higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

COMPUTER-INTEGRATED MANUFACTURING
NQF LEVEL 4

(6030324)

15 November 2022 (X-paper)
09:00–12:00

This question paper consists of 5 pages and 2 information sheets

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TIME: 3 HOURS
MARKS: 100

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. Start each section on a new page.
5. Use only a black or blue pen.
6. Write neatly and legibly.

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QUESTION 1

1.1 Identify the FOUR functions that can be carried out by the CIM factory of the future. (4)

1.2 Draw a CIM system block diagram that represents the following subsystems: 2 × machine tools, 1 × industrial robot and a linear transfer bed. (5)

1.3 Draw the system diagram of a CNC machine tool with a feedback loop control. (6)

[15]

QUESTION 2

2.1 Explain the following terms:

2.1.1 G-code

2.1.2 M-code

(2 × 2) (4)

2.2 Explain the FOUR components that make up a program line. (4)

2.3 The NC program is a set of written English instructions given in the order they are to be executed.

Write down the basic format that you will follow to write an NC program. (8)

2.4 Study FIGURE 1 below. Design the NC program so as to meet the outcome of the technical drawing specifications.

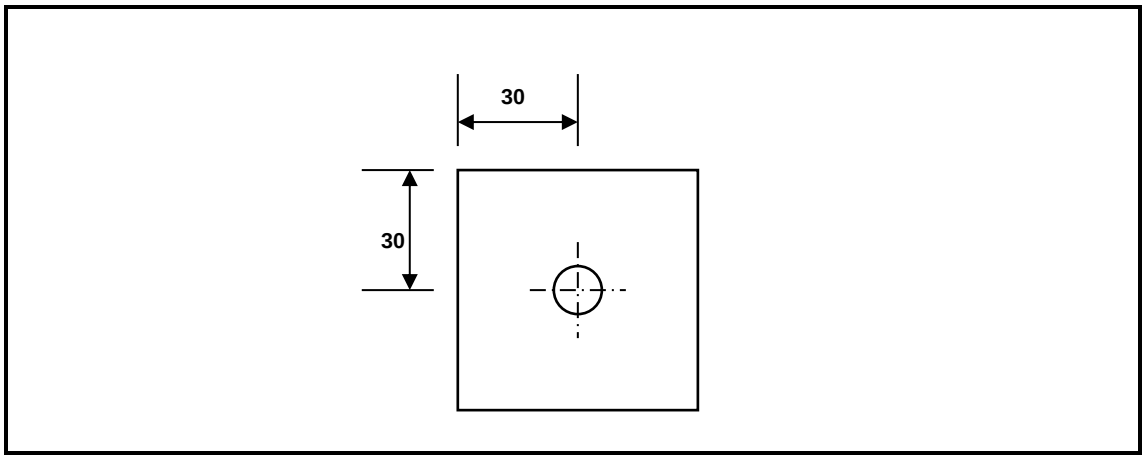


FIGURE 1 (8)

2.5 Identify the SIX design safety protocols you would consider when designing a CNC machine tool. (6)

[30]

QUESTION 3

3.1 Explain the SIX safety considerations that must be considered when working on an industrial robot. (6)

3.2 Explain what is meant by *the dead man's switch.* (1 × 2) (2)

3.3 Explain the function of the HMI unit found on an industrial robot system. (2)

3.4 Study the tool path given in FIGURE 2. Write an industrial robot program to meet the outcomes of the tool path.

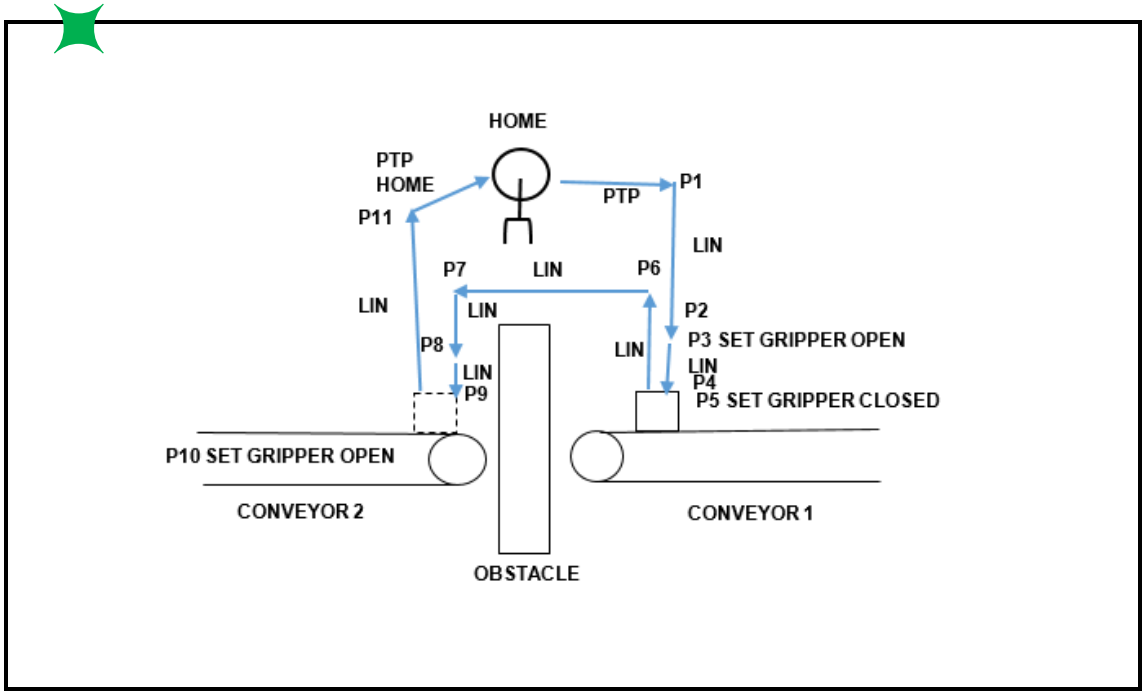


FIGURE 2 (14)

3.5 Explain the function of the manipulator with respect to the end effector. (1 × 2) (2)

3.6 Explain the difference between *event-based control* and *time-based control*. (2 × 2) (4)

[30]

QUESTION 4

4.1 Explain how manufacturing quality is improved in the factory of the future. (3 × 2) (6)

4.2 What are the quality-related tasks that must be done by human intervention? (3)

4.3 What chart would you use to monitor quality? (1)

[10]

QUESTION 5

5.1 Answer the following CAD/CAM-related questions:

5.1.1 What is the output of a CAD system?

5.1.2 What is the output of a CAM system?

5.1.3 Name ONE CAD/CAM application software available.

(3 × 1) (3)

5.2 Draw a block diagram of a CAD/CAM/FMS-distributed control system showing data flow including an automated conveyor belt, industrial robot and a CNC machine tool. (10)

5.3 Write down TWO advantages of using a CAD/CAM system in the factory of the future. (2)

[15]

TOTAL: 100

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INFORMATION SHEETS

G- Codes	
Code	**Function**
G00	Rapid positioning, point-to-point, high rate
G01	Linear interpolation, controlled feed rate
G02	Circular interpolation CW
G03	Circular interpolation CCW
G04	Dwell for program duration
G17	XY plane select (milling)
G18	XZ plane select (milling)
G19	YZ plane select (milling)
G24	Radius programming (lathe)
G28	Return to reference point
G29	Return from reference point
G32	Thread cutting (lathe)
G40	Cutter compensation cancel
G41	Cutter compensation left
G42	Cutter compensation right
G70	Inch units
G71	Metric units
G90	Absolute dimension
G91	Incremental dimension
G94	Feed rate (inches per minute)
G95	Feed rate (inches per revolution)

M-Codes	
Code	**Function**
M00	Program stop
M01	Optional stop
M02	End of program
M03	Spindle on CW
M04	Spindle on CCW
M05	Spindle off
M06	Tool change
M07	Mist coolant off
M08	Flood coolant on
M09	Coolant off
M19	Orient spindle
M30	End of program, reset program

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IR PSUEDO CODE	
ADDRESS	**DESCRIPTION OF THE (IR) PROGRAMMING CODE**
INI_'NAME'	**Program start followed by the program name**
;	**Non-action: semi-colon followed by a comment**
P1- Pn	**The numbering of the programming points**
HOME	**The HOME position of the industrial robot manipulator**
PTP	**Undefined motion (air movement)**
LIN	**Linear motion (straight line movement)**
CIRC	**Circular motion (curve/radius line movement)**
CONT	**Continuous motion around a programmed point**
WAITFOR_T	**Wait for a time delay to elapse**
WAITFOR_I	**Wait for input from PLC**
SEND_O	**Send output to PLC**
GRIPPER_O	**Open the gripper**
GRIPPER_C	**Close the gripper**
SUCTION_ON	**Suction ON**
SUCTION_OFF	**Suction OFF**

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