higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

T720(E)(A10)T
APRIL EXAMINATION

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N4

(8080164)

10 April 2015 (Y-Paper)
13:00–16:00

This question paper consists of 6 pages, and 1 formula sheet.

DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N4
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 answer on a NEW page.
5. ALL calculations must be shown.
6. ALL final answers must be approximated accurately to THREE decimal places.
7. Write neatly and legibly.

QUESTION 1

Use Thevenin's method to determine the current flowing through R_4 in FIGURE 1 below.

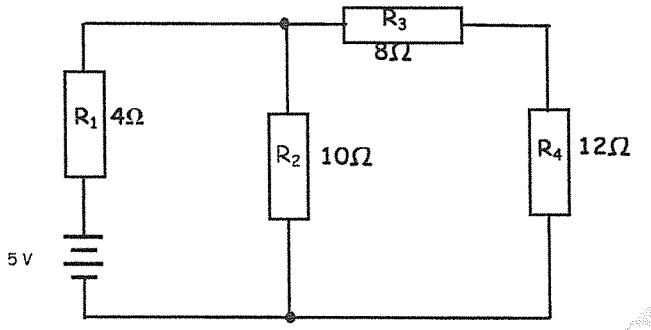

FIGURE 1 **[10]**

QUESTION 2

A coil of 20Ω resistance and 100µH inductance are connected in parallel with a variable capacitor across a 5 V, 1 MHz AC supply.

Calculate the following:

2.1 The capacitance of the capacitor when the supply current is at minimum. (5)

2.2 The dynamic impedance. (3)

2.3 The supply current. (2)
[10]

QUESTION 3

3.1 Draw a circuit diagram of a varactor diode used in tuning circuits and give THREE of its areas of application. (6)

3.2

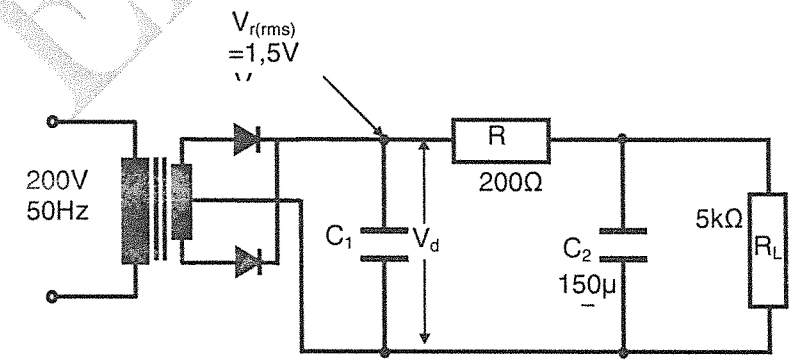

FIGURE 2

Consider the circuit diagram shown in FIGURE 2 above and calculate the following:

3.2.1 The output DC voltage (3)

3.2.2 The output ripple voltage (4)

3.2.3 The output ripple factor (2)
[15]

QUESTION 4

4.1 Draw a neat labelled symbol and characteristic curve of P-channel depletion MOSFET. (5)

4.2 The following dynamic values of a common emitter amplifier are given:

- Vbe = 0,67 V and 0,69 V
- I_C = 1 mA and 3 mA
- Vce = 5 V and 15 V
- Ib = 10 µA and 30 µA

Calculate the following:

4.2.1 The dynamic forward current gain (2)

4.2.2 The dynamic input impedance (3)

4.2.3 The dynamic reverse voltage gain (2)

4.2.4 The dynamic output impedance (3)
[15]

QUESTION 5

5.1 Draw a neat circuit symbol of an operational amplifier. (2)

5.2 How can the gain of an operational amplifier be changed? (2)

5.3 Name THREE operational amplifiers that use negative feedback. (3)

5.4 Consider FIGURE 3 below and answer the questions that follow:

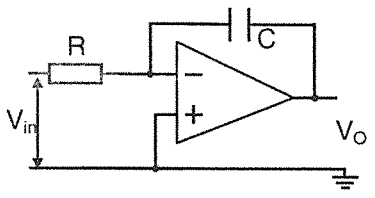

FIGURE 3

5.4.1 Identify the operational amplifier. (1)

5.4.2 Draw a 360^0 input sine wave form and the expected output waveform. (3)

5.4.3 Calculate the resistance if C = 15 µF, Vin = 10 V and the rate of change of the output voltage = 0,6 V/sec. (4)
[15]

QUESTION 6

6.1 Draw neat, labelled symbols of the following Thyristors:

6.1.1 SCR

6.1.2 Triac

6.1.3 LASCR

6.1.4 Diac

6.1.5 QUADRAC

(5 x 2) (10)

6.2 Give THREE differences between the open-loop and closed-loop control systems. (3)

6.3 What is the purpose of the diode in the gate of an SCR? (2)
[15]

QUESTION 7

7.1 Use a circuit diagram to indicate how a photo-diode can be used in an emitter-coupled amplifier to secure a dangerous area. (4)

7.2 Name THREE convention methods by means of transducers. (3)

7.3 Explain the basic operating principle of a strain gauge. Also give the formula that describes the principle of its operation. (3)
[10]

QUESTION 8

8.1 With reference to the oscilloscope, which circuit would you investigate if:

8.1.1 The oscilloscope is turned on and there is no horizontal trace but only a spot of light on the screen?

8.1.2 There is a horizontal trace on the screen but no vertical deflection when a sine wave is applied?

8.1.3 It is impossible to stabilize the signal display?

(3 x 2) (6)

8.2 Calculate the width of one cycle of the sine wave if the frequency of the signal is 15 kHz in an oscilloscope at the scale setting of 60 µsec/cm. (3)

8.3 Indicate whether the following statement is TRUE or FALSE. Choose the answer and write only 'true' or 'false' next to the question number (8.3) in the ANSWER BOOK.

One application of a square wave is in timing circuits in digital electronics. (1)

[10]

TOTAL: 100

INDUSTRIAL INSTRUMENTS N4

FORMULA SHEET

$$^{\circ}C = \frac{5}{9}(^{\circ}F - 32)$$

$$^{\circ}F = \left(^{\circ}C \times \frac{9}{5}\right) + 32$$

$$K = 273{,}15 + ^{\circ}C$$

$$W = \sigma T^4$$

$$W = \in \sigma T^4$$

$$W = \in \sigma (T_b^4 - T_a^4)$$

$$R_t = R_o\ (1 + \alpha t)$$

$$R_t = R_o\ (1 + \alpha t + \beta t^2)$$

$$I_s = \frac{1}{S} = \frac{V}{R} \rightarrow S = \frac{R}{V}$$

$$R_{sc} = \frac{V_{sc}}{I_s}$$

$$R_{cj} = R_o + \Delta R$$

$$R_z = \frac{V_{\min}}{I_s} + R_{cj}$$

$$R_s = \frac{R_{sw} \times R_t}{R_{sw} - R_t} \rightarrow R_t = \frac{V_{\max} - V_{\min}}{I_s}$$

$$R_u = \frac{V_{sc} - V_{\max}}{I_s}$$