higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N5

25 November 2024

This marking guideline consists of 7 pages.

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QUESTION 1: ALTERNATING CURRENT THEORY

1.1 1.1.1 DC
1.1.2 AC
1.1.3 AC
1.1.4 DC

(4 × 1) (4)

1.2 1.2.1 $Z_S = Z_1 + Z_2 = 300 + j\,46{,}441 = 303{,}57 \angle -8{,}8°\Omega$ ✓

$Z_3 = 100 + j\,47{,}31 = 110{,}627 \angle 25{,}319°\,\Omega$ ✓

$$Z_T = \frac{Z_S Z_3}{Z_S + Z_3}$$

$$= \frac{303{,}57 \angle -8{,}8° \times 110{,}627 \angle 25{,}319°}{400 + j\,0{,}869}$$ ✓

$$= \frac{33583{,}038 \angle 16{,}519°}{400 \angle 0{,}124°}$$ ✓

$= 83{,}958 \angle\angle 16{,}395°\Omega$ ✓ (5)

1.2.2 $$Z_T = \frac{Z_1 Z_2}{Z_1 + Z_2} + Z_3$$

$$= Z_3 + \frac{121{,}86 \angle -10° \times 181{,}8 \angle -7{,}98°}{300 + 46{,}441}$$ ✓✓

$$= Z_3 + \frac{22149 \angle -17{,}98°}{303{,}57 \angle -8{,}8°}$$ ✓

$= Z_3 + 72{,}962 \angle -9{,}18°$ ✓

$= 100 + j\,47{,}31 + 72{,}028 - j\,11{,}64$ ✓

$= 172{,}028 + j\,35{,}67$

$= 175{,}687 \angle 11{,}714°\,\Omega$ ✓ (6)

[15]

QUESTION 2: POWER SUPPLIES

2.1 $$\%r = \frac{V_{r(rms)}}{V_{DC}} \times 100$$

$$0{,}03 = \frac{0{,}5}{V_{DC}} \checkmark$$

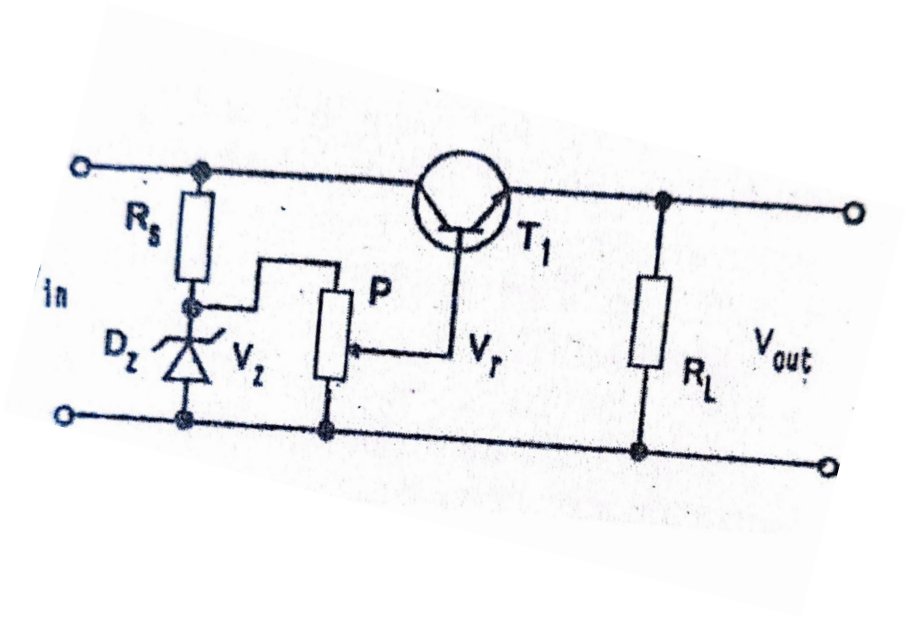
$$V_{DC} = 16{,}667\ V \checkmark$$

$$\%VR = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100$$

$$= \frac{16{,}667 - 12{,}7}{12{,}7} \times 100 \checkmark$$

$$= 31.24\ \% \checkmark$$ (4)

2.2 2.2.1



Allocate ONE mark for each correct labelled component. (5)

2.2.2 To regulate the output voltage (2)

2.3 The control circuit adjusts the output current✓ to maintain the required voltage.✓ But, the excess that is not taken up by the load is diverted✓ to the common ground and wasted.✓ (4)

[15]

QUESTION 3: AMPLIFIERS

3.1 $V_E = \frac{1}{10}V_{CC} = \frac{11}{10} = 1{,}1\ V$ ✓

$I_C = \frac{V_{CC} - V_{CE} - V_E}{R_C}$

$= \frac{11 - 5 - 1{,}1}{2400}$ ✓

$= 2{,}04\ mA$ ✓

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

$= \frac{1{,}1}{2{,}04 \times 10^{-3}}$ ✓

$= 539{,}215\ \Omega$ ✓ (5)

3.2 $Z_1 = h_{ie} = 12000\ \Omega$

$I_B = \frac{I_C}{\beta} = \frac{2{,}04 \times 10^{-3}}{200} = 10{,}2\ \mu A$ ✓

$R_B = \frac{V_{CC} - V_{BE} - V_E}{I_B}$

$= \frac{11 - 0{,}6 - 1{,}1}{10{,}2 \times 10^{-6}}$ ✓

$= 911{,}764\ k\Omega$ ✓

$Z_{In} = R_b \quad // Z_1$

$= \frac{911765 \times 12000}{911765 + 12000}$

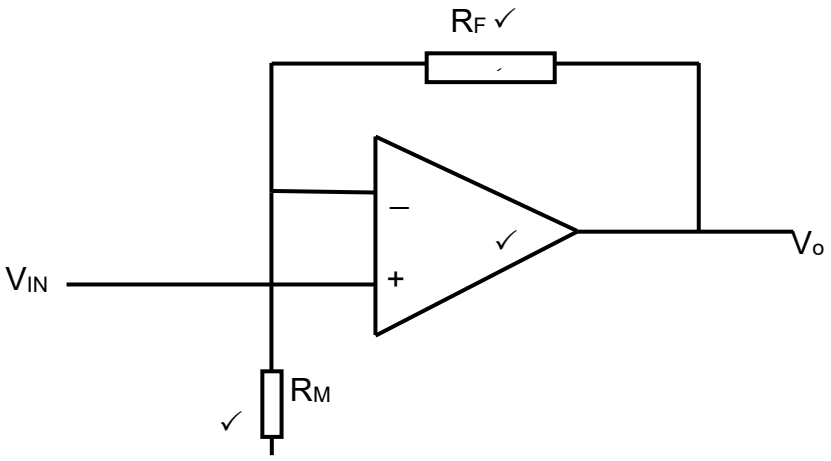
$= 11{,}844\ k\Omega$ ✓ (4)

3.3 3.3.1 $\frac{V_O}{V_{IN}} = \frac{R_F}{R_M} + 1$

$\frac{110 \times 10^{-3}}{V_{IN}} = \frac{10000}{1000} + 1$ ✓✓

$V_{IN} = 10\ mV$ ✓ (3)

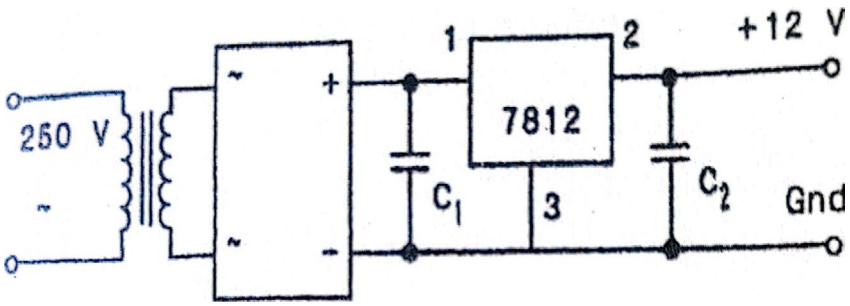
3.3.2



(3)
[15]

QUESTION 4: INTEGRATED CIRCUIT AND TRANSDUCERS

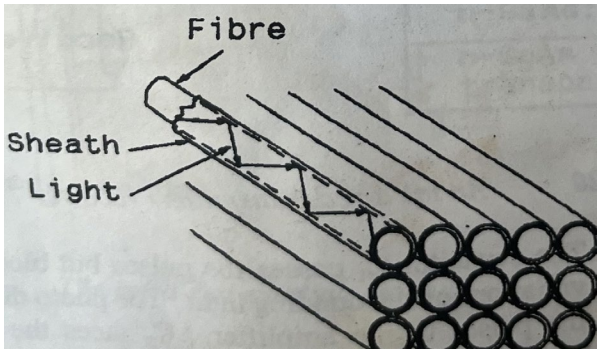
4.1



Allocate 1 full mark for transformer; regulator and rectifier circuit, and half mark for any correctly labelled component. (6)

4.2
- Passive✓ – need power to conduct.✓
- Active✓ – do not need power to operate.✓ (4)

4.3



Allocate 1 mark for structure and 2 marks for any correctly labelling inside the fibre.

- Medical cameras
- Ornaments
- Communication systems (Any 2 × 1) (5)

[15]

QUESTION 5: ELECTRONIC PHASE CONTROL

5.1 As soon as the capacitor reaches the require gate voltage, the thyristor switches on.✓ The thyristor will stay on until the bias drops to such an extent that the current is less than the holding current value.✓ This period is called the conduction angle.✓ If a potentiometer is used, the phase angle can be adjusted to the required value. This way the effective voltage across the load is controlled.✓ (4)

5.2

OPEN LOOP	CLOSE LOOP
Operate manual✓	Operate automatic✓
Fast and cheaper✓	Expensive✓
There is no feedback line✓	It has a feedback line✓

(6)
[10]

QUESTION 6: MEASURING INSTRUMENTS

6.1 Start: 0000✓
Step 1: 1000 (8 V): sets 1✓
Step 2: 1100 (12 V): resets 1 to 0✓
Step 3: 1010 (10 V): sets 1✓
Step 4: 1011 (11 V): sets 1✓ (5)

6.2 6.2.1 As soon as the value of Vr is reached, the output condition of the comparator changes to trigger the pulse generator. (2)

6.2.2 The rate at which the capacitor charges and discharges,✓ supplies a square pulse✓ with a certain frequency, which is supplied by the comparator.✓ (3)
[10]

QUESTION 7: OSCILLATORS

7.1 $f_o = \frac{1,5}{RC}$

$R = \frac{1,5}{15000 \times 10x10^{-6}}$ ✓

$= 10\ \Omega$✓ (2)

7.2 1 - Ground
2 – Trigger
3 – Output
4 – Reset
5 – Voltage control
6 – Threshold
7 – Discharge
8 – $^{++}V_{cc}$

(8 × 1) (8)
[10]

QUESTION 8: LIQUID CRYSTAL DISPLAY

8.1 8.1.1 Affordable, with quick response times but low in contrast ratios, viewing angles and colour contrasts.

8.1.2 Offers superior contrast ratios, viewing angles and colour contrast compared with twisted nematic LCD.

8.1.3 Considered a middle ground between twisted nematic and in-plane switching displays.

8.1.4 Outperforms IPS displays in the colour reproduction range.

(4 × 2) (8)

8.2
- Passive matrix
- Active matrix

(2)
[10]

TOTAL: 100

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