

**T680(E)(N21)T
NOVEMBER EXAMINATION
NATIONAL CERTIFICATE**

INDUSTRIAL ELECTRONICS N2

(8080602)

**21 November 2014 (Y-Paper)
13:00–16:00**

**Candidates will require drawing instruments.
Calculators may be used.**

**This question paper consists of 6 pages, 1 diagram sheet and a formula sheet of 2
pages.**

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. ALL the sketches and diagrams must be large, clear and neat.
 5. ALL the final answers must be approximated accurately to THREE decimal places.
 6. Questions must be answered in BLUE or BLACK ink.
 7. Use $\pi = 3,142$.
 8. Keep questions and subsections of questions together.
 9. Start each question on a NEW page.
 10. Write neatly and legibly.
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- 1.4 A diode has TWO PN-junctions.
- 1.5 A negative number of dBs represents a power loss.
- 1.6 In positive temperature coefficient (PTC) thermistors, its resistance decrease as the temperature increases.
- 1.7 When we measure current we place the meter in parallel with the component.
- 1.8 The arrow of a diode points in the direction of electron current flow.
- 1.9 The total current in a series circuit decreases when resistances are connected in parallel.
- 1.10 P-type material has a positive charge just after formation.

(10 × 1) [10]

TOTAL SECTION A: 10

- | | | |
|-----|------------------------------------|-----|
| 2.3 | Value of I_1 and I_2 | (3) |
| 2.4 | Value of V_{cd} | (2) |
| 2.5 | Value of R | (3) |
| 2.6 | Power consumed by the $70\ \Omega$ | (2) |
- [18]

QUESTION 3

3.1 For the circuit of FIGURE 2 on the DIAGRAM SHEET calculate the:

- | | | | |
|-------|--------------------|---------|------|
| 3.1.1 | Z | (6 × 2) | (12) |
| 3.1.2 | I_T | | |
| 3.1.3 | L | | |
| 3.1.4 | C | | |
| 3.1.5 | Phase angle | | |
| 3.1.6 | Resonant frequency | | |

3.2 A network has an overall gain of 25 dB. If the input and output impedances are equal, calculate the input voltage if the output voltage is 7,5 V.

(6)
[18]

a pure or intrinsic semiconductor is called doping. If a (4.2.1 *pentavalent/trivalent*) impurity atom (5 valence electrons) was added, an excess of (4.2.2 *holes/electrons*) would be produced. This process is called (4.2.3 *acceptor/donor*) doping and results in (4.2.4 *P-type/N-type*) material being formed. In this type of material, the majority charge carriers are the (4.2.5 *holes/electrons*).

However, if a (4.2.6 *pentavalent/trivalent*) atom (an atom that has 3 valence electrons) was added, an excess of (4.2.7 *holes/electrons*) will result and this process is called [4.2.8 *acceptor/donor*] doping. This process results in (4.2.9 *P-type/N-type*) material being formed. Here the majority charge carriers are (4.2.10 *holes/electrons*). (10 x 1/2) (5)

4.3 Briefly explain how an atom becomes:

4.3.1 Positive ion (1)

4.3.2 Negative ion (1)

4.4 Briefly explain what is meant by ionisation. (1) [18]

QUESTION 5

5.1 Draw a labelled circuit diagram of a common base transistor amplifier making use of an NPN transistor. Show the input and output waveforms. (6)

5.2 Explain how the PN junctions of a transistor is biased in the:

5.2.1 Cut-off region (2)

5.2.2 Saturation region (2)

5.3 Describe a thermocouple used as a transducer by providing the following:

5.3.1 A labelled sketch of the construction (4)

5.3.2 The basic principle of operation (2)

5.3.3 Characteristic curve (2) [18]

TOTAL SECTION B: 90
GRAND TOTAL: 100

ENGINEERING

Alternating current theory:

$$t = \frac{1}{f}$$

$$e = E_m \sin 2\pi ft$$

$$V_{rms} = 0,707 V_{max}$$

$$I_{ave} = 0,637 I_{max}$$

$$e = E_m \sin \theta$$

$$i = I_m \sin \theta$$

$$I_{rms} = 0,707 I_{max}$$

$$\text{Form factor} = \frac{\text{rms value}}{\text{average value}}$$

$$e = E_m \sin \omega t$$

$$i = I_m \sin \omega t$$

$$V_{ave} = 0,637 V_{max}$$

$$\text{Crest factor} = \frac{\text{maximum value}}{\text{rms value}}$$

$$E_{ave} = \frac{e_1 + e_2 + e_3 + e_4 + e_5 + \dots + e_n}{n}$$

$$E_{rms} = \sqrt{\frac{e_1^2 + e_2^2 + e_3^2 + e_4^2 + e_5^2 + \dots + e_n^2}{n}}$$

$$I_{ave} = \frac{i_1 + i_2 + i_3 + i_4 + i_5 + \dots + i_n}{n}$$

$$I_{rms} = \sqrt{\frac{i_1^2 + i_2^2 + i_3^2 + i_4^2 + i_5^2 + \dots + i_n^2}{n}}$$

$$\omega = 2\pi f$$

$$X_L = 2\pi fL$$

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

$$V = I \cdot R$$

$$V_T = \sqrt{V_R^2 + V_C^2}$$

$$V_T = \sqrt{V_R^2 + V_L^2}$$

$$V_T = \sqrt{V_R^2 + (V_L \sim V_C)^2}$$

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

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

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

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

$$I_R = \frac{V_T}{R}$$

$$I_L = \frac{V_T}{X_L}$$

$$I_C = \frac{V_T}{X_C}$$

$$I_T = \sqrt{I_R^2 + I_X^2}$$

$$I_X = I_L \sim I_C$$

$$V_L = I \cdot X_L$$

$$V_C = I \cdot X_C$$

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

$$\theta = \tan^{-1} \frac{I_X}{I_R}$$

$$\theta = \cos^{-1} \frac{I_R}{I_T}$$

$$\theta = \cos^{-1} \frac{R}{Z}$$

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

If $R_{in}=R_{out}$:

$$N = 20 \log \frac{V_{out}}{V_{in}}$$

$$N = 20 \log \frac{I_{out}}{I_{in}}$$

Resistance

$$R = \frac{\rho \ell}{A}$$

$$A = \frac{\pi d^2}{4}$$

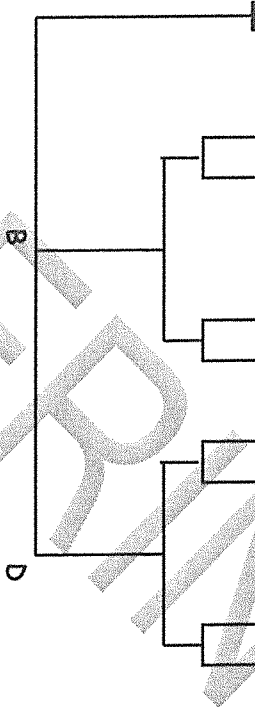


FIGURE 1

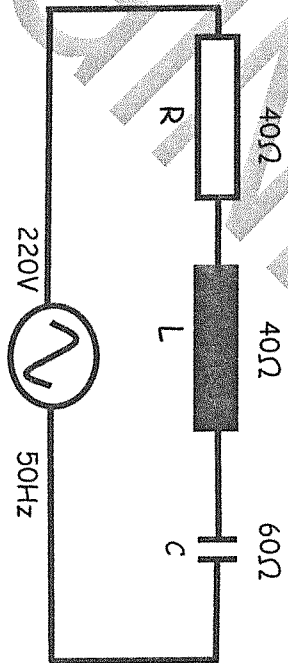


FIGURE 2