higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

# NATIONAL CERTIFICATE (VOCATIONAL)

## MECHATRONIC SYSTEMS
### NQF LEVEL 4

(6040334)

**22 November 2018 (Y-Paper)**
**13:00–16:00**

**This question paper consists of 6 pages.**

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**TIME: 3 HOURS**
**MARKS: 100**

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**INSTRUCTIONS AND INFORMATION**

1. Answer ALL the questions.
2. Read ALL the questions carefully.
3. Number the answers according to the numbering system used in this question paper.
4. Write neatly and legibly.

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## QUESTION 1

1.1 Explain what you understand a *design specification* to be. (5 × 1) (5)

1.2 Give FIVE headings that one will use when writing a design specification. (5 × 1) (5)

**[10]**

## QUESTION 2

2.1 Two charts are used when planning the design process of any mechatronic system.

2.1.1 Name the TWO charts. (2)

2.1.2 Give a brief explanation of each. (2 × 2) (4)

2.2 As a mechatronic person, you will have to plan different projects, which will influence your workflow.

Draw a flow diagram that will allow fellow colleagues to better understand the workflow of the construction of a pneumatic stamping machine that needs to be installed in the workshop. (12 × 1) (12)

2.3 Explain why technical drawings are important for a mechatronic system. (2)

2.4 Explain why approval must be obtained before drawing up technical drawings. (2)

2.5 Name THREE technical drawings do one need to develop a mechatronic system? (3)

**[25]**

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## QUESTION 3

3.1 FIGURE 1 shows a PLC system, which manufactures plastic gears. The injectors are pneumatic, and the die assembly is hydraulic.

The system is activated with a start button. The system is initialised with the injector retracted and the die assembly closed. The injector heater (element) is switched on and the granules melt when the required temperature is reached.

The injector is then extended, and the hot melted granules is forced under pressure into the die assembly. The heater is switched off after 20 seconds and the injector retracts. The die assembly then opens and allows the gears to fall into the chute. The die assembly then closes and the whole process is repeated.

The system will sound an alarm if the process is halted. The feeder must be refilled before the system restarts.

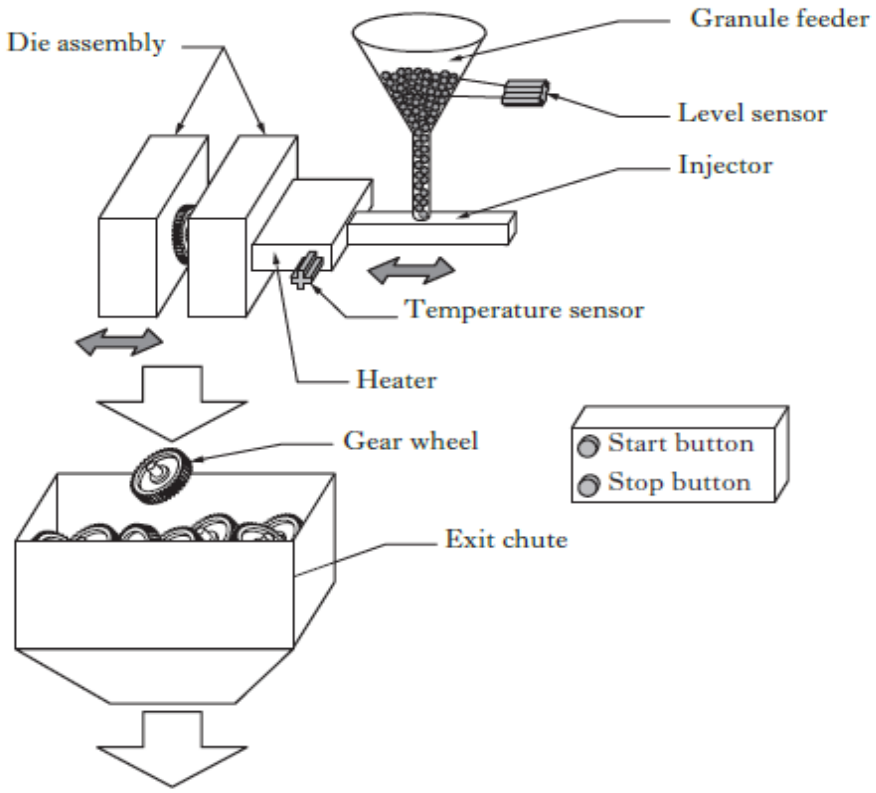


**FIGURE 1**

3.1.1 Design a function block PLC program that will control the system in FIGURE 1. (18 × ½) (9)

3.1.2 Design a ladder PLC program that will control the system in FIGURE 1. (24 × ½) (12)

3.1.3 Redraw the table below in the ANSWER BOOK and complete it by indicating all the outputs used in this device.

| OUTPUT | DESCRIPTION |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |

(6 × 1) (6)

3.2 Explain why it is necessary to produce an evaluation checklist when assembling a mechatronic system. (3 × 1) (3)

**[30]**

**QUESTION 4**

4.1 Explain why adjustment control is important in the commissioning of a mechatronic system. (2 × 2) (4)

4.2 Briefly explain what you understand by *retro-commissioning.* (4 × 1) (4)

4.3 During the commissioning process a system error had occurred. You are tasked to investigate the cause of the system error.

Describe the possible causes of the system error. (7)

**[15]**

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## QUESTION 5

5.1 Safety should always be a prime concern for maintenance personnel. The safety manual should contain information that is important for the owner/operator to know and understand.

Give SIX guidelines that one would find in a safety manual. (6)

5.2 The industrial environment varies from one company to another, so does the air pollution.

Explain the effects of air pollution. (4 × 1) (4)

5.3 Troubleshooting using a chart approach is a method that is used extensively in industry.

Complete the chart provided with reference to indication lamps.

Write only the answer next to the question number (5.3.1–5.3.7) in the ANSWER BOOK.

| LAMPS | | |
|---|---|---|
| **SYMPTOM** | **CAUSE** | **REMEDY** |
| LAMP NOT BURNING | 1. Lamp loose | 5.3.1 |
| | 2. Loose terminals | 5.3.2 |
| | 3. Broken connection | 5.3.3 |
| LAMP BURNS DIM | 5.3.4 | 1. Match lamp rating to line voltage |
| | | 2. Increase line voltage |
| SHORT LAMP LIFE | 1. High voltage<br>2. Mechanical damage<br>3. Excessive vibrations | 5.3.5<br>5.3.6<br>5.3.7 |

(7)

5.4 A PLC program is used to monitor conditions of production processes for failure.

Explain how this can be achieved. (3)

**[20]**

**TOTAL: 100**

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