; 2.8 μF and 5.6 μF are connected in series. This combination is then connected across an applied voltage of 240 volts.

Calculate the following:

2.1.1 The total capacitance of the circuit diagram (4)
2.1.2 The charge across the circuit (3)

2.2 Explain how the following factors will have an influence on the capacitance of a capacitor:

2.2.1 The distance between the plates (2)
2.2.2 The area of the plates (2)
2.2.3 The type or kind that the insulating material is made of (2)

2.3 An 800 meter long copper conductor with a diameter of 3 mm has a resistivity of 0.017 μΩm.

Calculate the following:

2.3.1 The cross sectional area of the conductor (5)
2.3.2 The resistance of the conductor (3)

2.4 Calculate the secondary current of a transformer with a primary current of 36 mA. The input voltage to the transformer is 110 V and the turns ratio is 3:1. (4)

[25]
QUESTION 3

3.1 Three resistors connected in series across a 220 V supply have the following values:

\[ R_1 = 5 \, \Omega; \, R_2 = 10 \, \Omega \, \text{and} \, R_3 = 15 \, \Omega. \]

Calculate the following:

3.1.1 The total resistance of the circuit \( (3) \)
3.1.2 The current through the 15 \( \Omega \) resistor \( (3) \)
3.1.3 The potential difference across the 5 \( \Omega \) resistor \( (3) \)
3.1.4 The power consumed by the 10 \( \Omega \) resistor \( (3) \)
3.1.5 The colour code for the 5 \( \Omega \) resistor with a tolerance of 5\% \( (3) \)

3.2 The resistance of a conductive material, like copper, may increase or decrease as a result of certain factors. State FOUR such factors that will cause an increase or decrease on the resistance of a conductive material. \( (4) \)

3.3 Transformers usually encounter some defects when they are in use. State FOUR common defects that transformers may encounter. \( (4) \)

3.4 When direct current is passed through certain components, the reaction differs from component to component. Describe the reaction that will take place when the direct current is passed through the following components:

3.4.1 A capacitor \( (1) \)
3.4.2 A diode \( (1) \)

QUESTION 4

4.1 Complete the following sentences by filling in the missing word(s). Write only the word(s) next to the question number (4.1.1 - 4.1.10) in the ANSWER BOOK.

4.1.1 A diode will only pass current when it is ... biased. \( (1) \)
4.1.2 Germanium atom has got only ... valence electrons. \( (1) \)
4.1.3 An ammeter has got a very ... internal resistance. \( (1) \)
4.1.4 A P-type material is termed a ... material. \( (1) \)
4.1.5 The junction voltage of a Germanium diode is ... volts. \( (1) \)
4.1.6 A transistor may be used as ...

4.1.7 A diode consists of ...

4.1.8 The plates of a capacitor are separated by ...

4.1.9 The ability of a conductor to indulge a voltage in itself when the current changes is known as ...

4.1.10 A ... is an instrument designed to measure very small amounts of current.

4.2 Explain how a junction barrier of a diode is formed.

4.3 Define the following terms:

4.3.1 Doping

4.3.2 Valence electrons

4.4 Construct a half-wave rectifier circuit. On your diagram show the load resistor and the supply.

4.5 Show the input and the output wave forms of the half-wave rectifier circuit in QUESTION 4.4 above.

TOTAL: 100
INDUSTRIAL ELECTRONICS N1

FORMULA SHEET

\[ I = \frac{V}{R} \]

\[ I = \frac{E}{R + r} \]

\[ P = V \times I \]

\[ R_t = R_1 + R_2 + \ldots + R_n \]

\[ \frac{1}{R_t} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots + \frac{1}{R_n} \]

\[ C_t = C_1 + C_2 + \ldots + C_n \]

\[ \frac{1}{C_t} = \frac{1}{C_1} + \frac{1}{C_2} + \ldots + \frac{1}{C_n} \]

\[ Q = C \times V \]

\[ L_t = L_1 + L_2 + \ldots + L_n \]

\[ \frac{1}{L_t} = \frac{1}{L_1} + \frac{1}{L_2} + \ldots + \frac{1}{L_n} \]

\[ \frac{V_p}{V_s} = \frac{N_p}{N_s} = \frac{I_s}{I_p} \]

\[ R_t = R_s(1 + \alpha_f) \]

\[ R = \frac{\rho l}{A} \]