higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

NOVEMBER EXAMINATION

INDUSTRIAL ELECTRONICS N2

18 NOVEMBER 2016

This marking guideline consists of 7 pages.

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✓ = 1 MARK √ = ½ MARK

QUESTION 1

1.1

1.1.1	B
1.1.2	E
1.1.3	F
1.1.4	H
1.1.5	J
1.1.6	D
1.1.7	C
1.1.8	A
1.1.9	I
1.1.10	G

(10 × 1) **[10]**

QUESTION 2

2.1

$$R_{P_1} = \frac{2200 \times 3300}{2200 + 3300} \checkmark$$
$$= 1320\,\Omega \checkmark$$
$$R_{S_1} = 200 + 400 + 1320 + 220 \checkmark$$
$$= 2140\,\Omega \checkmark$$
$$R_T = \frac{2140 \times 600}{2140 + 600} \checkmark$$
$$= 468,6\,\Omega \checkmark$$

(6)

2.2

$$I_T = \frac{V_T}{R_T}$$
$$= \frac{60}{468,6} \checkmark$$
$$= 0,128\,\text{A} \checkmark$$

(2)

2.3

$$V_{600\Omega} = 60\,\text{V}$$
$$I_{600\Omega} = \frac{V_{600\Omega}}{R}$$
$$= \frac{60}{600} \quad \surd$$
$$= 0,1\,\text{A} \checkmark$$
$$\text{I}_{P_1} = 0,128 - 0,1 = 0,028\,\text{A} \surd$$
$$\text{V}_{2K2\Omega} = I_{P_1} \times R_{P_1}$$
$$= 0,028 \times 1320 \checkmark$$
$$= 36,96\,\text{V} \checkmark$$

(4)
[12]

QUESTION 3

3.1
$$X_C = \frac{1}{2\pi f C}$$
$$= \frac{1}{2\pi \times 50 \times 200 \times 10^{-6}} \checkmark$$
$$= 15,915\,\Omega \checkmark$$
(2)

3.2
$$X_L = 2\pi f L$$
$$= 2\pi \times 50 \times 20 \times 10^{-3} \checkmark$$
$$= 6,283\,\Omega \checkmark$$
(2)

3.3
$$Z = \sqrt{R^2 + (X_C \sim X_L)^2}$$
$$= \sqrt{20^2 + (15,915 - 6,283)^2} \checkmark$$
$$= 22,199\,\Omega \checkmark$$
(2)

3.4
$$I_T = \frac{V_T}{Z}$$
$$= \frac{100}{22,199} \checkmark$$
$$= 4,505\,\text{A} \checkmark$$
(2)

3.5
$$\theta = \cos^{-1}\frac{R}{Z}$$
$$= \cos^{-1}\frac{20}{22,199} \checkmark$$
$$= 25,718° \checkmark$$
(2)

3.6
$$V_R = I \times R = 4,505 \times 20 = 90,1\,\text{V} \checkmark$$
$$V_L = I \times X_L = 4,505 \times 6,283 = 28,305\,\text{V} \checkmark$$
$$V_T = \sqrt{V_R{}^2 + V_L{}^2}$$
$$= \sqrt{90,1^2 + 28,305^2} \quad \surd$$
$$= 94,441\ \text{V} \quad \surd$$

or $V_L = I \times X_L = 4,505 \times 6,283 = 28,305\text{V}$

(3)

3.7
$$f_O = \frac{1}{2\pi\sqrt{LC}}$$
$$= \frac{1}{2\pi\sqrt{20 \times 10^{-3} \times 200 \times 10^{-6}}} \checkmark$$
$$= 79,577\,\text{Hz} \checkmark$$
(2)

[15]

QUESTION 4

4.1 $V_{max} = 200\ V$ (2)

4.2 $V_{AVE} = 0,637 \times 200 = 127,4\ V$ √√
$V_{RMS} = 0,707 \times 200 = 141,4\ V$ √√ (2)

4.3 $\text{Form factor} = \dfrac{RMS\ \text{value}}{AVE\ \text{value}} = \dfrac{141,4}{127,4} = 1,11$ √√

$\text{Crest factor} = \dfrac{\text{Maximum value}}{RMS\ \text{value}} = \dfrac{200}{141,4} = 1,414$ √ (2)

4.4 $\omega = 2\pi f$

$f = \dfrac{\omega}{2\pi}$

$= \dfrac{31,41}{2\pi}$ ✓

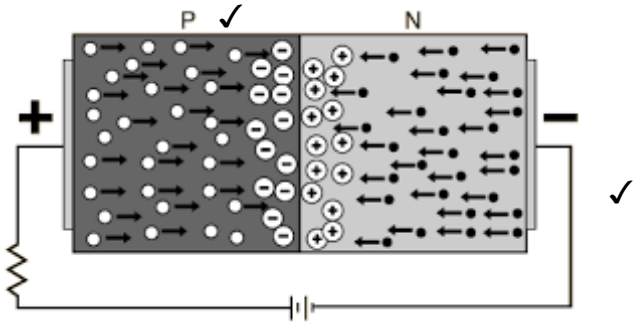
$= 5\,\text{Hz}$ ✓ (2)

4.5 $e = 200 \sin 31,41 \times 6 \times 10^{-3} \times \dfrac{180}{\pi}$ ✓

$= 35,832\,\text{V}$ ✓ (2)
[10]

QUESTION 5

5.1

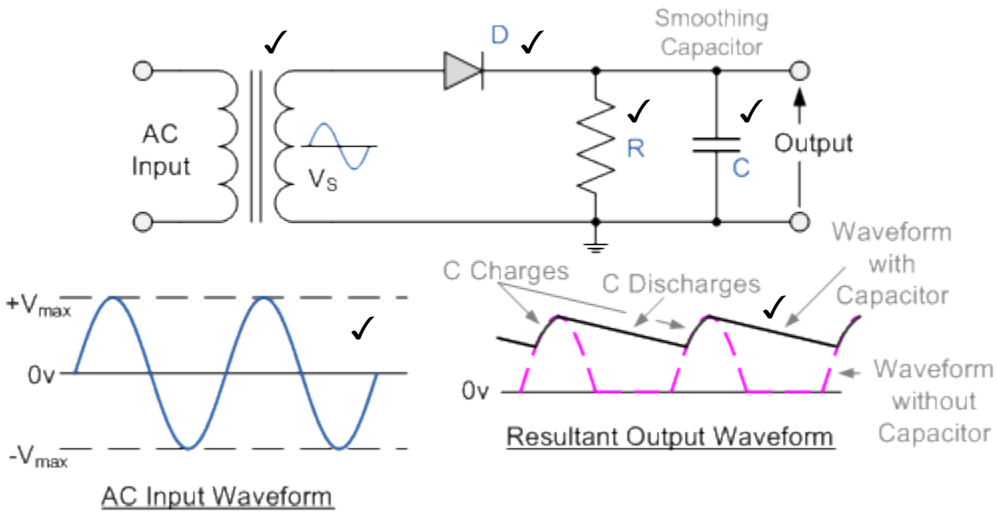


✓

Forward bias occurs when the external voltage source is connected in such a way that its positive terminal is connected to the P-type material and its negative terminal is connected to the N-type material. The holes are repelled by the positive and the electrons are repelled by the negative. The depletion layer is reduced. If the biased voltage is increased so that it overcomes the barrier potential, electrons will flow freely. ✓✓

(2 MARKS FOR CIRCUIT DIAGRAM + 2 FOR EXPLANATION) (4)

5.2



(6)
[10]

QUESTION 6

6.1
- Accuracy is higher
- More robust (stronger)
  ALTERNATE ANSWERS
- Much more sensitive
- Error of parallax is eliminated
- Can handle negative quantities
- Reverse polarity is indicated by means of an indicator on the display.

(Any 2 x 1) (2)

6.2 6.2.1

$$R_{SH} = \frac{I_M \times R_M}{I_{SH}} \checkmark$$

$$= \frac{3\times10^{-3} \times 50}{27} \checkmark\checkmark$$

$$= 5{,}556\,\text{mA} \checkmark$$

(4)

6.2.2

$$V = 3\times10^{-3} \times 50 \checkmark$$

$$= 0{,}15\,\text{V} \checkmark$$

(2)

6.2.3

$$R_S = \frac{V_T}{I_M} - R_M \checkmark$$

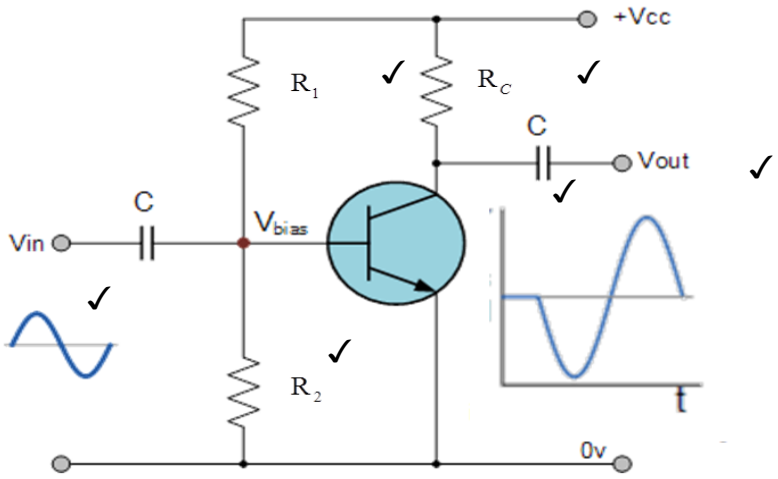
$$= \frac{12}{3\times10^{-3}} - 50 \checkmark\checkmark$$

$$= 3950\,\Omega \checkmark$$

(4)
[12]

QUESTION 7

7.1



(6)

7.2 Class A ✓
Class B ✓
Class C ✓

(3)
[9]

QUESTION 8

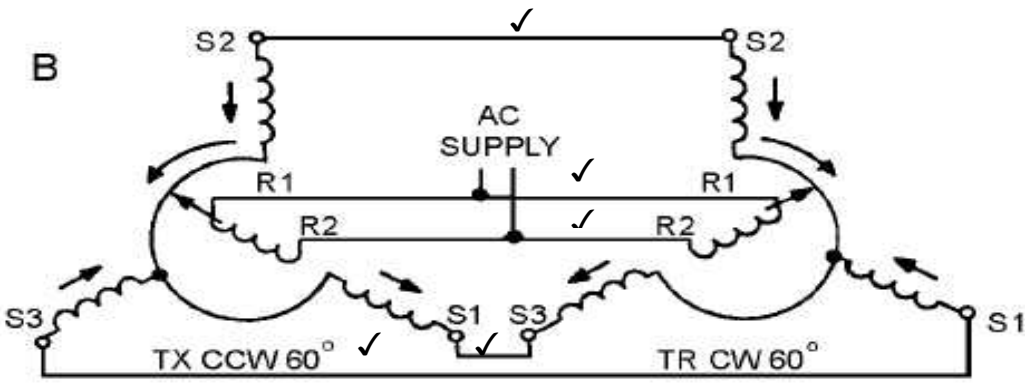
8.1 Lenz's law states that when a magnetic field cuts through a coil and induces a voltage in the coil causing a current to flow,✓ that current will in turn generate its own magnetic field✓ which will oppose the original inducing magnetic field. ✓

(3)

8.2 Very little electrical energy is used by the synchro-system.√
Contact between the two systems can be by means of telemetering, radio or wires.✓
ALTERNATE ANSWER
The quantity to be controlled and the device from which control is given can be far apart.

(2)

8.3



(5)
[10]

QUESTION 9

9.1 9.1.1 The thermocouple is a temperature-sensitive device consisting of two metals joined at the ends.✓ When one end is heated a potential difference is set up across the two ends.✓ The potential difference is proportional to the difference in temperature between the two ends.✓ (3)

9.1.2 Instead of generating a voltage, a bimetal strip indicates a change in temperature.✓ The two metals are bonded together and have different expansion coefficients.✓ When heat is applied one metal expands faster than the other thereby causing the bonded metal to bend.✓ (3)

9.2

$$P_O = \frac{V^2}{R} = \frac{(12)^2}{20} \checkmark = 7,2W \checkmark$$

$$P_{IN} = I^2 \times R = (14 \times 10^{-3})^2 \times 15000 \checkmark = 2,94\ W \checkmark$$

$$N = 10 \log \frac{7,2}{2,94} \checkmark$$

$$= 3,889 \text{ db} \checkmark$$

(6)
[12]

TOTAL: 100

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