higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE

INDUSTRIAL ELECTRONICS N6

31 JULY 2018

This marking guideline consists of 6 pages.

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QUESTION 1: TRANSIENTS

1.1 1.1.1 Zero volts:✓✓ The capacitor is initially uncharged and the circuit is open therefore all voltage drops in the circuit will be zero. (2)

1.1.2 At switch on $V_{C1} = V_{R3}$✓ because the capacitor is connected in parallel to R_3 in the circuit. (1)

1.1.3 $V_{C1} = V_{R3} = \frac{R_3}{R_1+R_2+R_3} \times V_T$✓✓

$= \frac{4,5\times10^3}{1,5\times10^3+3\times10^3+4,5\times10^3} \times 9$✓

$= 4,5\ V$✓ (4)

1.2 Damping refers to a reduction in the amplitude of an oscillation✓ as a result of energy being drained from a system✓ to overcome resistive forces.

- Critical damping
- Under-damping
- Over-damping (2 + 3) (5)

[12]

QUESTION 2: TRANSDUCERS

2.1
- Transducers
- Signal conditions
- Visual display units
- Graphic recording instruments
- Computer systems (Any 3 × 1) (3)

2.2 2.2.1 $°C_{MAX} = \frac{V_{i(MAX)}}{V/C}$

$°C_{MAX} = V_{i(MAX)} \div \frac{V}{°C}$✓

$V_{i(MAX)} = °C_{MAX} \times V/°C$

$= 500 \times \frac{10\times10^{-3}}{10} = 0,5\ V$✓✓

$\therefore R_F = R_M \times \frac{V_O}{V_L}$✓

$= 10 \times 10^3 \times \frac{5}{0,5} = 100\ k\Omega$✓✓ (6)

2.2.2 $V_O = V_i\left[1 + \frac{R_F}{R_M}\right]$

$R_F = R_M\left[\frac{V_O}{V_I} - 1\right]$✓

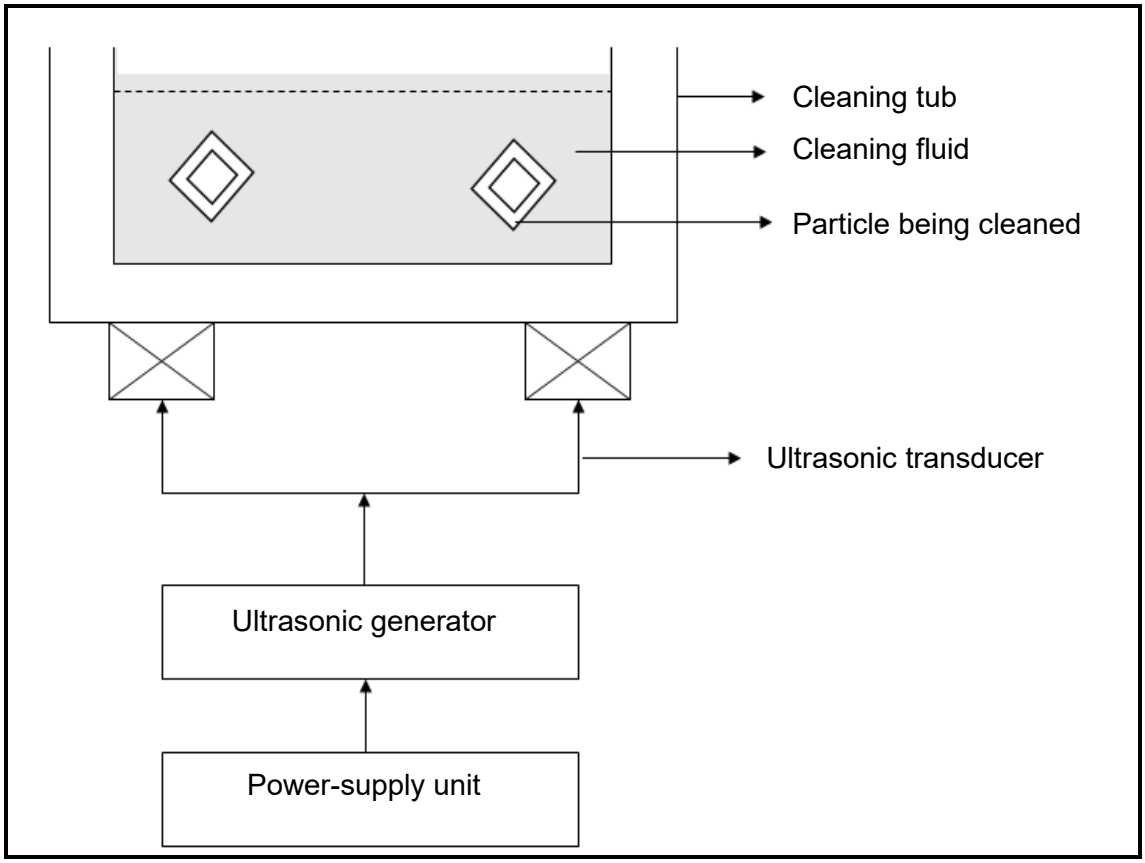
$= 10 \times 10^3\left[\frac{5}{0,5} - 1\right]$✓

$= 90\ k\Omega$✓ (3)

[12]

QUESTION 3: ULTRASONICS

3.1



(One mark for each labelled block) (6)

3.2 3.2.1 Nonexistent
3.2.2 Poor
3.2.3 Good
3.2.4 Excellent

(4 × 1) (4)

[10]

QUESTION 4: X-RAYS AND RADIO ACTIVITY

4.1
- Gamma rays
- Hard and soft X-rays
- Ultraviolet radiation rays
- Visible light rays
- Infrared radiation rays
- Microwaves
- Radio waves (7)

4.2 h = Planck's constant
c = velocity of light
E = applied voltage
Q = electron charge (4)
[11]

QUESTION 5: AUTOMATIC TESTING AND NDT

5.1 5.1.1 $V = \frac{2 \times d}{t}$✓

$= \frac{2 \times 1\,080 \times 10^{-3}}{552 \times 10^{-6}}$✓

$= 3{,}913 \times 10^{3}\ m/s$✓ (3)

5.1.2 $F = \frac{1}{t} = \frac{1}{552 \times 10^{-6}} = 1{,}812\ kHz$✓✓ (2)

5.1.3 $d = \frac{V \times t}{2}$

$d = \frac{3{,}913 \times 10^{3} \times 0{,}42 \times 10^{-3}}{2}$✓

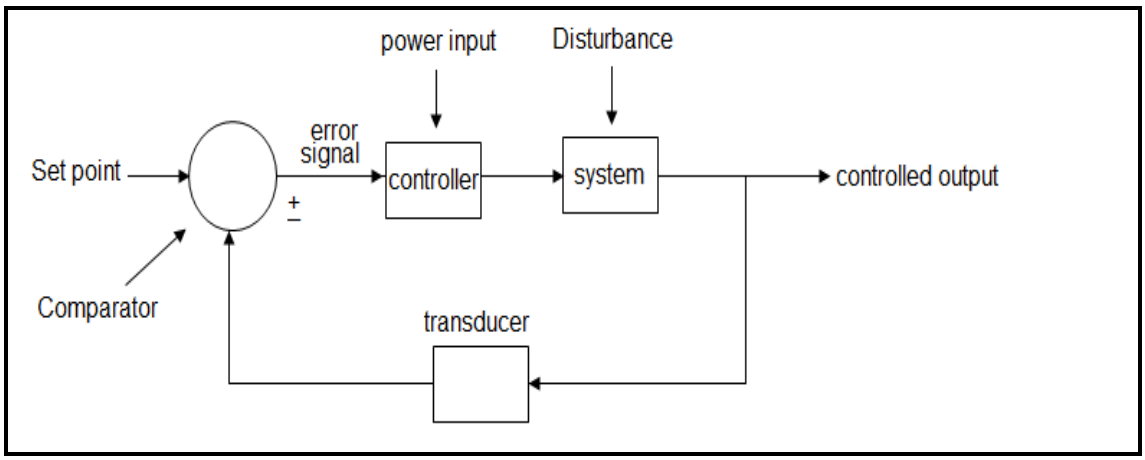
$= 821{,}73\ mm$✓ (2)

5.2
- Mining industry
- Processed-foods industry
- Timber-manufacturing industry
- Military
- Security industry
- Private enterprise (6)
[13]

QUESTION 6: ELECTRONIC POWER CONTROL

6.1 Closed-loop control system (1)

6.2



(One mark for each label) (9)
[10]

QUESTION 7: ELECTRONIC SAFETY DEVICES

7.1
7.1.1 Force
7.1.2 Punch
7.1.3 Mirror
7.1.4 Medium
7.1.5 Workbench
7.1.6 Workpiece
7.1.7 Foot control
7.1.8 Light
7.1.9 R1
7.1.10 Capacitor
7.1.11 LASCR
7.1.12 R2
7.1.13 Press enabler
7.1.14 Relay

(14 × ½) (7)

7.2 In the absence of any unwanted object on the path of the punch✓ the light beam from the source will fall onto the photoconductive cell.✓ The resistance of the photoconductive cell will be lowered,✓ thus enabling sufficient current to flow through the relay coil.✓ This current flow will ensure that the relay contacts remain in the closed position,✓ thus allowing the operator to operate the press by means of pulling the lever of the punch up or down.✓

(Any 5 × 1) (5)
[12]

QUESTION 8: THYRISTOR DEVICES AND SCR SPEED CONTROL

8.1 $V_{MEAN} = \frac{3\sqrt{2}}{\pi} V_{LINE} \times \cos \propto$ ✓

$\cos \propto = \frac{\pi V_{MEAN}}{3\sqrt{2}\, V_{LINE}}$ ✓

$= \frac{\pi \times 200}{3\sqrt{2} \times 158}$ ✓

$= 0{,}937$ ✓

$\therefore \alpha = \cos^{-1}(0{,}937)$

$= 20{,}394°$ ✓ (5)

8.2 Starting current $I_{50A} = \frac{V_{MEAN}}{R}$ ✓

$\therefore V_{\underset{(NEW)}{MEAN}} = I_{50A} \times R$ ✓

$= 50 \times 0{,}29 = 14{,}5\ V$ ✓

Then:

$V_{\underset{(NEW)}{MEAN}} = \frac{3\sqrt{2}}{\pi} V_{LINE} \times \cos \propto_{new}$ ✓

$\cos \propto_{new} = \frac{\pi V_{MEAN}}{3\sqrt{2}\, V_{LINE}}$ ✓

$= \frac{\pi \times 14{,}5}{3\sqrt{2} \times 158}$ ✓

$= 0{,}0679$ ✓

$\therefore \propto_{new} = \cos^{-1}(0{,}0679)$ ✓

$= 86{,}103°$ ✓ (9)

[14]

QUESTION 9: PROGRAMMABLE LOGIC CONTROLLERS

9.1 The individual wiring together of relays and contactors to solve typical problems

9.2 The process of developing a specific program to replace the functions of individually wired relays and contactors to solve a problem

9.3 The process whereby the reliable operation of the CPU is ensured through the performing of a self-test of its internal operation by a built-in circuit

(3 × 2) **[6]**

TOTAL: 100

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