T1070(E)(N17)T  
NOVEMBER 2011

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N3  
(8080613)

17 November (X-Paper)  
09:00 – 12:00

Calculators may be used.

Candidates will require drawing instruments, pens and a ruler.

This question paper consists of 8 pages, 1 diagram sheet and 1-page formula sheet.
MINISTRY OF EDUCATION

INDUSTRIAL ELECTRONICS

[Undecipherable text]

[Undecipherable text]
DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA
NATIONAL CERTIFICATE
INDUSTRIAL ELECTRONICS N3
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. Start each question on a NEW page.
5. ALL the sketches and diagrams must be large, clear and neat.
6. Keep questions and subsections of questions together.
7. Leave margins clear.
8. Questions must be answered in blue or black ink.
9. ALL the final answers must be approximated accurately to THREE decimal places.
10. Use $\pi = 3.142$.
11. Write neatly and legibly.
1.2.2 The method used to switch an SCR off in a DC circuit:
A Cyclotronic control
B Phase control
C Forced commutation
D Cycle control

1.2.3 The output from a ... clipper consists only of the positive half of the input signal.
A positive series or positive shunt
B negative series or positive shunt
C positive shunt or negative shunt
D negative shunt or negative series

1.2.4 The output voltage waveform shown in FIGURE 2 on the attached DIAGRAM SHEET is that of a ... diode clipper.
A positive series
B negative series
C positive shunt
D negative shunt

1.2.5 A delay line is added to the ...
A horizontal deflection plates.
B vertical deflection plates.
C horizontal amplifier.
D vertical amplifier.

1.2.6 The deviation from the true value of the quantity being measured is known as the ...
A sensitivity.
B error.
C resolution.
D precision.

1.2.7 When a PN-junction is formed, some free electrons from the N-type material are attracted across the junction to fill the holes in the P-type material. This is known as ...
A reverse bias.
B forward bias.
C diffusion.
D doping.
2.2 Draw neat, labelled circuit diagrams of an operational amplifier used in the following modes:

2.2.1 Inverting
2.2.2 Non-inverting
2.2.3 Summing
2.2.4 Integrating

[16]

QUESTION 3

3.1 Study the phasor diagram in FIGURE 4 on the attached DIAGRAM SHEET and determine the following:

3.1.1 The supply current
3.1.2 The phase angle
3.1.3 The value of the resistor in kΩ
3.1.4 The value of the inductor in μH
3.1.5 The value of the capacitor in pF

[3]

3.2 If the wave form given in FIGURE 5 on the attached DIAGRAM SHEET is used as the input to the following operational amplifiers, draw the corresponding output wave forms in the ANSWER BOOK:

3.2.1 Integrator
3.2.2 Differentiator
3.2.3 Summing amplifier

[16]

QUESTION 4

4.1 Show, with the aid of a labelled circuit diagram using a transistor, how series-current negative feedback is achieved.

4.2 Draw a neat, labelled circuit diagram of a push-pull amplifier. Indicate on the circuit ALL relevant wave forms and bias polarities.

4.3 FIGURE 6 on the attached DIAGRAM SHEET is the output characteristic curves (with a load line drawn) for a common emitter amplifier. Redraw this output characteristic curves in the ANSWER BOOK and answer the following questions:

4.3.1 (a) On the characteristic curve, mark off where you would place the Q-point for a class A amplifier.

(b) Choose the answer from those in brackets: In class A amplifiers current flows for (the whole cycle/half a cycle/less than half a cycle).

[1]
QUESTION 6

6.1 Draw a labelled block diagram of a continuous balance digital voltmeter. Use arrows to indicate data flow.

6.2 Name TWO types of errors pertaining to measuring instruments and provide a cause of each error.

6.3 Discuss the difference between a photodiode and an LED by giving the following:

6.3.1 A brief explanation of the principle of operation of a photodiode

6.3.2 A brief explanation of the principle of operation of an LED

TOTAL SECTION B: 80
GRAND TOTAL: 100
INDUSTRIAL ELECTRONICS N3

FORMULA SHEET

Direct-current theory

\[ V = I \cdot R \quad P = V \cdot I \quad P = \frac{V^2}{R} \]
\[ P = I^2 \cdot R \]

Alternating current theory:

\[ X_L = 2\pi fL \quad X_C = \frac{1}{2\pi fC} \quad Z = \sqrt{R^2 + (X_L - X_C)^2} \]
\[ V_T = \sqrt{V_R^2 + (V_L - V_C)^2} \quad I = \frac{V_T}{Z} \quad \theta = \cos^{-1} \frac{R}{Z} \]
\[ V = I \cdot R \quad V = I \cdot X_L \quad V = I \cdot X_C \]
\[ f_r = \frac{1}{2\pi \sqrt{LC}} \quad I_R = \frac{V_T}{R} \quad I_L = \frac{V_T}{X_L} \]
\[ I_C = \frac{V_T}{X_C} \quad I_T = \sqrt{I_R^2 + I_X^2} \quad I_X = I_L - I_C \]
\[ \theta = \tan^{-1} \frac{I_X}{I_R} \quad \theta = \cos^{-1} \frac{I_R}{I_T} \quad Z = \frac{V}{I_T} \]
\[ Z_D = \frac{L}{RC} \quad I_T = \frac{V}{Z_D} \quad f_r = \frac{1}{2\pi \sqrt{\frac{1}{LC} - \frac{R^2}{L^2}}} \]
\[ I_C = I_{RL} \sin \theta_L \quad I_T = I_{RL} \cos \theta_L \]
\[ I_C = I_{RL} \quad I_T = I_T^2 + I_T^2 \]

Transistors:

\[ I_C = \frac{V_{CC}}{R_L} \]

Transducers:

\[ R = \frac{\rho \cdot l}{a} \quad C = \frac{k \cdot A \cdot E_o}{d} \]