higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

APRIL EXAMINATION

INDUSTRIAL ELECTRONICS N5

2 APRIL 2013

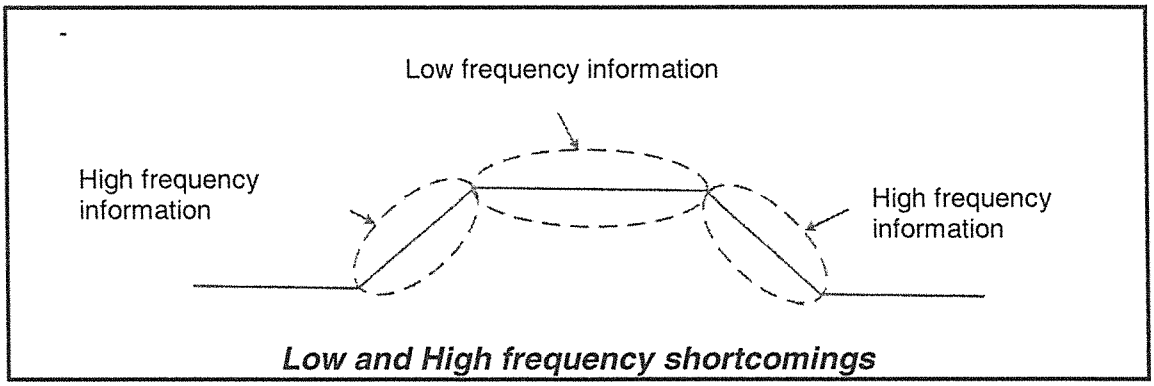
This marking guideline consists of 9 pages.

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QUESTION 1: ALTERNATING CURRENT THEORY

1.1
- The area of the plates.
- The distance between the plates.
- The dielectric constant. (3)

1.2



Low and High frequency shortcomings (3)

1.3 Square waves - suitable for testing certain electronic circuits
As soon as a perfect square waveform is sent through a faulty circuit, the existence of an error as well as an indication of the type of error that exists will be indicated. (2)

1.4 1.4.1 $Z_1 = 120 - j21,21\Omega$ $= 121,86\angle -10,02° \ \Omega$

$Z_2 = 180 - j25,31\Omega$ $= 181,77\angle 8° \ \Omega$

$Z_3 = 100 - j47,31\Omega$ $= 110,627\angle 25,32° \ \Omega$

$$Z_{//} = \frac{Z_1 \times Z_2}{Z_1 + Z_2}$$

$$= \frac{121,86\angle -10,02° \times 181,77\angle 8°}{120 - j21,21 + 180 + j25,31}$$

$$= \frac{22150,584\angle -2,02°}{300 + j4,1}$$

$$= \frac{22150,584\angle -2,02°}{300,03\angle 0,78°}$$

$$= 72,828\angle -2,8° \ \Omega$$

$$= 73,74 - j3,606 \ \Omega$$

$$Z_T = Z_{//} + Z_3$$

$$= 73,74 - j3,606 + 100 + j47,31$$

$$= 173,74 + j43,7 \ \Omega$$

$$= 179,152\angle 14,12° \ \Omega$$

(7)

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1.4.2 $I_T = \frac{V_T}{Z_T}$

$= \frac{250 \angle 0°}{179{,}152\ 14{,}12°}$

$= 1{,}395 \angle -14{,}12°$ →

(2)
[17]

QUESTION 2: POWER SUPPLIES

1.2 1.2.1 $V_{DC} = \frac{R_L}{R + R_L} \times V_{DC}$

$\therefore V_{DC} = \frac{R + R_L}{R_L} \times V_{DC}$

$= \frac{10 + 30}{300} \times 12$

$= 12{,}4\ V$ →

(3)

1.2.2 $V_{r(rms)} = \frac{Xc}{\sqrt{R^2 + X_C^2}} \times V_{r(rms)}$

$\therefore V_{r(rms)} = \frac{\sqrt{R^2 + X_{C2}}}{X_c} \times V_{r(rms)}$

$= \frac{\sqrt{10^2 + 8^2}}{8} \times 0{,}8$

$= 1{,}281\ V$

(3)

1.2.3 $r = \frac{V_{r(rms)}}{V_{DC}}$

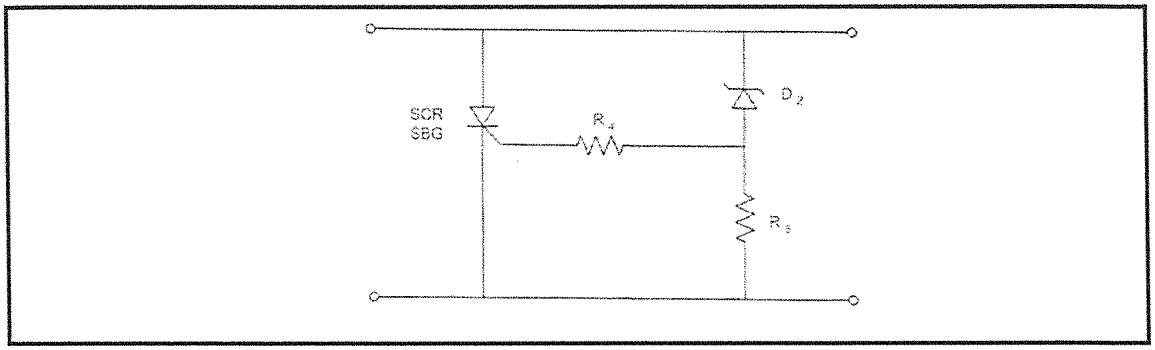
$= \frac{0{,}8}{12}$

$= 0{,}067$ →

(2)

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2.2



The voltage at which the circuit will limit is determined by the reverse breakthrough voltage of the zener diode. As soon as the output voltage is high enough to drive the zener diode into conduction, a pulse will be supplied to the gate of the SCR. The SCR will start conducting and therefore provides a virtual short circuit across the output terminals (6)
[14]

QUESTION 3: TRANSISTOR AMPLIFIERS

3.1 3.1.1

$$R_c = \frac{V_{cc} - V_{ce}}{I_c}$$

$$= \frac{12 - 6}{0{,}005}$$

$$= 1{,}2\ k\Omega \rightarrow$$ (2)

3.1.2

$$I_b = \frac{I_c}{\beta}$$

$$= \frac{5 \times 10^{-3}}{200}$$

$$= 25\ \mu A \rightarrow$$

$$R_b = \frac{V_{cc} - V_{be}}{I_b}$$

$$= \frac{12 - 0{,}6}{25 \times 10^{-6}}$$

$$= 456\ k\Omega \rightarrow$$ (3)

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3.2 3.2.1 $Z_1 = \dfrac{h_{ie} - h_{fe}.h_{re}.Z_L}{1 + h_{oe}.Z_L}$

$= \dfrac{1\,200 - 60 \times 2 \times 10^{-4} \times 2\,000}{1 + (20 \times 10^{-6} \times 2000)}$

$= 1\,200 - 23{,}077$

$= \underline{1176{,}923\ \Omega}$

$Z_i = \dfrac{R_b \times Z_1}{R_b + Z_1}$

$= \dfrac{220\,000 \times 1\,176{,}923}{220\,000 + 1\,176{,}923}$

$= \underline{1\,170{,}66\ \Omega}$ (3)

3.2.2 $A_i = \dfrac{h_e}{1 + h_{oe}.Z_L}$

$= \dfrac{60}{1 + (20 \times 10^{-6} \times 2\,000)}$

$= \underline{57{,}692}$ (2)

3.2.3 $A_v = \dfrac{-h_{fe}.Z_L}{h_{ie} + (h_{ie}.h_{oe} - h_{fe}.h_{re})Z_L}$

$= \dfrac{-60 \times 2\,000}{1\,200 + (1\,200 \times 10^{-6} - 60 \times 2 \times 10^{-4})2\,000}$

$= \underline{-98{,}039}$ (2)

3.3
- Amplitude distortion
- Non-linear distortion
- Frequency distortion (3)

[15]

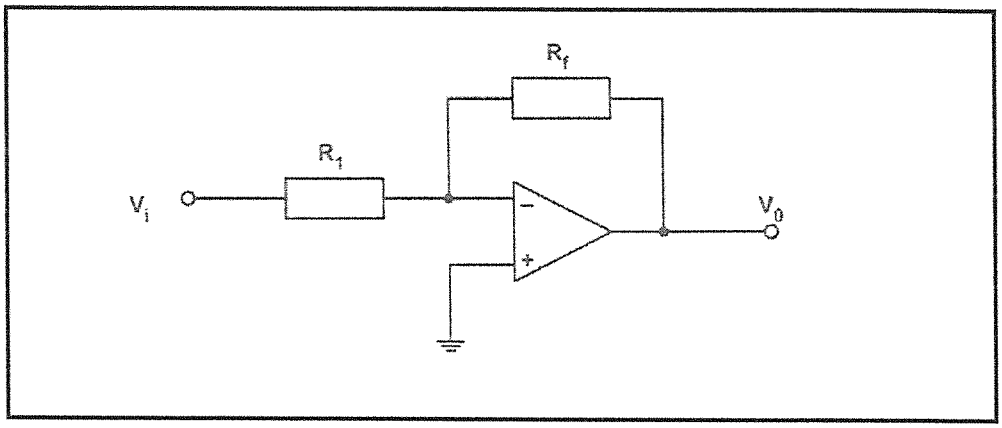
QUESTION 4: OPERATIONAL AMPLIFIERS

4.1 4.1.1 Input offset voltage – the necessary difference between bias voltage at the input to obtain zero output voltages (2)

4.1.2 Inverting input – Input terminal of a differential amplifier, which produces an anti-phase output when a signal is applied (2)

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4.2 4.2.1



THE INVERTING AMPLIFIER (3)

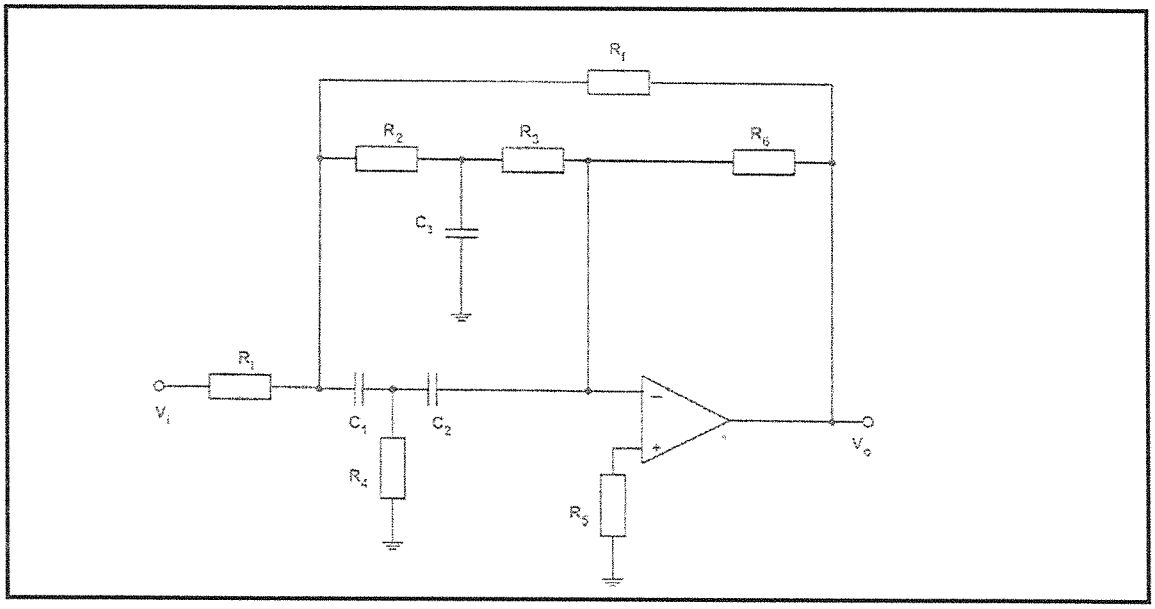
4.2.2 $V_0 = \frac{-R_f}{R_1} \times V_{in}$

$R_f = \frac{V_0 \times R_1}{V_{in}}$

$= \frac{20\,000 \times 20}{2}$

$= 200\ k\Omega$ (3)

4.3



THE BAND-REJECT FILTER (4)

[14]

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QUESTION 5: INTEGRATED CIRCUITS

- Earth soldering iron tips
- Use earthed wrist band
- Earth all test equipment
- Switch off the power as soon as you work on the circuit
- All unused inputs must be connected to V_{DD} or V_{SS}

(Any 3 × 1) **[3]**

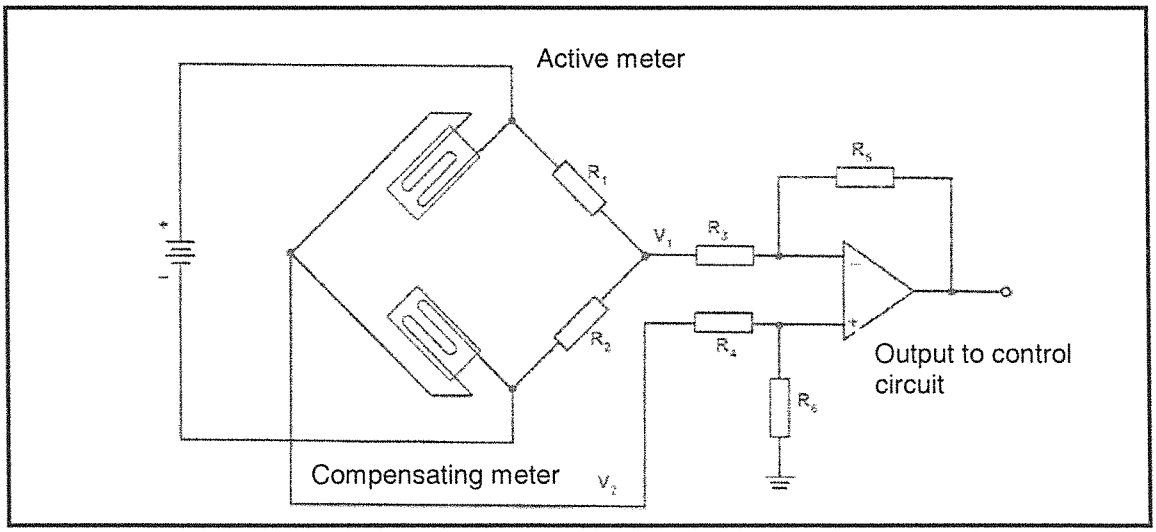
QUESTION 6: TRANSDUCERS

6.1 Passive transducer – need electrical power to operate

Active or self-generating transducer – generate an emf as soon as they are stimulated by some or other form of energy and therefore require no external power (4)

6.2 An infrared beam is an invisible beam, which can be invoked by an infrared emitting diode with a built-in lens to concentrate the energy in a narrow beam. The beam is observed by a photo-diode with an infrared filter in front of it to keep off normal light. The signal is amplified and can be used to control a relay. This principle can be applied in alarm systems, doorbells, automatic door openers and light switches, the detection of human movement, distance control circuits, etc. (4)

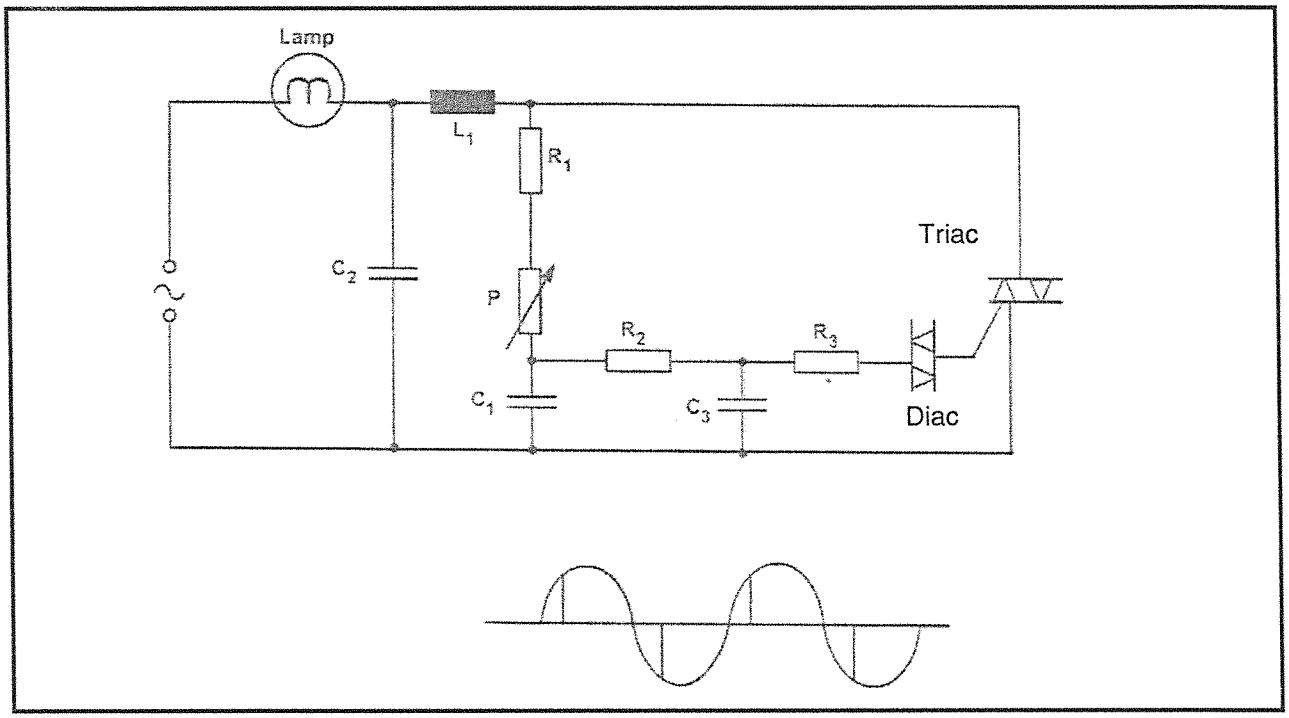
6.3



STRAIN GAUGE IN A WHEATSTONE BRIDGE (5)

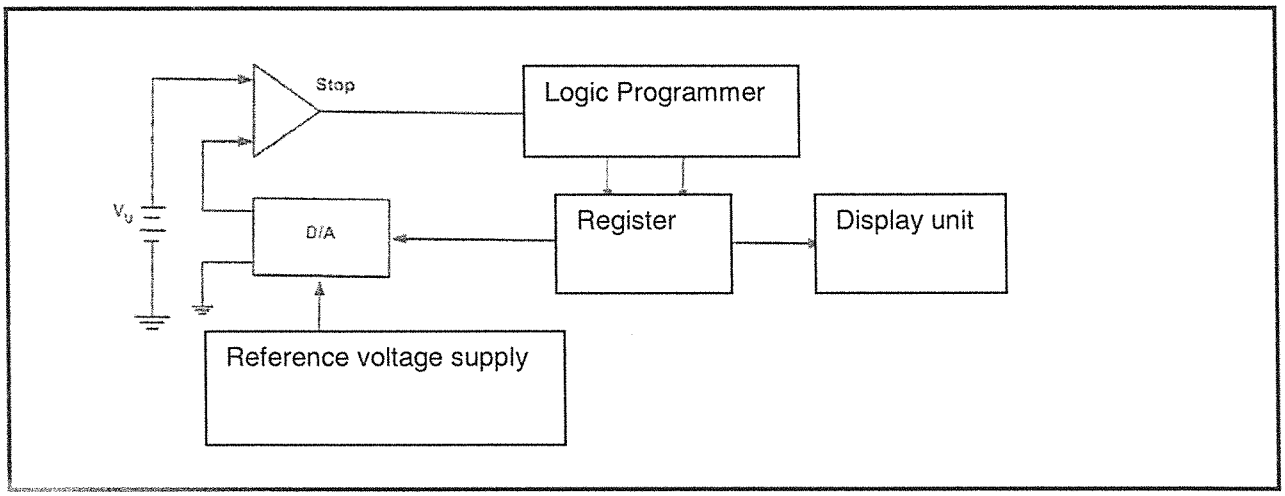
[13]

QUESTION 7: ELECTRONIC PHASE CONTROL



[6]

QUESTION 8: TEST EQUIPMENT

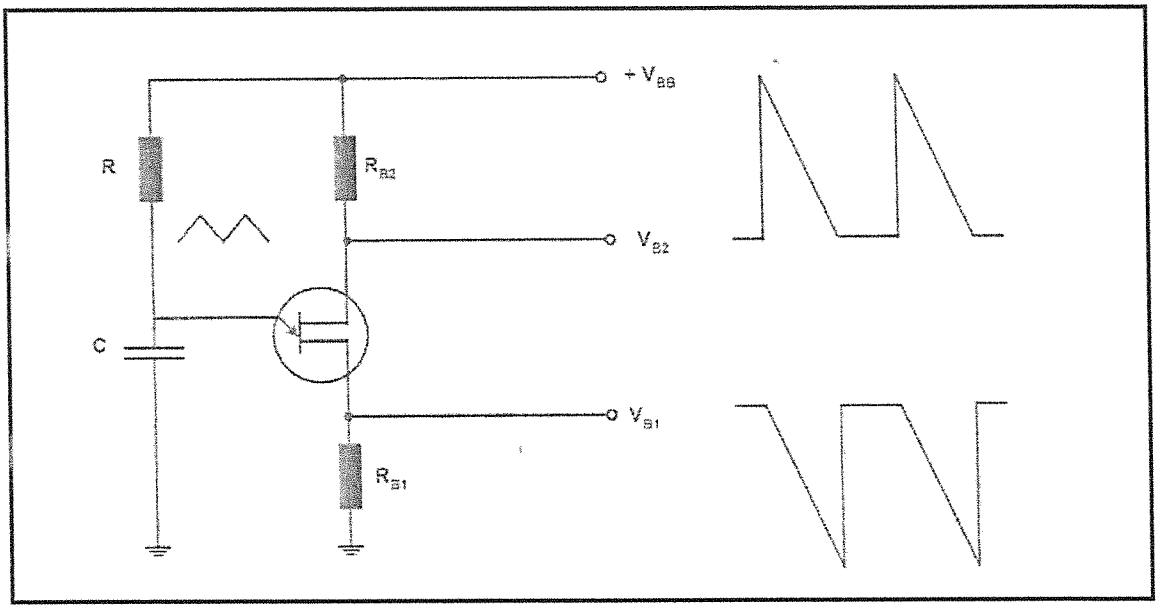


THE SUCCESSIVE APPROXIMATION A/D CONVERTER [5]

QUESTION 9: OSCILLATORS

9.1
- Variation in the turned circuit or transistor parameters
- Change in load conditions
- An unstable supply voltage (3)

9.2



A BASIC UJT OSCILLATOR (4)

9.3
- Sine waveform – power supply foe electrical equipment
- Square waveform – clock pulse for digital circuits, alarm systems, ultrasonic tests
- Saw tooth waveform – time base in an oscilloscope (6)

[13]

TOTAL: 100

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