higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N4

XX August 2021

This marking guideline consists of 7 pages.

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QUESTION 1

1.1 1.1.1 True
1.1.2 False
1.1.3 True
1.1.4 False
1.1.5 True

(5 × 1) (5)

1.2 (A) Short circuit V_1:

$R_{TA} = 7 \times 9 /(7 + 9) + 11 = 14{,}938\ \Omega$✓

$I_1 = V_2/R_{TA}$
$= 12/14{,}938 = 0{,}803\ A$✓

Use the current divider rule:
$I_{3A} = R_1/(R_1 + R_2) \times I_1$
$= 7/16 \times 0{,}803$
$= 0{,}351\ A$✓✓

(B) Short circuit V_2:

$R_{TB} = 9 \times 11/(9 + 11) + 7$
$= 34{,}65\ \Omega$✓

$I_1 = V_1/RT_B$
$= 30/34{,}65$
$= 0{,}866\ A$✓

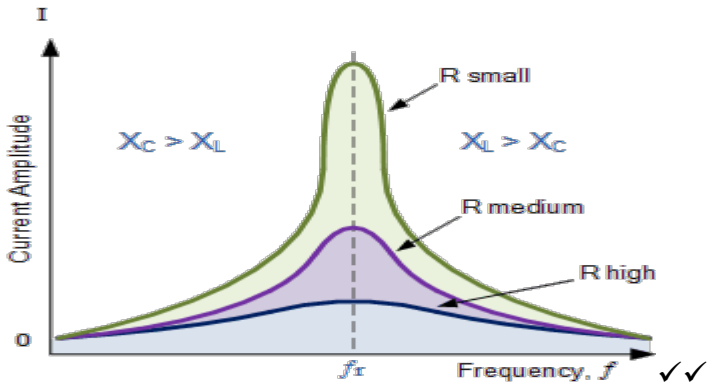
Use the current divider rule:
$I_{3B} = R_3/(R_3 + R_2) \times I_1$
$= 11/20 \times 0{,}866$
$= 0{,}476\ A$✓

Therefore:
$I_{3T(A+B)} = 0{,}351 + 0{,}476$
$= 0{,}827\ A$✓ (8)

[13]

QUESTION 2

2.1



✓✓

An increase in a Q factor will result in a decrease in the bandwidth. High values of inductance and low values of capacitance will then produce a high Q and a low bandwidth. (4)

2.2 $X_{C1} = 1/2 \times \pi \times 50 \times 145 \times 10^{-6}$
$= 21,952\ \Omega$✓

$X_{C2} = 1/2 \times \pi \times 50 \times 306 \times 10^{-6}$
$= 10,402\ \Omega$✓
$X_{L1} = 2 \times \pi \times 50 \times 203 \times 10^{-3}$
$= 63,774\ \Omega$

$X_{L2} = 2 \times \pi \times 50 \times 218 \times 10^{-3}$
$= 68,487\ \Omega$✓

$Z_1 = 101 - j21,952$
$= 103,358 \angle - 12,262$✓

$Z_2 = 65 + j53,372$
$= 84,105 \angle 39,39$✓

$Z_3 = 81 + j68,487$
$= 106,073 \angle 40,215$✓

$Z_p = (103,358 \angle - 12,262 \times 84,105 \angle 39,39)/(101 + j21,952 + 65 + j53,372)$
$= 51,454 \angle 16,41\ \Omega$
$= 49,358 + j14,536$✓✓

$Z_T = 49,358 + j14,536 + 81 + j68,487$
$= 130,358 + j83,023$
$= 154,551 \angle 32,492\ \Omega$✓✓

$I_T = 230 \angle 0/154,551 \angle 32,492$
$= 1,488 \angle - 32,492$ A✓✓
$I_T = I_{R3}$ (12)
[16]

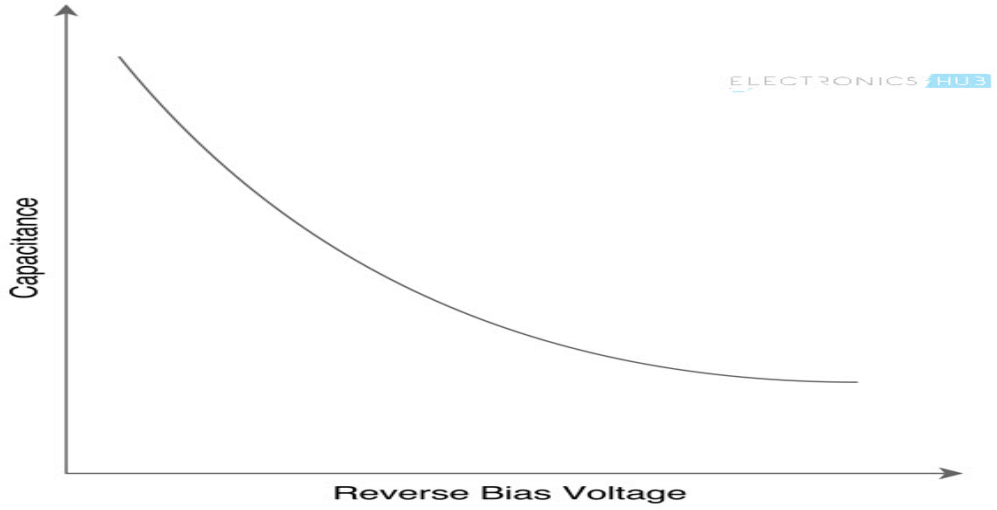
QUESTION 3

3.1 $I = I_S(e^x - 1) \times = (1,6 \times 10^{-19} \times 0,3)/(1,38 \times 10^{-23} \times 300)$
$= 45 \times 10^{-6}(e^x - 1) \times = (1,6 \times 10^{-19} \times 0,3)/(1,38 \times 10^{-23} \times 300)$✓✓
$= 4,881$ A✓ (3)

3.2 $I = KT/Rq$
$= (1,38 \times 10^{-23} \times 302)/(3,115 \times 1,6 \times 10^{-19})$✓✓
$= 8,362$ mA✓ (3)

3.3 $V_S = 28 - 20$
$= 8$ V✓
$I = V/R$
$= 8/316$✓
$= 25,316$ mA✓ (3)

3.4



(3)
[12]

QUESTION 4

4.1 4.1.1 The process of converting an alternating voltage into a unidirectional voltage

4.1.2 The voltage appearing across a diode during the reverse condition period

4.1.3 A load voltage waveform that consists of two components: a DC component with an AC component superimposed on it

(3 × 2) (6)

4.2 4.2.1 $V_m = \sqrt{2} \times 230/2$
$= 162,635$ V✓

$V_{dc} = 0,637 \times 162,635$
$= 103,598$ V✓ (2)

4.2.2 $V_{rms} = \sqrt{(115^2 - 103{,}598^2)}$✓
$= 49{,}924$ V✓
$r = V_{ac}/V_{dc}$
$= 49{,}924/103{,}598$✓
$= 0{,}482$✓ (4)

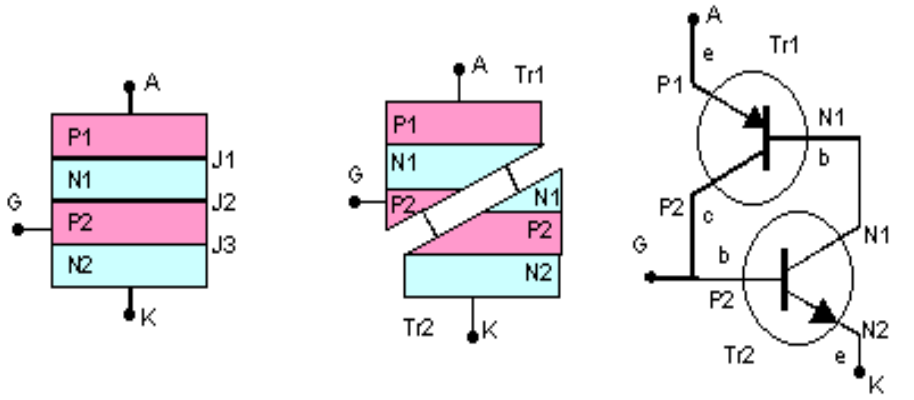
4.3 $V_{BE} = 25 - 15$
$= 10$ V✓
$R_B = (V_{cc} - V_{BE})/I_B$
$= (25 - 15)/10 \times 10^{-3}$✓
$= 1\ 000\ \Omega$✓ (3)

4.4 $I_{out} = \sqrt{(200/400 \times 10^{-3})}$
$= 22{,}361$
$= 22$ dB✓
$I_{in} = P_{in}/V_{in}$
$= 400 \times 10^{-3}/20$
$= 0{,}02$ A✓

$A_i = 20\log I_{out}/I_{in}$
$= 20\log 22{,}361/0{,}02$✓
$= 60{,}969$
$= 61$ dB✓ (4)
[19]

QUESTION 5

5.1



a. Simplified Construction **b. How we get the two transistor model** **c. The Two Transistor Model** (4)

5.2 It can be turned on by incident light falling upon the gate region that is normally supplied by the gate circuit. (2)

5.3 It is a triac and a diac combined together in a single package. (2)

5.4 5.4.1 It causes the corrective action that tends to bring the controlled condition of the process to the desired value.

5.4.2 A detecting element

(2 × 2) (4)
[12]

QUESTION 6

6.1 Potentiometer (1)

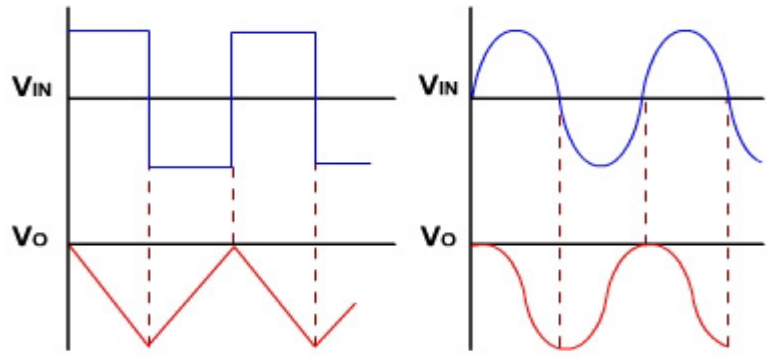
6.2 When the pressure is reduced, the Bourdon tube returns to its original shape. A potentiometer is connected to the rotating shaft of the Bourdon tube. When the Bourdon tube straightens, the shaft turns and the resistance of the potentiometer changes. (5)

6.3 Its resistance decreases, causing a current to flow through the device. (2)

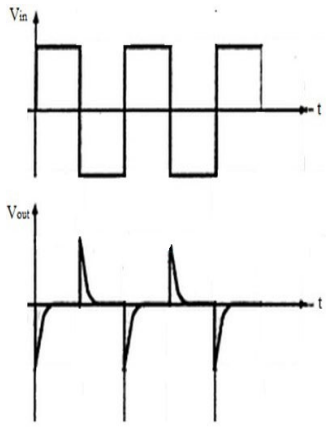
6.4 To allow the phototransistor to be operated as a normal bipolar transistor with or without being exposed to light (2)
[10]

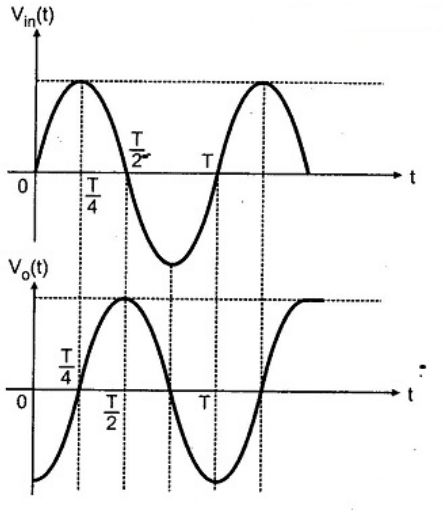
QUESTION 7

7.1 7.1.1



7.1.2





(4 × 2) (8)

7.2
- Electron beam generation
- Focusing system
- Deflection system
- Glass envelope
- Fluorescent screen

(Any 4 × 1) (4)

7.3 7.3.1 = 3,1 × 0,5
= 1,55V
V_{p-p} = 6,2 × 0,5✓✓
= 3,1 V✓

7.3.2 t = 5 × 0,5
= 20 µsec✓
F = $1/(20 \times 10^{-6})$✓
= 50 KHz✓

(3 × 2) (6)
[18]

TOTAL: 100

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