higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N5

4 APRIL 2018

This marking guideline consists of 9 pages.

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QUESTION 1: ALTERNATING CURRENT THEORY

1.1 1.1.1 time
1.1.2 current
1.1.3 square wave form
1.1.4 error (4 × 1) (4)

1.2 1.2.1 $X_C = \frac{1}{2\pi fc}$

$c = \frac{1}{2\pi f X_C}$

$= \frac{1}{2 \text{ x } \pi \times 200 \times 10^3 \times 18849{,}56}$ ✓

$= 42{,}217 \text{ ρf}$ ✓

$X_L = 2\pi fL$

$L = \frac{X_C}{2\pi f}$

$= \frac{18849{,}56}{2 \times \pi \times 200 \times 10^3}$ ✓

$= 15 \text{ mH}$ ✓

$Z_d = \frac{L}{RC}$

$= \frac{0{,}015}{42{,}217 \times 10^{-12} \times 10}$ ✓

$= 35{,}53 \text{ MΩ}$ ✓ ⟶ (6)

1.2.2 $I_C = \frac{V_T}{X_C}$

$= \frac{60 \angle 0^0}{18849,56 \angle -90^0}$ ✓

$= 0,0032 \angle 90° \text{ A}$ ✓

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

$= \frac{60 \angle 0^0}{18849,56 \angle 89,97^0}$

$0,0032 \angle 89.97^0 \text{ A}$ =✓✓⟶

(4)
[14]

QUESTION 2: POWER SUPPLIES

2.1 2.1.1 $r = \frac{1}{2\sqrt{3}fCR_L}$

$R_L = \frac{1}{2\sqrt{3}fC.r}$

$= \frac{1}{2\sqrt{3} \times 50 \times 100 \times 10^{-6} \times 0,03}$ ✓

$= 1924,5\ \Omega$ ✓⟶ (2)

2.1.2 $I_{dc} = \frac{V_{dc}}{R_L}$

$= \frac{15}{1924,5}$✓

$= 7,8\ \text{mA}$✓

$V_{dc} = V_M - \frac{I_{dc}}{2FC}$

$V_M = V_{dc} + \frac{I_{dc}}{2FC}$✓✓

$= 15 + \frac{7,8 \times 10^{-3}}{2 \times 50 \times 100 \times 10^{-6}}$

$= 15,78\ \text{V}$ ✓✓⟶ (6)

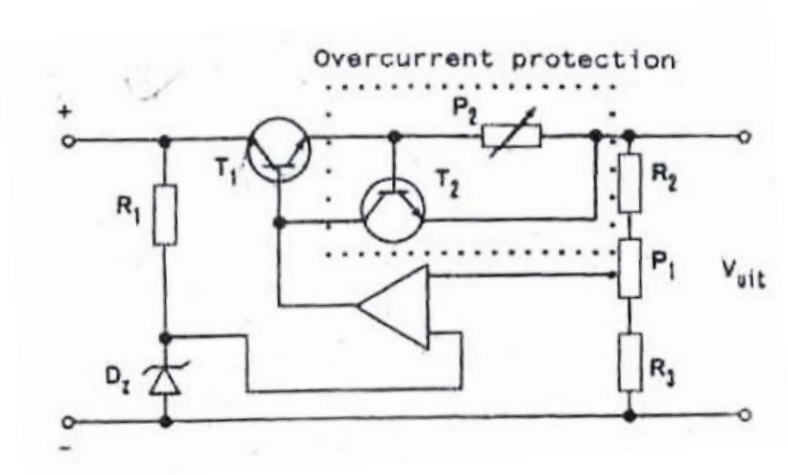
2.2 $VR = \frac{V_{NL} - V_{FL}}{V_{FL}}$

$= \frac{13,8-12,2}{12,2}$✓

$= 0,131$✓⟶ (2)

2.3 The degree of stabilising during a voltage regulator (1)

2.4



Overcurrent protection: Half a mark for each correct connection or component

Potentiometer P_2 is adjusted during a normal load current so that transistor T_1 is not forward biased sufficiently and is therefore off.✓ An increase in load current will cause an increase in voltage drop across P_2.✓ During overload conditions the increased voltage drop across P_2 will switch transistor T_2 on to conduct a part of the base current of transistor T_1 and limit the increase in load current to a safe value.✓ (6)

[17]

QUESTION 3: TRANSISTOR AMPLIFIERS

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

$= \frac{12}{10}$

$= 1{,}2\ V$✓ ⟶

$R_c = \frac{V_{CC} - V_{ce} - Ve}{I_C}$

$I_c = \frac{V_{CC} - V_{ce} - V_e}{R_C}$✓

$= \frac{12-8-1{,}2}{2600}$✓

$= 11\ mA$✓

$R_E = \frac{V_E}{I_C}$

$= \frac{1{,}2}{0{,}011}$✓

$= 109{,}1\ \Omega$✓ ⟶ (6)

3.1.2 $C_E = \frac{10}{2\pi F R_e}$

$= \frac{10}{2.\pi.100.109{,}1}$✓

$= 145{,}881\ \mu f$✓ ⟶ (2)

3.1.3 $I_B = \frac{I_C}{\beta}$

$= \frac{0{,}011}{250}$✓

$= 44\ \mu A$✓

$R_b = \frac{V_{CC} - V_{be} - V_e}{I_b}$

$= \frac{12 - 0{,}7 - 1{,}2}{44 \times 10^{-6}}$✓

$= 229{,}55\ k\Omega$✓ ⟶ (4)

3.2 $Z_i = R_B // Z_1$

$Z1 = h_{ie}$

$Z_i = 1{,}8\ k\Omega$✓✓

$Z_2 = \frac{1}{h_{oe}}$

$= \frac{1}{20 \times 10^{-6}}$

$= 50\ k\Omega$✓

$Z_O = R_C // Z_2$

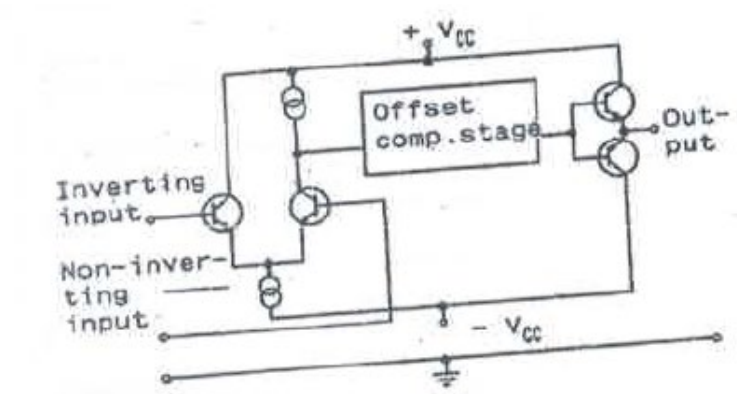
$= \frac{2600\ x\ 50000}{2600+50000}$✓

$= 2471{,}5\ \Omega$✓ ⟶ (5)

[17]

QUESTION 4: OPERATIONAL AMPLIFIERS

4.1



Simplified circuit of an operational amplifier: Half a mark per correct label and component (5)

4.2 4.2.1 The necessary difference between bias voltages at the input to obtain zero output voltages

4.2.2 Input terminal of a differential amplifier which produces an antiphase output when a signal is applied

(2 × 2) (4)

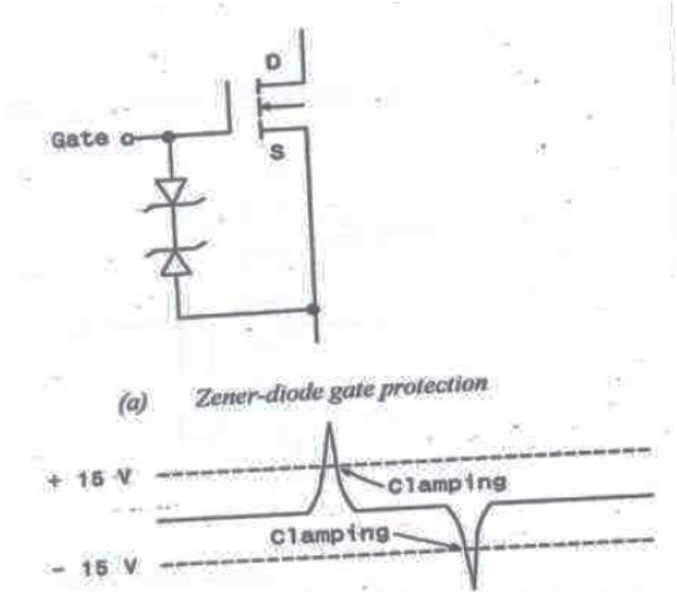
4.3 $V_O = \frac{-R_F}{R_{in}}(V_1 + V_2 + V_3)$

$R_{in} = \frac{-R_F}{V_O}(V_1 + V_2 + V_3)$✓

$= \frac{-20000}{20}(1 + 1{,}5 + 3{,}5)$✓

$= 6\ \text{k}\Omega$✓ ⟶ (3)
[12]

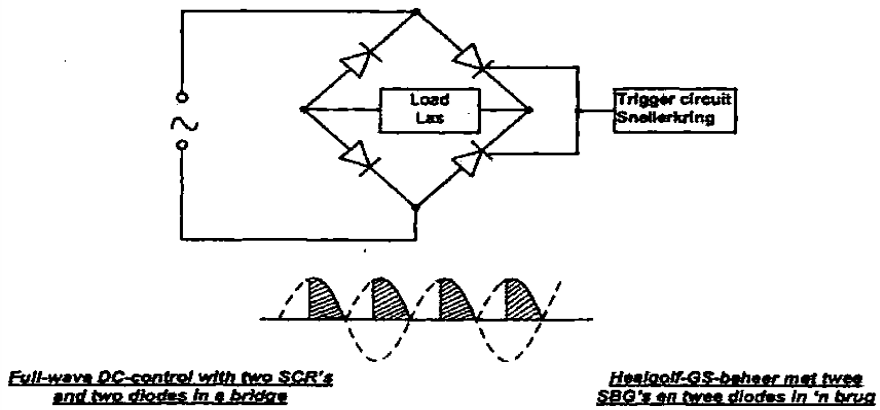
QUESTION 5: INTEGRATED CIRCUITS



Zener-diode gate protection
Circuit = 2 marks
Output wave = 2 marks **[4]**

QUESTION 6: ELECTRONIC PHASE CONTROL

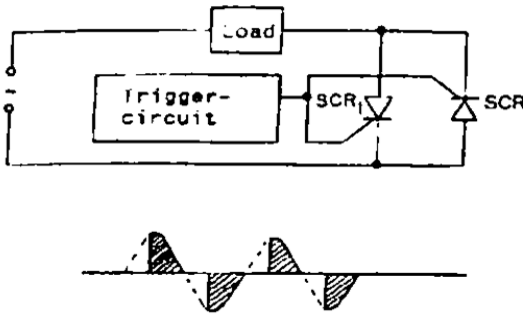
6.1



Full-wave DC-control with two SCR's and two diodes in a bridge

Heelgolf-GS-beheer met twee SBG's en twee diodes in 'n brug

6.2



(2 × 4) **[8]**

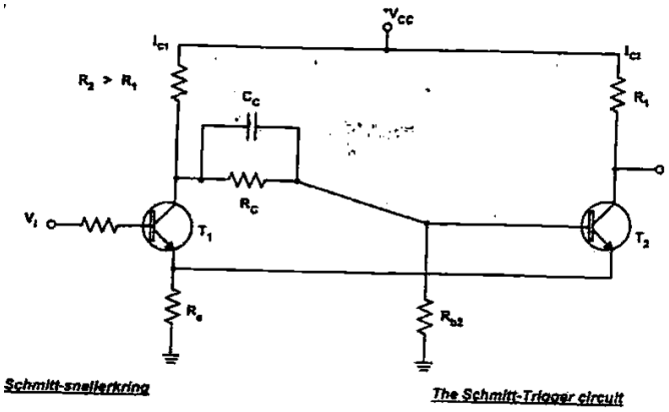
QUESTION 7: TEST EQUIPMENT

The control unit resets the circuit to zero. With the application of input voltage the comparator will have an output to the clock pulse generator. Clock pulses will be passed through to the counter which counts the clock pulses. A digital output is provided to the D/A-converter, which provides an analogue voltage for the comparator. As soon as Vu = Vr the comparator output will return to zero, the clock pulse generator will stop supplying clock pulses to the counter and the counter will stop counting. The count that the counter has reached gives an indication. **[6]**

QUESTION 8: OSCILLATORS

8.1
- Variation in the tuned circuit or transistor parameters
- Change in load conditions
- Unstable supply of voltage (3)

8.2



(4)

8.3 $F_O = \frac{1}{2\pi\sqrt{L_T C}}$

$C = \frac{1}{(2\pi f)^2 . L_T}$ ✓

$= \frac{1}{(2 \times \pi \times 250 \times 10^3)^2 \times 20 \times 10^{-3}}$ ✓

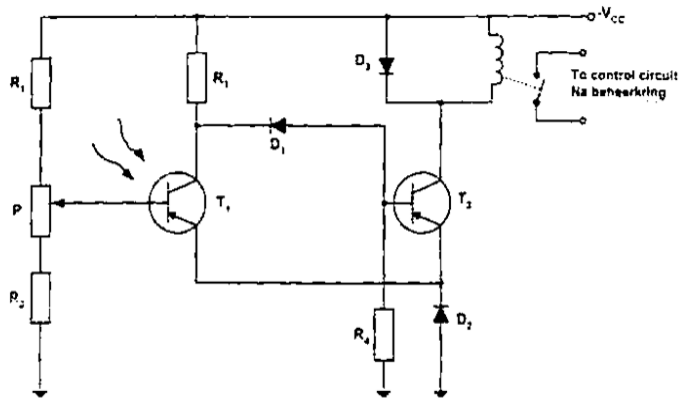
$= 20{,}26\ \mu f$ ✓ ⟶ (3)
[10]

QUESTION 9: TRANSDUCERS

9.1
- Passive transducers✓ need electrical power to operate.✓
- Active or self-generating transducers✓ generate an EMF as soon as they are stimulated by a form of energy and therefore require no external power.✓ (2 × 2) (4)

9.2 Uses the change in resistance to convert other forms of energy such as displacements, heat, light, power, torsi and humidity to proportional current or voltage (2)

9.3



Schmitt-trigger circuit which includes a photo transistor

Schmitt-snellerkring wat 'n fototransistor insluit

(6)
[12]

TOTAL: 100

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