higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N6

5 APRIL 2018

This marking guideline consists of 7 pages.

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QUESTION 1: TRANSIENTS

1.1 1.1.1

$$I_M = \frac{V}{R} = \frac{50}{20} = 2.5\ A\checkmark$$

$$T = \frac{L}{R} = \frac{24 \times 10^{-3}}{20} = 1.2\ ms\checkmark$$

$$\therefore i = I_M\left[1 - e^{\frac{-t}{T}}\right]$$

$$= 2.5\left[1 - e^{\frac{-0.5\times10^{-3}}{1.2\times10^{-3}}}\right]\checkmark$$

$$= 0.852\ A\ or\ 852\ mA\checkmark$$ (4)

1.1.2

$$V_R = V_L$$

$$E_M\left[1 - e^{\frac{-t}{T}}\right] = E_M \times e^{\frac{-t}{T}}\ \checkmark$$

$$1 - e^{\frac{-t}{T}} = e^{\frac{-t}{T}}$$

$$1 = e^{\frac{-t}{T}} + e^{\frac{-t}{T}}$$

$$1 = 2e^{\frac{-t}{T}}\ \checkmark$$

$$0.5 = e^{\frac{-t}{T}}$$

$$ln0.5 = lne^{\frac{-t}{T}}\checkmark$$

$$-0.693 = \frac{-t}{T}\checkmark$$

$$\therefore t = 0.693 \times 1.2 \times 10^{-3}$$

$$= 831.777\ \ \mu s\checkmark$$ (5)

1.2 Passive Components

- Resistor
- Capacitor
- Inductor (3 × ½)

Active Components

- Transistor
- Diode
- I C's (3 × ½) (3)

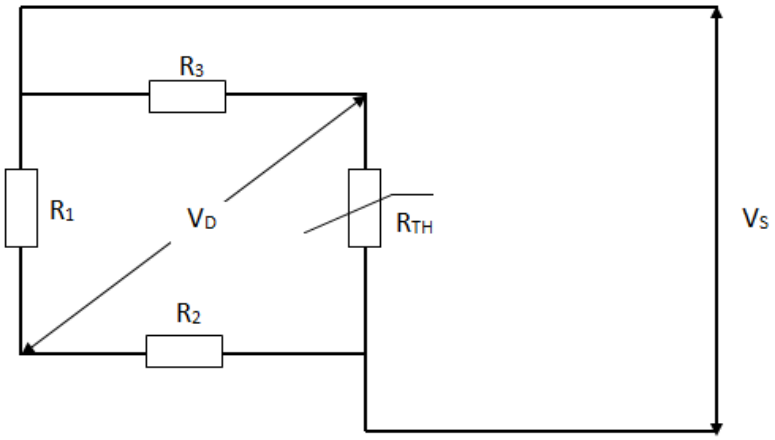
[12]

QUESTION 2: TRANSDUCERS

2.1 2.1.1
- Operational amplifiers
- Bridge network (2)

2.1.2
- Attenuation
- Linearisation
- Offsetting
- Impedance transformation
- Level transformation (5)

2.2



(Allocate half mark for each labelled circuit symbol) (3)
[10]

QUESTION 3: ULTRASONICS, X-RAYS AND RADIO ACTIVITY

3.1 3.1.1 False
3.1.2 True
3.1.3 True
3.1.4 False

(4 × 1) (4)

3.2
- The type of radiation
- The amount/dose of radiation absorbed
- The rate at which the dose was absorbed
- The radio-sensitivity of the tissues involved (4)

3.3 3.3.1 Amplification

$A = S^N = 2^4$ ✓

$= 16$ ✓ (2)

3.3.2 $Tube\ Sensintivity = Cathode\ Sensitivity \times A$
$= 10 \times 10^{-6} \times 16$ ✓
$= 160\mu\ A/lumen$ ✓ (2)

3.3.3 $$Max\ Safe\ illumination = \frac{I_{MAX}}{Tube\ Sensitivity}$$ ✓

$$= \frac{1 \times 10^{-3}}{160 \times 10^{-6}}$$ ✓

$$= 6.25\ lumen$$ ✓ (3)

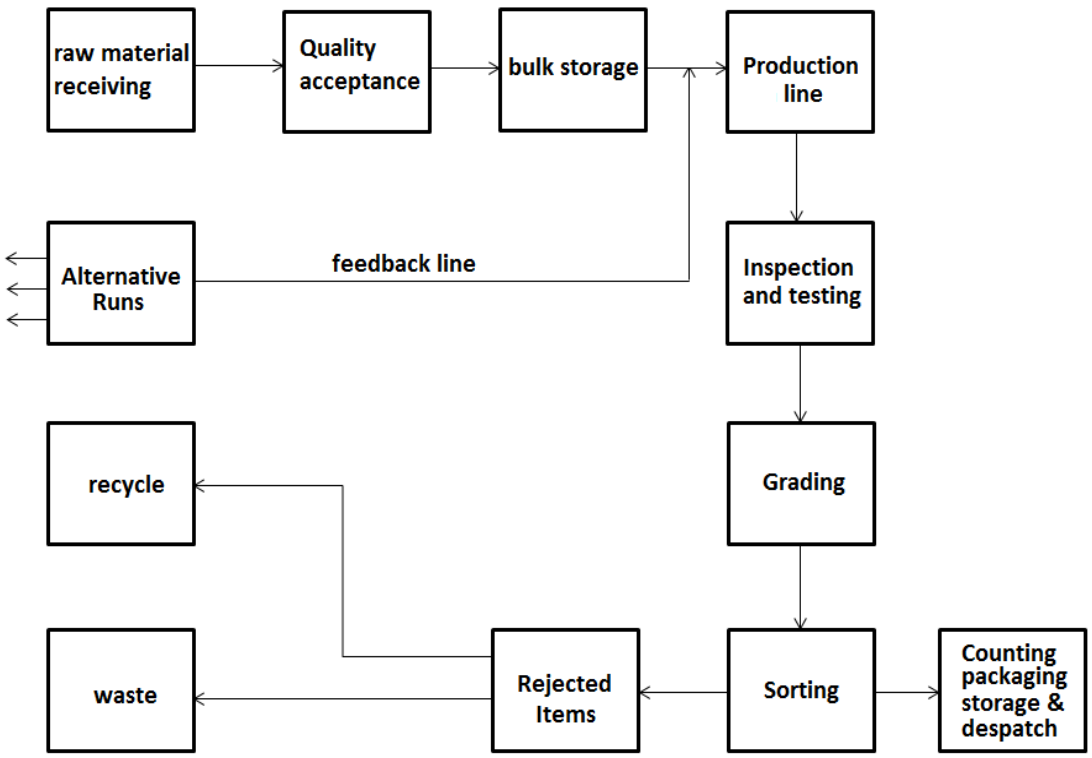
[15]

QUESTION 4: AUTOMATIC INSPECTION, TESTING AND NDT

4.1 If an operator detects a flaw in the object being tested, it is immediately marked and rejected as faulty (1)

4.2
- A permanent record is made of the flaw in a particular object
- A skilled operator can view a large batch of X-ray films in succession
- There is less danger of exposure to X radiation to the operator (3)

4.3



(Allocate half mark for each correctly labelled block) (6)

[10]

QUESTION 5: ELECTRONIC SAFETY DEVICES & ELECTRONIC POWER CONTROL

5.1

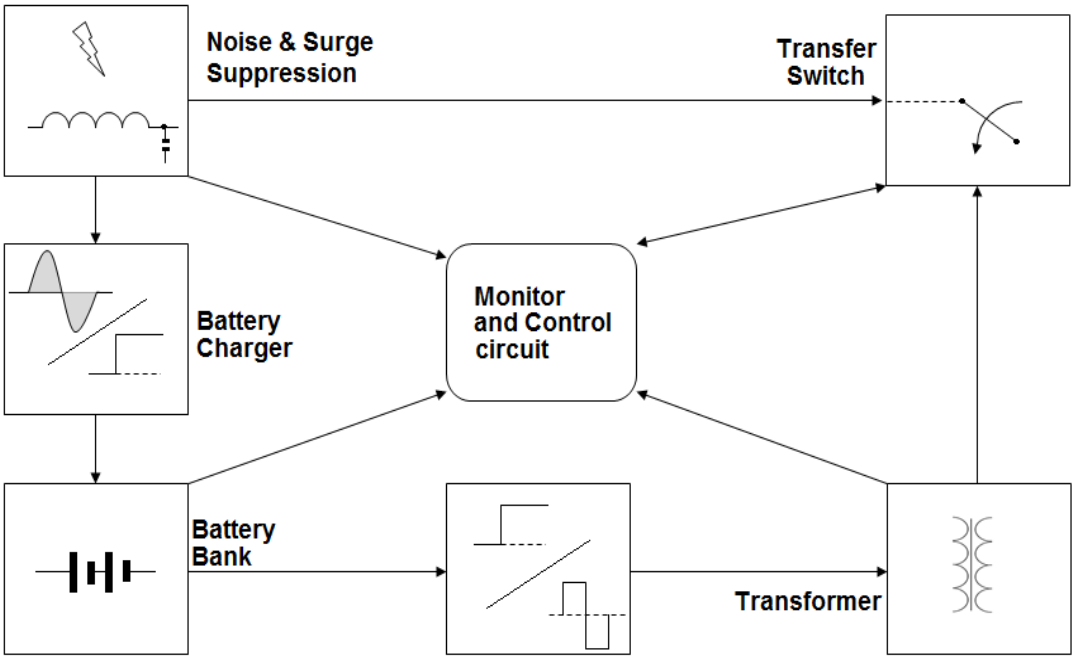
5.1.1 Hot electrode
5.1.2 Flame
5.1.3 Burner
5.1.4 R_1
5.1.5 R_1
5.1.6 FET
5.1.7 R_2
5.1.8 R_3
5.1.9 C_1
5.1.10 UJT
5.1.11 R_4
5.1.12 R_4
5.1.13 Relay
5.1.14 Press enable contacts
5.1.15 LASCR
5.1.16 Solenoid control

(16 × ½) (8)

5.2

- The bias on the source-follower FET controlled UJT will be reduced.
- The thyristor will be triggered, thus energizing the relay.
- Once the relay is energized, the burner enable contacts will be opened, thus ensuring no further arrival of the gas fuel. (3)

5.3



1 full mark for each correct label outside each block.
1 full mark for each correct block with the correct circuit symbol inside. (12)

[23]

QUESTION 6: THYRISTOR DEVICES AND SCR SPEED CONTROL

6.1 $P = \frac{T_1 - T_2}{R}$

$Total\ Thermal\ resistance = R_{TH1} + R_{TH2}$

$= 0.9 + 1.0$✓

$= 1.9\ ℃/W$✓

$Then\ P = \frac{T_1 - T_2}{R_{TH(TOT)}}$

$= \frac{125-20}{1.9}$✓

$= 55.264\ W$✓ (4)

6.2 $Z_{TH} = \frac{T_{RISE}}{T_{LOSS}}$

$\therefore T_{RISE} = Z_{TH} \times P_{LOSS}$

$= 0.03 \times 2000$

$= 60\ ℃$✓✓

$junction\ Temparature = T_a + T_{RISE}$✓

$= 40 + 60$

$= 100\ ℃$✓ (4)

6.3
- Series resonance
- Parallel resonance (2)

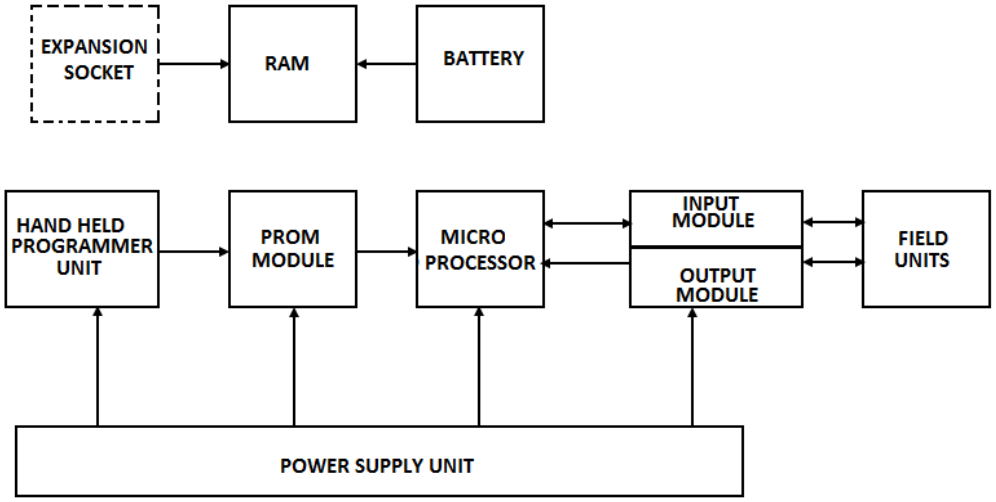
6.4
- Uncontrolled rectifiers
- Fully controlled rectifiers
- Half controlled rectifiers (3)

6.5
- Single phase input – single phase output
- Single phase bridge inverter (2)

[15]

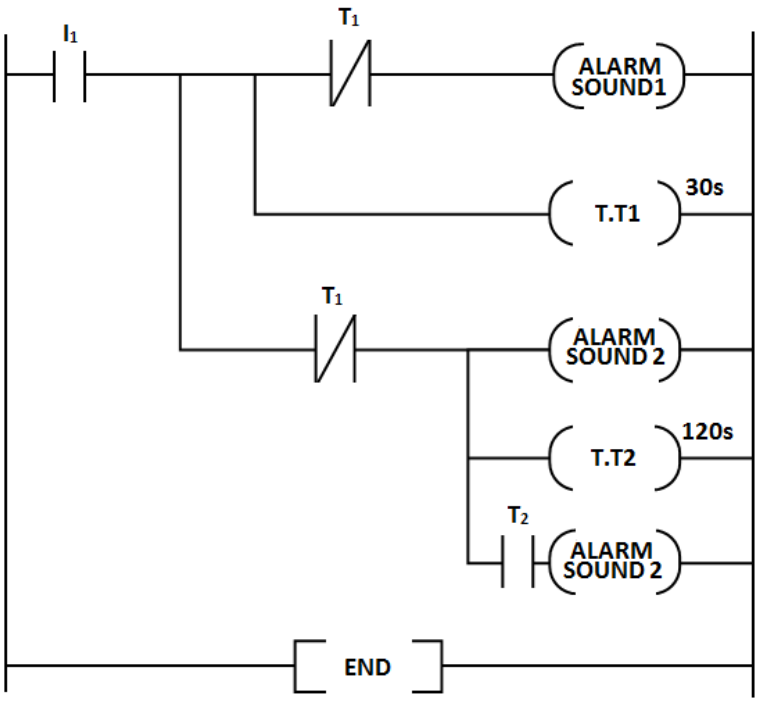
QUESTION 7: PROGRAMMABLE LOGIC CONTROLLERS

7.1



(Allocate half mark for each correctly labelled block) (5)

7.2



(Allocate 1 full mark for each correctly labelled circuit component) (10)
[15]

TOTAL: 100

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