higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N6

12 April 2021

This marking guideline consists of 6 pages.

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QUESTION 1

1.1 1.1.1 b-d: Charging cycle
d-h: Discharging cycle (2)

1.1.2 a: $+V_M$
c: $-V_M$
f: V_R
g: V_C (4 × ½) (2)

1.1.3 At points a-d V_R is decreasing exponentially from the maximum value to zero volts. At points b-e V_C is increasing exponentially from zero volts to the maximum value. (2)

1.2 Use critical damping:✓

$$\frac{1}{LC} = \frac{R^2}{4L^2}\checkmark$$

$$C = \frac{4L}{R^2}\checkmark$$

$$= \frac{4 \times 20 \times 10^{-3}}{(90)^2}\checkmark$$

$$= 9{,}876\ \mu F\checkmark$$ (5)

[11]

QUESTION 2

2.1 Step 1: $\Delta R = \Delta t \times R_{TH} \times \propto$
$= (100 - 20) \times 0{,}5 \times 10^3 \times 0{,}001\checkmark$
$= 40\ \Omega\checkmark$ (2)

Step 2: R_{TH} at 100 °C

$= \Delta R + \text{nominal resistance}\checkmark$
$= 40 + 0{,}5 \times 10^3\checkmark$
$= 540\ \Omega\checkmark$ (3)

Step 3: $V_D = V_S\left[\frac{R_1}{R_1 + R_2} - \frac{R_3}{R_3 + R_{TH}}\right]$

$$V_S = \frac{V_D}{\left[\frac{R_1}{R_1+R_2} - \frac{R_3}{R_3+R_{TH}}\right]}\checkmark$$

$$= \frac{57{,}7 \times 10^3}{\left[\frac{0{,}5\times10^3}{0{,}5\times10^3+0{,}5\times10^3} - \frac{0{,}5\times10^3}{0{,}5\times10^3+540}\right]}\checkmark\checkmark$$

$= 3\ \text{V}\checkmark$ (4)

2.2
- Input device
- Signal-conditioning device
- Output device (3)

[12]

QUESTION 3

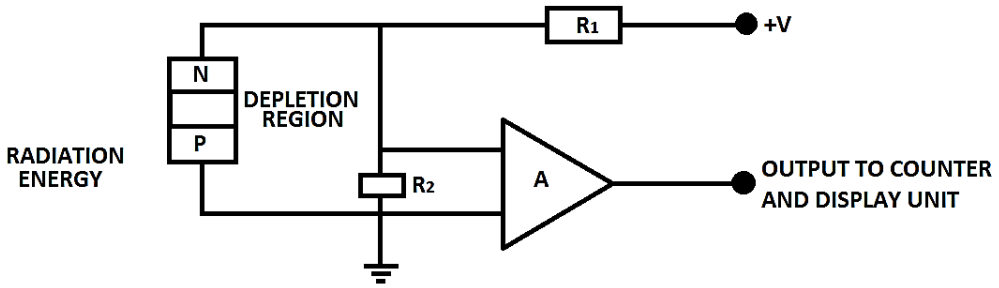
3.1
- Ultrasonic cleaning
- Ultrasonic machining
- Ultrasonic soldering
- Ultrasonic welding (4)

3.2
- Keeping the workpiece cool
- Washing away any burs that may form on the workpiece
- Eliminating any sparks that may exist
- Serving as a transport medium for the abrasive particles in the cutting fluid (4)

3.3
3.3.1 C
3.3.2 A
3.3.3 B
3.3.4 D

(4 × 1) (4)

3.4



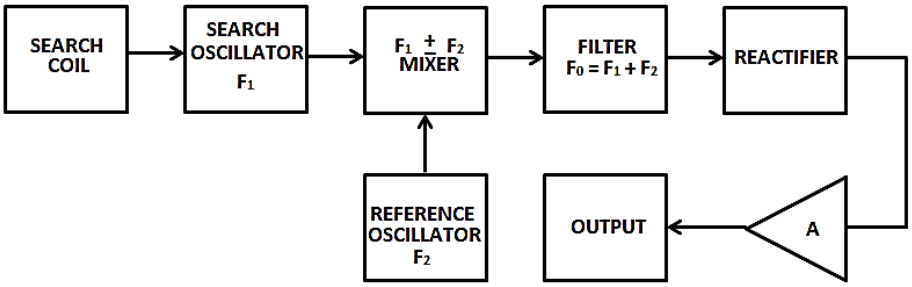
(1 for each label + ½ for each component) (6)

3.5
- Ionisation chamber
- Proportional counter
- Geiger-Muller counter (Any 2 × 1) (2)

[20]

QUESTION 4

4.1



(½ for each block) (4)

4.2 4.2.1 The search-coil oscillator frequency (f1) is initially tuned to the same frequency as the reference oscillator frequency (f2).✓ When no metal is detected, f1 and f2 are equal in magnitude,✓ thus the output signal from the mixer to the filter becomes zero✓ and therefore the warning system from the comparator output remains inactivated.✓ (4)

4.2.2 If metal enters the detection range of the search coil, the frequency of the search-coil oscillator (f1) changes.✓✓ The output from the mixer to the filter is now the difference between the search-coil oscillator frequency and the reference oscillator frequency.✓ This difference voltage signal is fed to the rectifier and amplified.✓ The amplified output signal is used to activate a warning system that will indicate that metal has been detected.✓ (5)

[13]

QUESTION 5

5.1 E
5.2 A
5.3 B
5.4 C
5.5 D

(5 × 2) **[10]**

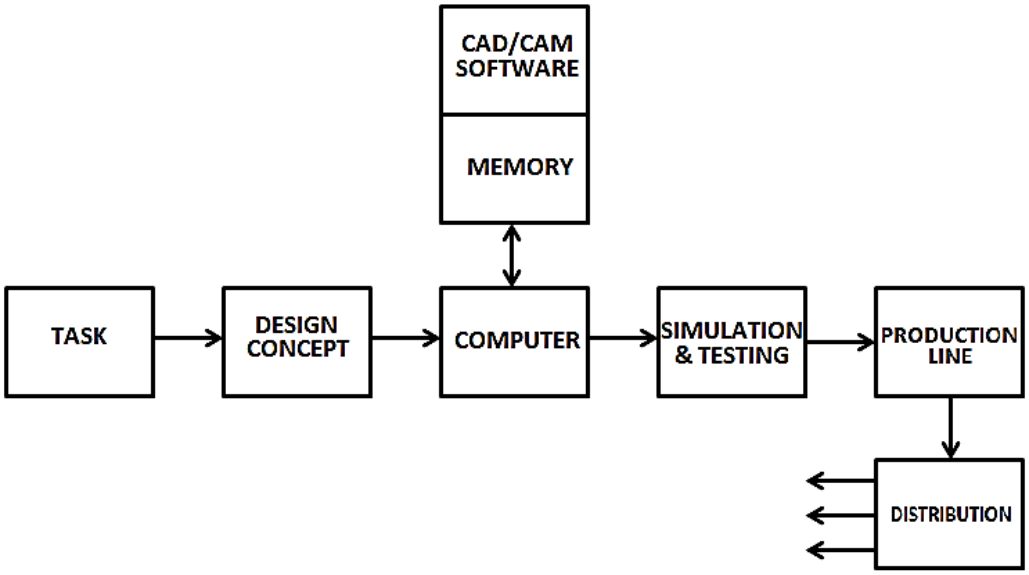
QUESTION 6

6.1 6.1.1
- Degree of closeness between the desired value and the measured value
- Speed of response/setting time
- Residual error/steady state error/offset (3)

6.1.2 (a) True
(b) True
(2 × 1) (2)

6.2 6.2.1 High gain
6.2.2 Low to medium gain
6.2.3 Low gain
(3 × 1) (3)

6.3



(½ for each block) (4)
[12]

QUESTION 7

7.1 7.1.1 False
7.1.2 False
7.1.3 False
(3 × 1) (3)

7.2 Total thermal resistance $= 1{,}8 + 2{,}0 = 3{,}8\ °C/W$✓✓

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

$$P = \frac{125 - 40}{3{,}8}$$✓

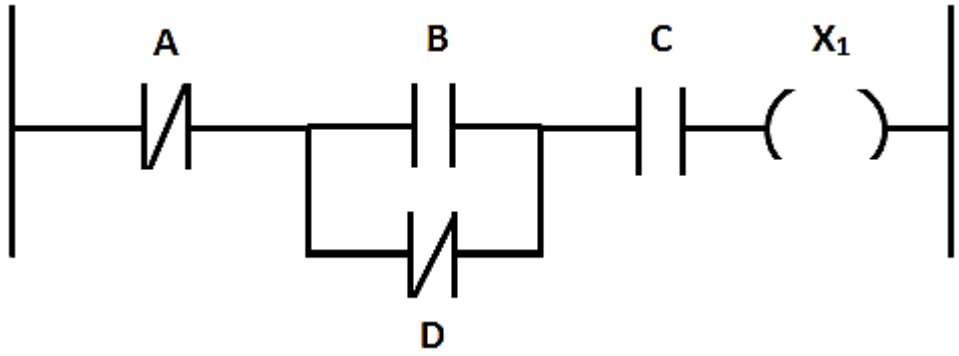
$$P = 22{,}37\ W$$✓ (4)

7.3
- Wide range of speed control possible
- Operate under constant or variable torque conditions
- Rapid acceleration, deceleration and reversing
- Open- or closed-loop operation
- Operate under regenerative conditions (5)

[12]

QUESTION 8: PROGRAMMABLE LOGIC CONTROLLERS

8.1



(1 for each symbol + 1 for each rung) (7)

8.2
- Programmer
- Programmable controller
- Expansion units (3)

[10]

TOTAL: 100

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