higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

COMPUTER INTEGRATED MANUFACTURING
NQF LEVEL 4

(6030324)

24 November 2023 (X-paper)
09:00–12:00

This question paper consists of 6 pages and an information sheet of 2 pages.

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DEPARTMENT OF HIGHER EDUCATION AND TRAINING
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)
COMPUTER INTEGRATED MANUFACTURING
NQF LEVEL 4
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. Use only a black or blue pen.
5. All drawings must be neat and drawn to IEC standards.
6. Write neatly and legibly.

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QUESTION 1

1.1 Explain the relationship between the industrial robot *flange* and *end effector.* (2 × 2) (4)

1.2 Show by means of a block diagram how and automated conveyor belt, an industrial robot and two CNC machines are connected for distributed control in a work cell. (7 × 1) (7)

1.3 Draw a block diagram of the three sub systems that make up a CNC machine tool. (3 × 1) (3)

1.4 What is the main function of an industrial robot manipulator? (1)

[15]

QUESTION 2

2.1 Explain what is meant by the following programming terms:

2.1.1 Miscellaneous codes

2.1.2 Technology codes

2.1.3 Preparatory codes

(3 × 2) (6)

2.2 Why is it necessary to determine a tool path with coordinates when doing CNC part programming? (3 × 1) (3)

2.3 Using drawings to show the difference between using *G90* and *G91* codes in a CNC program. (2 × 3) (6)

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2.4 Study FIGURE 1 below (not to scale) and answer the questions that follow.

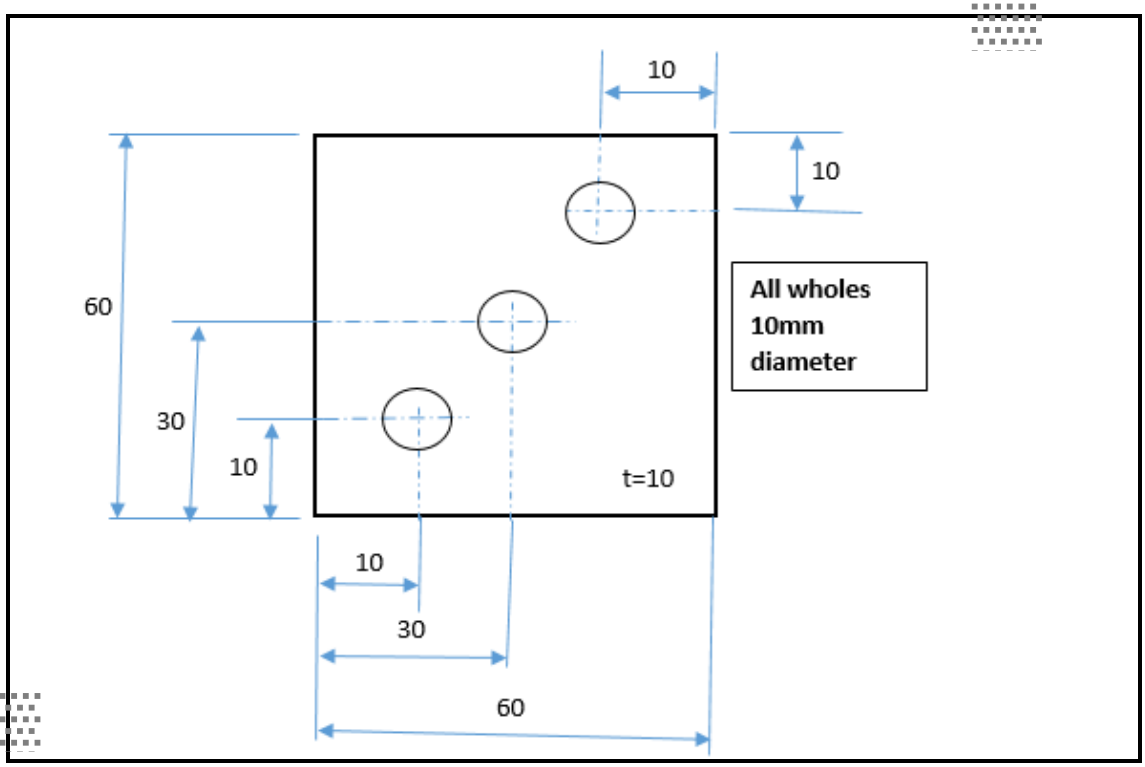


FIGURE 1

2.4.1 Redraw the work piece shown in FIGURE 1.

Determine the tool path from the work piece zero (0:0). (4 × 1) (4)

2.4.2 Redraw the work piece shown in FIGURE 1.

Draw the tool path showing the coordinates determined in QUESTION 2.4.1. (4 × 1) (4)

2.4.3 Write a basic test program to check the operation of a coolant water pump that has just been replaced. (7 × 1) (7)

[30]

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QUESTION 3

3.1 Answer the following questions on industrial robots.

3.1.1 What is an industrial robot with six axes called? (1 × 2) (2)

3.1.2 What is meant by the term *teach-in*? (1 × 2) (2)

3.1.3 What is meant by the term *degrees of axis*? (1 × 2) (2)

3.1.4 What motion command is used when air programming? (1 × 2) (2)

3.1.5 What command would one use to instruct the robot not to stop at a programmed point but to go around it? (1 × 2) (2)

3.2 Explain the relationship between *jogging* and the *dead-man's switch*. (2 × 2) (4)

3.3 Study FIGURE 2 below and draw the tool path showing the motion commands that one would use to move the work piece over an obstacle. (12)

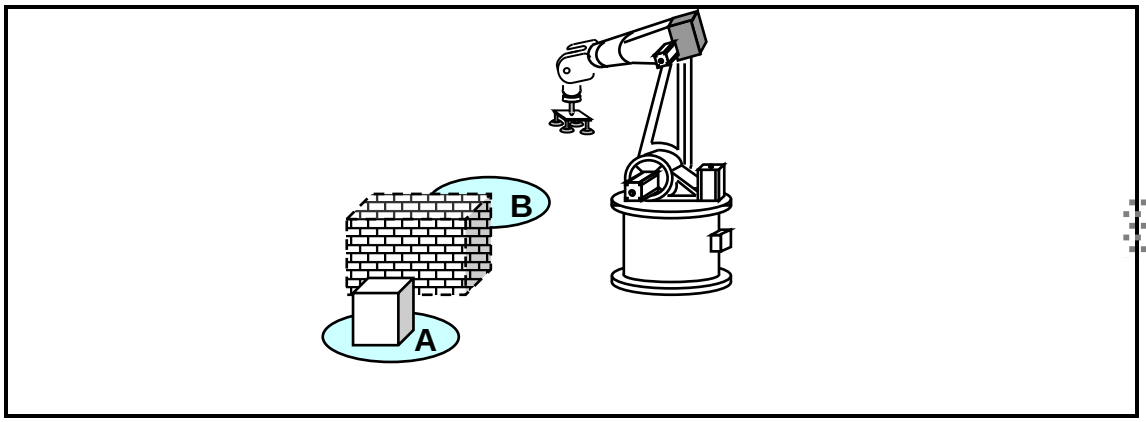


FIGURE 2

3.4 Draw the top view and side view of the work area of the robot shown in FIGURE 3 below. (2 × 2) (4)

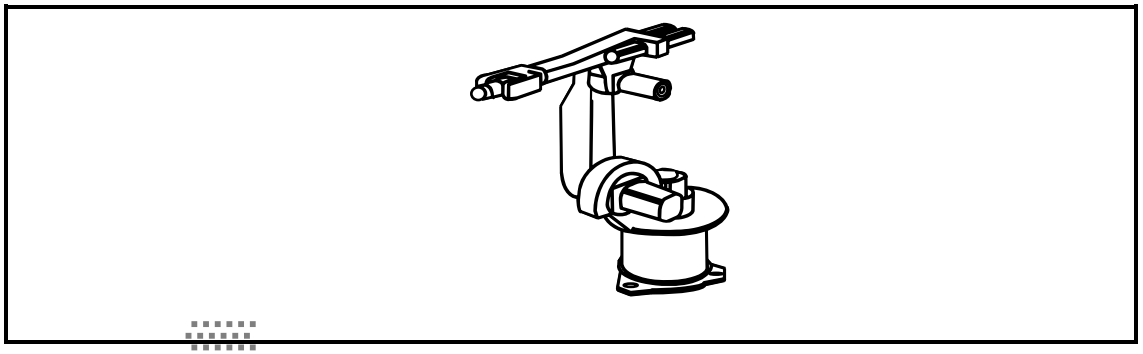


FIGURE 3

[30]

QUESTION 4

4.1	Records should be kept about assembly operations and the components used. For what purposes are the records necessary?	(5 × 1)	(5)
4.2	What are the results of improved quality for a manufacturing concern?	(3 × 1)	(3)
4.3	Explain what the following acronyms mean.		
	4.3.1 QC		
	4.3.2 QA	(2 × 1)	(2)
			[10]

QUESTION 5

5.1	Explain the output of a CAD system.	(1 × 2)	(2)
5.2	What are THREE geometric model types that can be produced in CAD/CAM application software?		(3)
5.3	Name THREE CAD/CAM application software packages.		(3)
5.4	Draw a block diagram of a CAD/CAM system.	(7 × 1)	(7)
			[15]
		TOTAL:	**100**

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INFORMATION SHEET

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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Table 1.1	
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

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