higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# MARKING GUIDELINE

## NATIONAL CERTIFICATE

## INDUSTRIAL ELECTRONICS N4

**23 JULY 2018**

**This marking guideline consists of 7 pages.**

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## QUESTION 1

1.1 Short V1

$R_{p1}$ = (6 × 4)/(6+4)
= 2,4 Ω

$R_{p2}$ = (3 × 3)/(3+3)
= 1,5 Ω

$R_t$ = (2.4 × 7)/(2,4+7)+1,5
= 3,287 Ω

$I_1$ = 24/3,287
= 7,301 A

Using current divider rule

$I_{7\Omega}$ = 2,4/(2,4+7) × 7,301
= 1,864 Ω

Short V2

$R_t$ = (7 × 1,5)/(7+1,5)+2,4
= 3,635 Ω

$I_{1B}$ = 12/3,635
= 3,301A

$I_{7\Omega}$ = 1,5/(1,5+7) × 3,301
= 0,582 A

$I_{7\Omega(T)}$ = 1,864+0,582
= 2,446 A (8)

1.2 1.2.1 In any linear multiple source network, the resultant current in any branch is the algebraic sum of the currents that would be produced by each source acting separately. (2)

1.2.2 Any network can be viewed as a two-terminal network and can be replaced by a single source of EMF($V_{TH}$) in series with a single resistance($R_{th}$). (2)
**[12]**

## QUESTION 2

$X_L=2x\ \pi \times 50 \times 110 \times 10^{-3}$
$=314,269\ \Omega$

$X_{c1}=1/(2x\pi \times 50 \times 120 \times 10^{-6}$
$=26,526\ \Omega$

$X_{c2}=1/(2x\pi \times 50 \times 160 \times 10^{-6}$
$=19,894\ \Omega$

$Z_1=30 + j314,269$
$=315,698 \angle 84,547\ \Omega$

$Z_2=0 - j26,526$
$=26,526 \angle -90\ \Omega$

$Z_3=50 - j19,894$
$=53,812 \angle -21,697$

$Zp=(26,526 \angle -90 \times 53,812 \angle -21,697)/(0-j26,526)+(50-j19,894)$
$=1427,417 \angle -111,697/68,226 \angle -42,874$
$=20,922 \angle -68,823$
$=(7,558-j19,509)\ \Omega$

$Z_T=(7,558-j19,509) +(30+j314,269)$
$=297,143 \angle 82,739$

$I_T=V_T/Z_T$
$=250 \angle 0/297 \angle 82,739$
$=0,841 \angle -82,739\ A$ **[12]**

## QUESTION 3

3.1 3.1.1 The process of generating free electrons (2)

3.1.2 The process of generating holes (2)

3.2
- It is a silicon junction diode that is doped to obtain its unique characteristics.
- It will not break down in the reverse bias condition if it is used within the limits of its specifications.
- It will maintain a steady voltage across the diode in the reverse bias condition.
- It behaves like an ordinary junction diode in the forward bias condition.
- When the Zener voltage is exceeded, the avalanche point will be reached.
- A small reverse current flows in the reverse bias condition before the Zener reference value is reached.
- In the Zener area, a relatively large current flows through the diode.

(Any 4 × 1) (4)

3.3 $V_S = V_T - V_Z$
$= 15 - 10$
$= 5\ V$
$R_S = V_S/I_S$
$= 5/20 \times 10^{-3}$
$= 250\ \Omega$ (3)
**[11]**

**QUESTION 4**

4.1

| **BRIDGE CIRCUIT** | **CENTRE-TAP CIRCUIT** |
|---|---|
| It makes use of two diodes. | It makes use of four diodes. |
| It can function without the help of any transformer. | It cannot operate without the help of a transformer. |

(4)

4.2 4.2.1 $V_m = \sqrt{2} \times 30$
$= 42,426\ V$

$V_{dc} = V_m/(1+1/2fCR_L)$
$= 42,426/(1+1/2 \times 50 \times 120 \times 10^{-6} \times 200)$
$= 29,940\ V$

$I_{dc} = V_{dc}/R_L$
$= 29,940/200$
$= 0,147\ \Omega$ (4)

4.2.2 $V_m = \sqrt{2} \times 30$
$= 42,426$

$V_{dc} = V_m/(1+1/2fCR_L)$
$= 42,426/(1+1/4 \times 50 \times 120 \times 10^{-6} \times 200)$
$= 35,120\ V$

$I_{dc} = V_{dc}/R_L$
$= 35,120/200$
$= 0,176\ A$ (4)
**[12]**

## QUESTION 5

5.1
- Cut-off region – the collector and emitter junction are both reverse-biased, resulting in almost no collector current.
- Saturation region – both junctions are forward-biased.
- Active region – the base-emitter junction is forward-biased while the base-collector junction is reverse-biased. (3 × 2) (6)

5.2 $R_{out} = \Delta V_{out}/\Delta V_{out}$
$= (7\text{-}3)/(10 \times 10^{-3} - 2 \times 10^{-3})$
$= 500\ \Omega$ (3)

5.3
- Non-complementary class B push-pull
- Symmetrical push-pull class AB
- Complementary symmetry push-pull class B
- Complementary symmetry push-pull class AB (Any 3 × 1) (3)

**[12]**

## QUESTION 6

6.1 $V_o = -R_f(V_1/R_1 + V_2/R_2 + V_3/R_3)$
$6{,}14 = -35 \times 10^3(3{,}5/8000 + V_2/15000 + 8{,}5/25000)$
$6{,}14 = -27{,}2125 + 2{,}333V_2$
$V_2 = 14{,}296\ V$ (4)

6.2 Comparator (1)

6.3 6.3.1

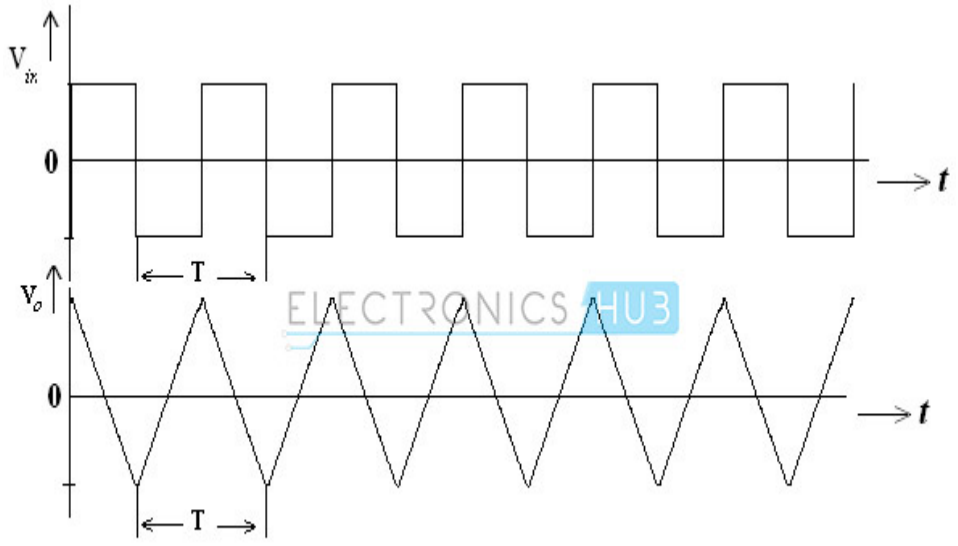



Fig: Input and Output Waveforms of an Integrator

(2)

6.3.2

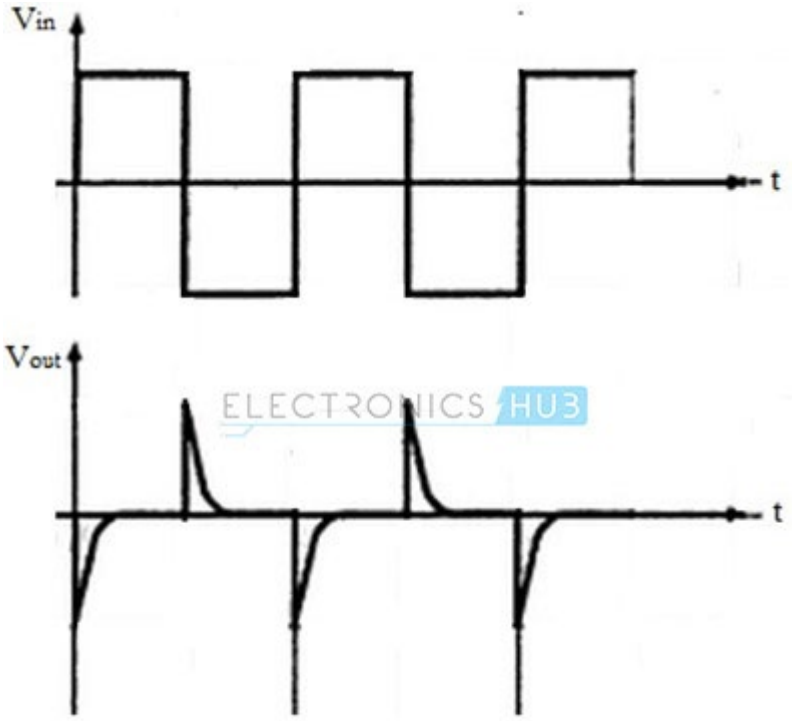



Fig: Input and Output waveforms for Square wave (2)

**[9]**

**QUESTION 7**

7.1 LASCR is a silicon-controlled rectifier that conducts when the gate is exposed to light. The gate still operates as a normal gate in an SCR but is in many cases left disconnected. (3)

7.2
- The gate has control over conduction once the triac is turned ON as in the case of an SCR.
- The triac has very high switching delay.
- The triac is not suitable for DC power applications. (3)

7.3
7.3.1 SCR
7.3.2 with feedback
7.3.3 sense
7.3.4 correcting signal
7.3.5 positive half cycle

(5 × 1) (5)

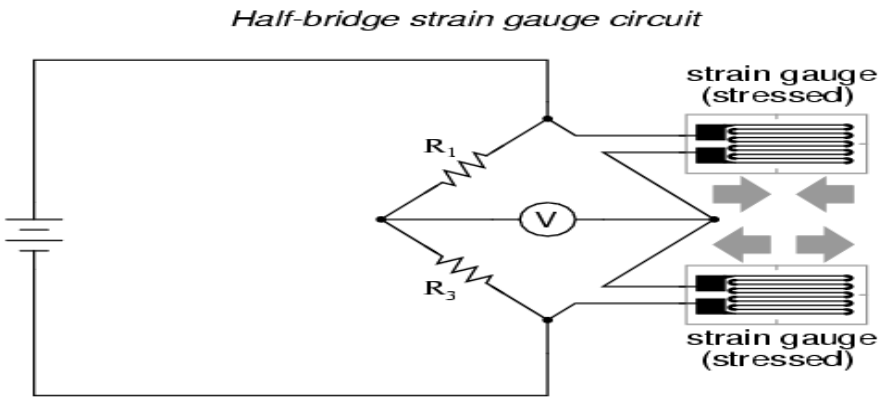
**[11]**

## QUESTION 8

8.1 8.1.1 Capacitive
8.1.2 Capacitive
8.1.3 Resistive

(3 × 1) (3)

8.2




(4)

8.3 The photodiode is operated under reverse-bias conditions. When light falls on the PN junction, electron/hole pairs are created which increase the availability of minority carriers. The minority carries under the reverse-bias condition cause an increase in the leakage current. As the light intensity increases, the leakage current increase and the diode becomes more conductive. (4)

**[11]**

## QUESTION 9

9.1
- Internal
- External
- Line (Any 2 × 1) (2)

9.2 Voltage scale is the vertical axis of an oscilloscope screen.
Time scale is the horizontal axis of an oscilloscope screen. (2)

9.3 9.3.1 Adjustment that allows the operator to produce a small, clear spot or thin line when measuring

9.3.2 It determines the brightness of the spot on the display.

9.3.3 Adjusts the amplitude of the waveform

(3 × 2) (6)

**[10]**

**TOTAL: 100**

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