higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

NATIONAL CERTIFICATE (VOCATIONAL)

COMPUTER INTEGRATED MANUFACTURING
NQF LEVEL 4

(6030324)

8 March 2018 (Y-Paper)
13:00–16:00

This question paper consists of 7 pages and ONE information sheet of 2 pages.

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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. Subsections of questions must be kept together.
5. Write neatly and legibly.

NCV

QUESTION 1

1.1 A robot system is a general purpose, programmable machine processing certain anthropomorphic characteristics enabling it to perform various industrial tasks.

Give THREE other attributes of the industrial robot system that makes it a versatile system. (3)

1.2 Robots are classified by their degree of freedom and their physical configurations.

Draw a basic configuration in the form of the work envelope for each of the following:

1.2.1 Cartesian configuration

1.2.2 Cylindrical configuration

1.2.3 Revolute configuration

(3 × 2) (6)

1.3 List the THREE additional degrees of freedom which resemble the human arm and wrist. (3)

1.4 Explain the action of each movement named in QUESTION 1.3. (3)
[15]

QUESTION 2

2.1 Demonstrate your understanding of each of the following listed preparatory G codes by using basic drawings:

2.1.1 G00

2.1.2 G01

2.1.3 G02

(3 × 2) (6)

2.2 Demonstrate your understanding of each of the following listed miscellaneous M codes by using basic drawings:

2.2.1 M03

2.2.2 M08

(2 × 2) (4)

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2.3 State the FOUR steps representing the steps to follow from the drawing to the workpiece when planning for a CNC programming task. (4)

2.4 Write one block of information made up of FIVE words having the following:

- Sequence number
- Preparatory function
- Dimension X
- Dimension Z
- Miscellaneous function

(5 × 1) (5)

2.5 For which type of CNC machine has this block of code been written? (1)

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2.6 Redraw the TABLE in the ANSWER BOOK and complete the coordinates 1 to10 in the table by studying FIGURE 1.

TABLE	
Point #	**Coordinates**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

TABLE

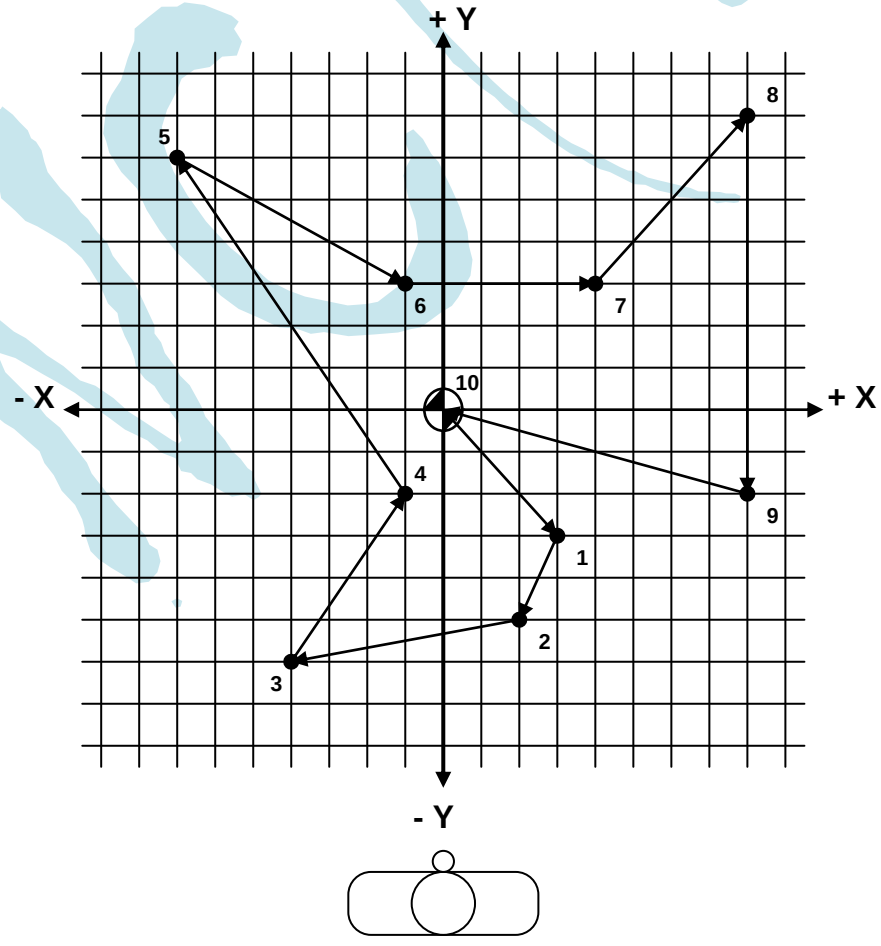


FIGURE 1

(10 × 1) (10)
[30]

QUESTION 3

3.1 Name the THREE parts of an industrial robot system. (3)

3.2 Explain the function of the THREE parts named in QUESTION 3.1. (6)

3.3 State FIVE operations that can be performed by the teach pendant of an industrial robot system. (5)

3.4 You have been informed by the workshop manager that one of the welding functions is going to be done by three industrial robots. The welding operation requires that one robot transfers a relatively small workpiece to a welding table where it will be clamped. The second robot brings a gusset to the workpiece and the third robot welds the gusset in place. The table unclamps the workpiece and the first robot then retrieves the completed workpiece, places it on a conveyor and then fetches a new piece to be welded.

State the safety aspects that must be followed to protect the operator, the service person and passers-by from injury. (8 × 1) (8)

3.5 Study FIGURE 2 and write an industrial robot program in pseudocode to put glue on a car door panel.

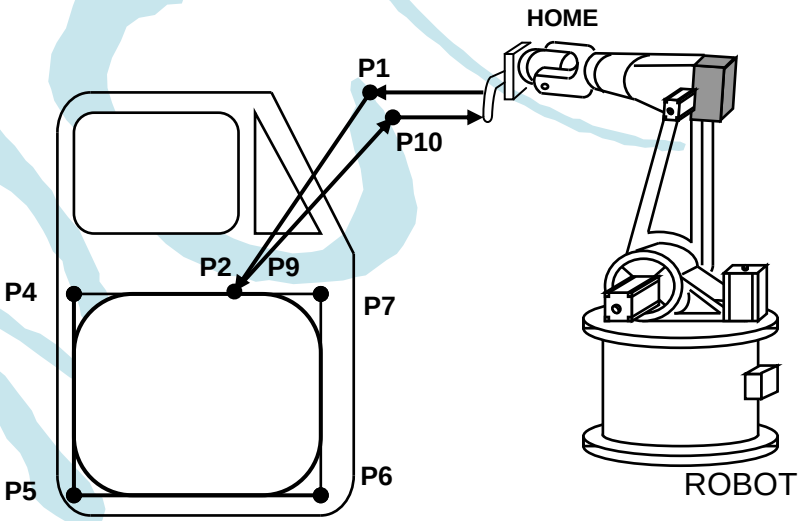


FIGURE 2 (8)

[30]

QUESTION 4

4.1 Explain why it is necessary to perform control code modifications. (2)

4.2 List THREE reasons why an application program must be modified on a CNC machine. (3)

4.3 Explain what quality control steps you would take to prevent empty tooth paste boxes from arriving at a customer. (5)
[10]

QUESTION 5

5.1 Modern CNC computer-based systems enable concurrent engineering design part-programming and operation in the CAD/CAM application software.

Draw a block diagram that represents the CAD/CAM integration process.
(10 × 1) (10)

5.2 Give FIVE technologies that can be found in CAD/CAM applications. (5)
[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**
M39	**Rotate tool turret**
M80	**Automatic door open**
M81	**Automatic door close**
M82	**Tool unclamp**
M86	**Tool clamp**

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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**
SIGNAL_IN	**Wait for input from PLC**
SIGNAL_OUT	**Send output to PLC**
GRIPPER_O	**Open the gripper**
GRIPPER_C	**Close the gripper**
SUCTION_ON	**Turn on suction gripper**
SUCTION_OFF	**Turn off suction gripper**
SPOT_ON	**Close and turn on spot welder**
SPOT_OFF	**Open and turn off spot welder**
DELAY_ON	**Turn on an end effector after a certain time has elapsed**
DELAY_OFF	**Turn off an end effector after a certain time has elapsed**

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