higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

INDUSTRIAL ELECTRONICS N5

23 NOVEMBER 2016

This marking guideline consists of 11 pages.

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QUESTION 1: ALTERNATING CURRENT THEORY

1.1 1.1.1 $T = RC$

$\therefore C = {}^{T}\!/_{R}$

$= \dfrac{1\times10^{-3}}{100\times10^{-3}}$

$= 0{,}01\ \mu f$

1.1.1 $V_C = 0{,}632 \times V_T$

$= 0{,}632 \times 6$

$= 3{,}792\ V$

(2 × 2) (4)

1.2 1.2.1 $X_C = \dfrac{1}{2.\pi.f.C}$

$= \dfrac{1}{2\times\pi\times50\times100\times10^{-6}}$

$= 31{,}831\ \Omega$

$X_L = 2\ \pi\ f\ L$

$= 2 \times \pi \times 50 \times 20 \times 10^{-3}$

$= 6{,}283\ \Omega$

$${}^{1}\!/_{Z_T} = {}^{1}\!/_{R} - j\left({}^{1}\!/_{X_L} - {}^{1}\!/_{X_C}\right)$$

$$\frac{1}{Z_T} = \frac{1}{5} - j\left(\frac{1}{6{,}283} - \frac{1}{31{,}831}\right)$$

$= 0{,}2 - j(0{,}159 - 0{,}0314)$

$\dfrac{1}{Z_T} = 0{,}2 - j\ 0{,}128$

$= 0{,}237\angle -32{,}57^0\ \Omega$

$Z_T = 4{,}214\angle 32{,}57^0\ \Omega$

(4)

1.2.2 $I_T = \frac{V_T}{Z_T}$

$= \frac{10\angle 0^0}{4,214\angle 32,57^0}$

$= 2,373\angle -32,57^0$ A (2)

1.2.3 $I_R = V_T / Z_T$

$= \frac{10\angle 0^0}{5\angle 0^0}$

$= 2\angle 0^0$ A

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

$= \frac{10\angle 0^0}{6,283\angle 90^0}$

$= 1,592\angle -90^0$ A

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

$= \frac{10\angle 0^0}{31,831\angle -90^0}$

$= 0,314\angle -90^0$ A (6)

[16]

QUESTION 2: POWER SUPPLIES

2.1 $V_{DC} = V_m - \frac{I_{DC}}{2.f.C}$

$= 15 - \frac{10 \times 10^{-3}}{2 \times 50 \times 470 \times 10^{-6}}$

$= 14,787\ V$

$V_{R(RMS)} = \frac{I_{DC}}{2.\sqrt{3}.f.C}$

$= \frac{10 \times 10^{-3}}{2 \times \sqrt{3} \times 50 \times 470 \times 10^{-6}}$

$= 0,123\ V$

$R_L = \frac{V_{DC}}{2.\sqrt{3}.f.C.V_{r(rms)}}$

$= \frac{14,787}{2 \times \sqrt{3} \times 50 \times 470 \times 10^{-6} \times 0,123}$

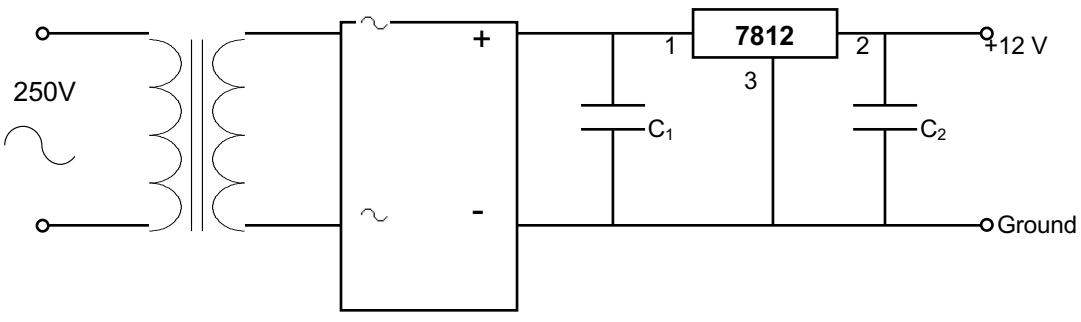
$= 1\ 478,1\ \Omega$ (6)

2.2 $\%\ VR = \frac{V_{rL} - V_{fL}}{V_{fL}} \times 100$

$= \frac{12,4 - 11,9}{11,9} \times 100$

$= 4,2\%$ (2)

2.3



(4)

2.4 The degree of stabilising during a voltage regulator is called the stabilising factor.

Determined by: $S = \frac{\Delta V_{out}}{\Delta V_{in}}$ (1)

2.5 2.5.1 Control element

2.5.2 Fixed

(2 × 1) (2)
[15]

QUESTION 3: TRANSISTOR AMPLIFIERS

3.1 3.1.1 $V_e = \frac{1}{10} \times V_{CC}$

But $V_e = I_C R_e$

$= 5 \times 10^{-3} \times 400$

$= 2$ V

$\therefore V_{CC} = 10 \times V_e$

$= 10 \times 2$

$= 20$ V (4)

3.1.2 $C_e = \frac{10}{2.\pi.f.R_e}$

$\therefore f = \frac{10}{2.\pi.C_e.R_e}$

$= \frac{10}{2 \times \pi \times 10 \times 10^{-6} \times 400}$

$= 397{,}887$ Hz (3)

3.2 3.2.1 $R_{BT} = \dfrac{R_{b1} \times R_{b2}}{R_{b1} + R_{b2}}$

$= \dfrac{56000 \times 5600}{56000 + 5600}$

$= 5\ 090{,}91\ \Omega$

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

$= 1\ 200 - \dfrac{60 \times 2 \times 10^{-4} \times 5000}{1 + \left(20 \times 10^{-6} \times 5000\right)}$

$= 1\ 145{,}455\ \Omega$

$A_i = \left(\dfrac{h_{fe}}{1 + h_{oe}.Z_L}\right) \times \left(\dfrac{R_{bT}}{R_{bT} + Z_1}\right)$

$= \left(\dfrac{60}{1 + 20 \times 10^{-6} \times 5000}\right) \times \left(\dfrac{5090}{5090 + 1145{,}45}\right)$

$= 44{,}53$ (7)

3.2.2 $Z_i = \dfrac{R_{bT} \times Z_1}{R_{bT} + Z_1}$

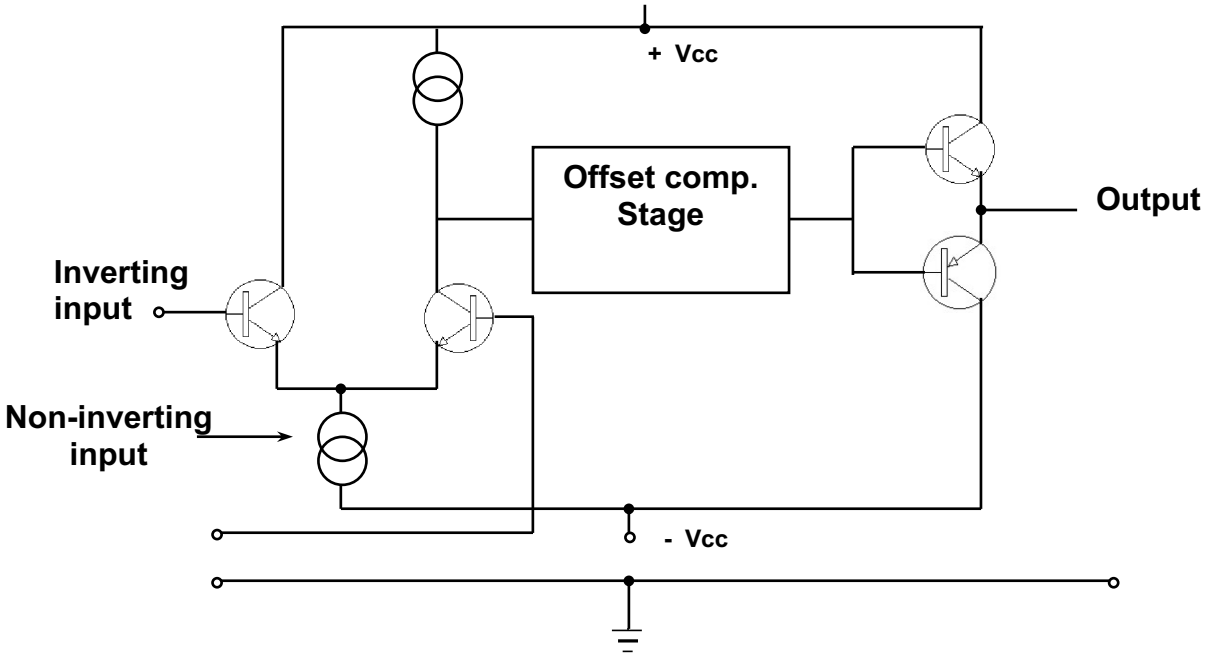
$= \dfrac{5090 \times 1145{,}45}{5090 + 1145{,}45}$

$= 935{,}07\ \Omega$ (3)

[17]

QUESTION 4: OPERATIONAL AMPLIFIERS

4.1



(4)

4.2
- Very high input impedance that causes almost no current load for circuits.
- Very high voltage gain that is suitable to amplify very small signals.
- Very low output impedance that is not affected easily by other loads. (3)

4.3

$$V_O = \frac{-R_f}{R_{in}}\left(V_1 + V_2 + V_3\right)$$

$$R_{in} = \frac{-R_f}{V_0}\left(V_1 + V_2 + V_3\right)$$

$$= \frac{-20000}{12}\left(1 + 1{,}5 + 3{,}5\right)$$

$$R_{in} = \frac{20000}{12}(6)$$

$$R = 10\ 000\ \Omega$$

$$= 10\ k\Omega$$

(3)
[10]

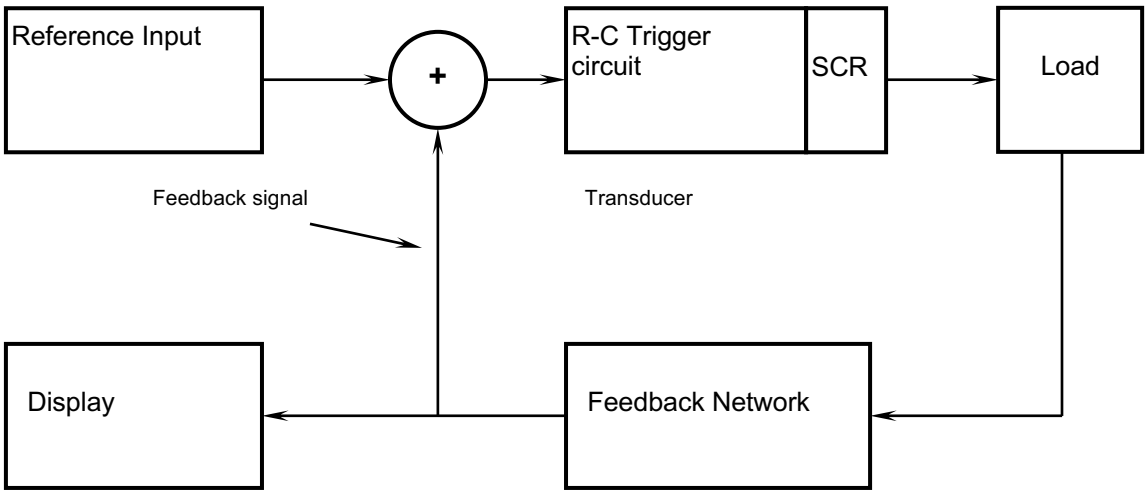
QUESTION 5: INTEGRATED CIRCUITS

5.1 All unutilised inputs must be connected to V_{DD} or V_{SS} (2)

5.2 5.2.1 True
5.2.2 False
5.2.3 True

(3 × 1) (3)
[5]

QUESTION 6: ELECTRONIC PHASE CONTROL



[5]

QUESTION 7: TEST EQUIPMENT

7.1 Presume that the unknown voltage V_U = 11 V and a 4-bit code is used.

Start 1: 0000

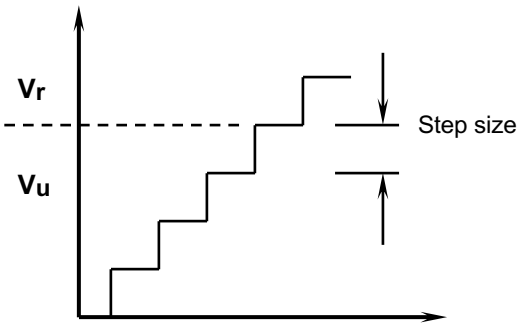
Step 1: 1000 (8 V) $V_r < V_u$: Sets 1

Step 2: 1100 (12 V) $V_r > V_u$: Resets 1 to 0

Step 3: 1010 (10 V) $V_r < V_u$: Sets 1

Step 4: 1011 (11 V) $V_r = V_u$: Sets 1 (5)

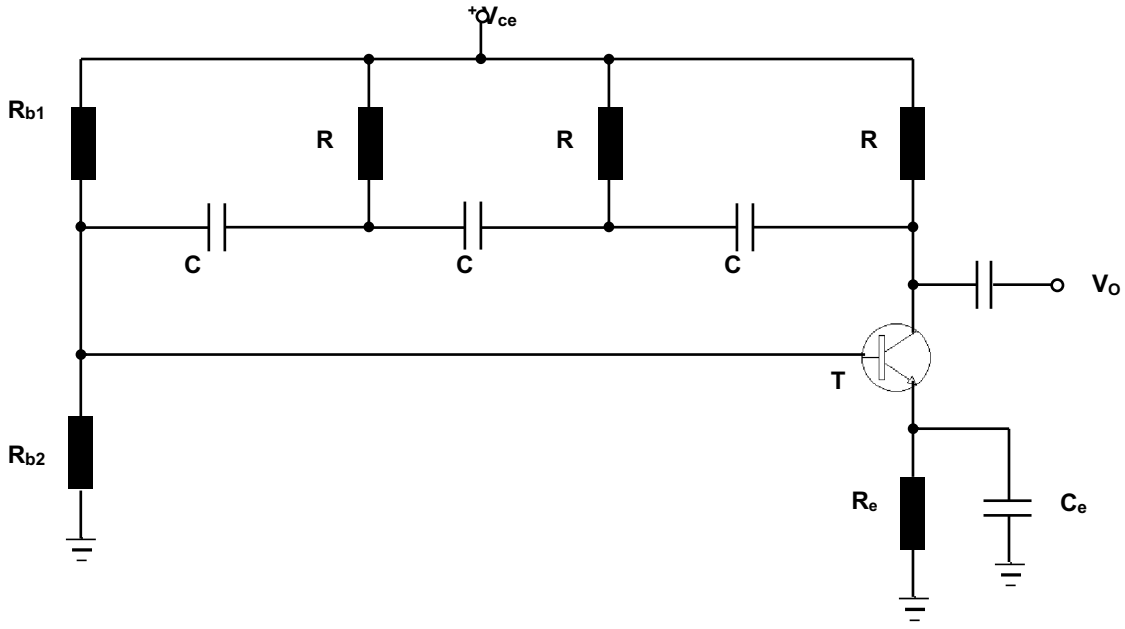
7.2



(2)
[7]

QUESTION 8: OSCILLATORS

8.1 8.1.1



(4)

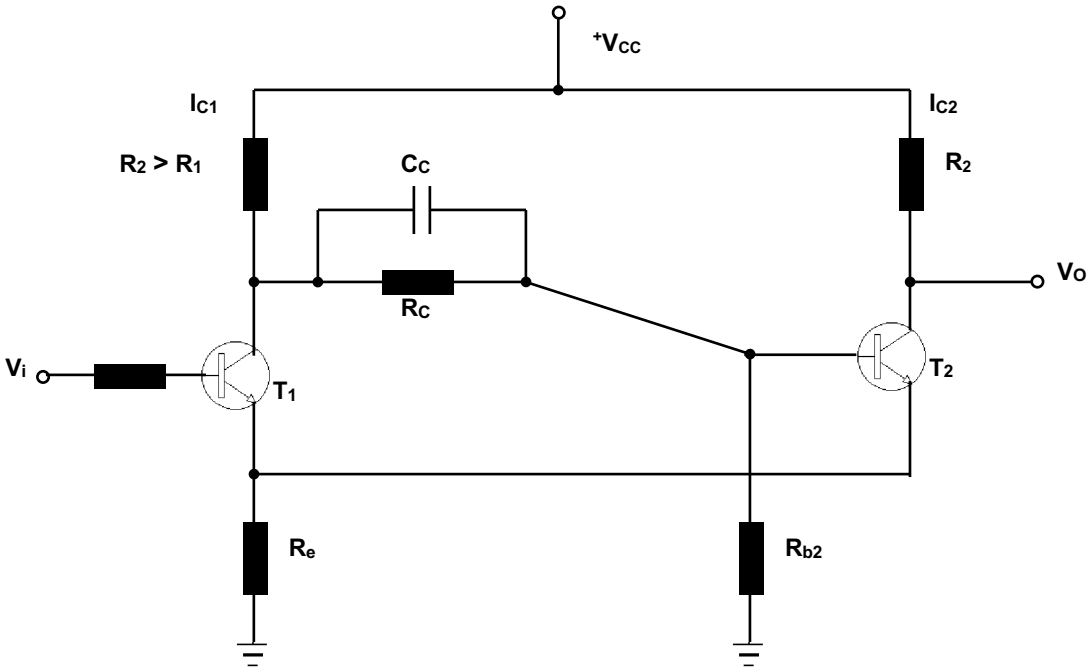
8.1.2 $$f = \frac{1}{2.\pi.R.C\sqrt{6}}$$

$$\therefore R = \frac{1}{2.\pi.f.C.\sqrt{6}}$$

$$= \frac{1}{2 \times \pi \times 50 \times 10^{6} \times 10 \times 10^{9} \times \sqrt{6}}$$

$$= 129{,}95\ \Omega$$ (3)

8.2 8.2.1



(4)

8.2.2
- Pulse detecting
- Signal level discriminating
- Forming of square wave pulse (Any 1 × 1) (1)

[12]

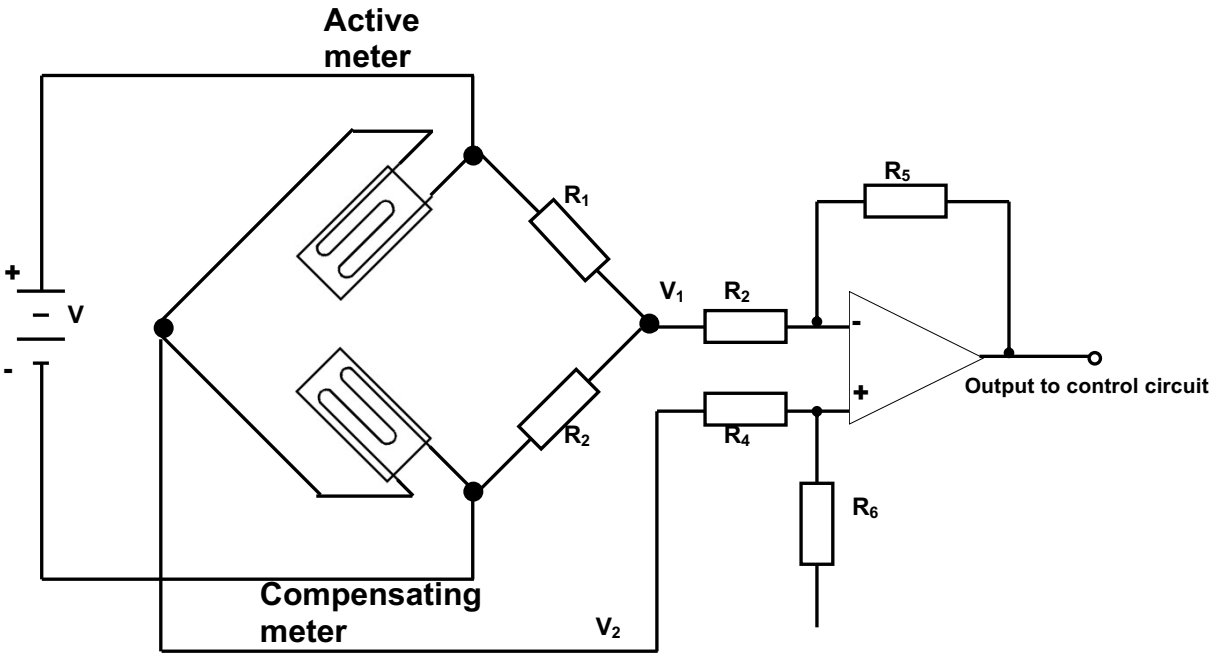
QUESTION 9: TRANSDUCERS

9.1 Passive transducer
- Needs electrical power to operate.

Active or self-generating transducer
- Generates an EMF as soon as they are stimulated by some or the other form of energy and therefore requires no external power. (4)

9.2 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, detection of human movement, distance control circuits, etc. (4)

9.3



(5)
[13]

TOTAL: 100

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