UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 6 Examination in Engineering: November 2016

Module Number: ME 6303 **Module Name: Computer Aided Manufacturing**

[Three Hours]

[Answer **all questions**, each question carries ten marks]

Q1. a) List four Computer Aided Manufacturing tools and briefly describe them.

[2 Marks]

b) Describe the term "Distributed Numerical Control" (DNC), emphasizing the objectives of the DNC system.

[2Marks]

c) i) Specify the main categories and sub categories of the Encoders which are used in machine tools and briefly describe "usage of Encoders in machine tools".

ii) Describe how encoders are used to detect the direction of rotation.

[3 Marks]

d) A servo motor, amplifier and a hand held controller were provided to you. With the aid of neat sketches explain how you would connect all the items to build a motor controlling unit.

[3 marks]

Q2. a) Sate most appropriate conditions to apply Group Technology (GT).

[1 Mark]

b) With the aid of neat sketches describe the draw backs of Process Type Layout compared to Group Technology.

[3 Marks]

c) Describe the followings with neat sketches;

i) Single machine cell

ii) Group machine cell with manual handling

iii) Group machine cell with semi-integrated handling

iv) Flexible manufacturing cell

[2 Marks]

d) Suppose that four machines, 1, 2, 3 and 4 have been identified as belonging in a GT machine cell. An analysis of 50 parts processed on these machines has been summarized in the From-To chart in ***Table Q2***.

i) Giving all steps, determine a logical machine arrangement using Hollier method 2.

ii) If 50 parts enter at machine 3, 20 parts leave after processing at machine 1, and 30 parts leave after machine 4, draw the flow diagram for the machine cell.

[4 Marks]

Q3. a) What do you mean by "6-sided complete machining"?

[1 Mark]

b) Compare 5-axis machining with 3-axis machining.

[2 Marks]

Q3 is continued on page 02

c) Discuss the significance of tool path generation available in commercial CAM packages. [3 Marks]

d) Briefly explain appropriate Computer Aided Manufacturing Techniques for the mass production of the following products. Discuss the benefits and limitations of each of the technique proposed.

i) The molds used for plastic injection molding.
ii) The load cells used in force measuring applications.

[4 Marks]

Q4. a) Briefly describe "Numerical control part programming". [1 Mark]

b) What are the advantages of computer assisted part programming over manual part programming? [2 Marks]

c) Write a part program for milling and drilling operations to machine the part shown in ***Figure Q4***. You may refer to ***Table Q4*** for relevant G codes and M codes. All dimensions are in inches. Diameter of the hole to be drilled is one inch. [4 Marks]

d) i) Differentiate the capabilities and limitations of Contact Inspection Techniques vs Non-Contact Inspection Techniques.
ii) Briefly explain the importance and functions of a CMM? [3 Marks]

Q5. a) There are certain basic activities that must be carried out in a factory to convert raw materials in to finished products. State those basic activities. [1 Mark]

d) You are requested to manufacture the product shown in ***Figure Q5.*** using a 3axis milling machine.

i) Discuss the Jigs and Fixtures required for the process.
ii) List down the sequence of milling operations required.
ii) Describe the type of tools that you would use to perform each of the proposed milling operations. Sketch the basic geometry of the selected tools. [4 Marks]

c) i) Discuss the possibility of manufacturing the product mentioned in above ***Q5.d)*** using an additive manufacturing process. Clearly mention the additive manufacturing method that you propose. Use a sketch if necessary.
ii) List down the advantages and disadvantages of the proposed additive manufacturing method with compared to manufacturing the component by milling. [3 Marks]

d) Illustrate the steps to be followed to produce the part using the manufacturing method proposed under ***Q3.c)***. Point out the factors to be considered during the design stage. [2 Marks]

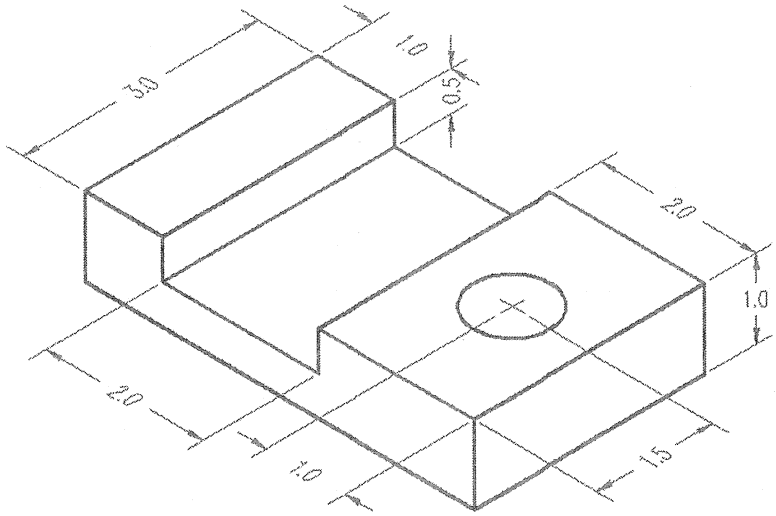

Figure Q4.

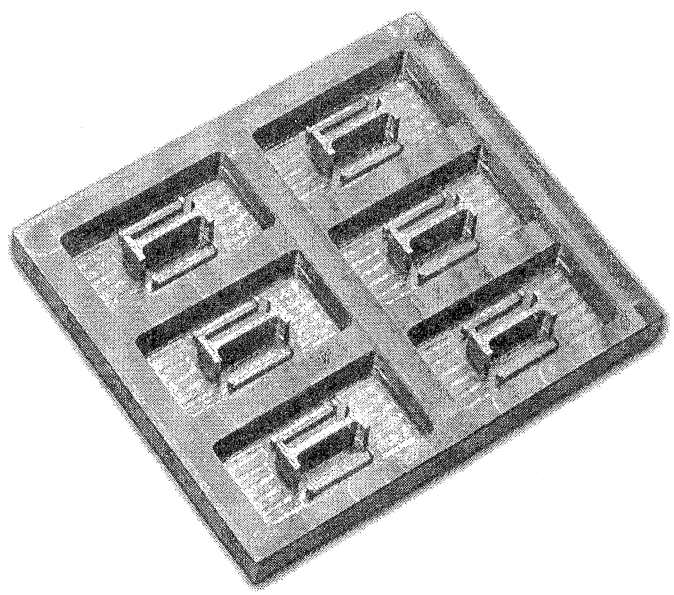

Figure Q5.

Table Q2. *From-To Chart*

	To :1	2	3	4
From: 1	0	5	0	25
2	30	0	0	15
3	10	40	0	0
4	10	0	0	0

Table Q4. G - Codes and M – Codes

G - Codes		G90	Absolute Positioning
G00	Positioning in Rapid	G91	Incremental Positioning
G01	Linear Interpolation	G92	Reposition Origin Point
G02	Circular Interpolation (CW)	G93	Inverse time feed
G03	Circular Interpolation (CCW)	G94	Per minute feed
G04	Dwell	G95	Per revolution feed
G07	Imaginary axis designation	G96	Constant surface speed control
G09	Exact stop check	G97	Constant surface speed control cancel
G10	Program parameter input	G98	Set Initial Plane default
G11	Program parameter input cancel	G99	Return to Retract (Rapid) Plane
G12	Circle Cutting CW		
G13	Circle Cutting CCW	M - Codes	
G17	XY Plane	M00	Program Stop
G18	XZ Plane	M01	Optional Program Stop
G19	YZ Plane	M02	Program End
G22	Stored stroke limit ON	M03	Spindle On Clockwise
G23	Stored stroke limit OFF	M04	Spindle On Counterclockwise
G28	Automatic return to reference point	M05	Spindle Stop
G29	Automatic return from reference point	M06	Tool Change
G30	Return to 2nd, 3rd, 4th reference point	M08	Coolant On
G31	Skip function	M09	Coolant Off
G52	Local coordinate system setting	M10	Clamps On
G53	Machine coordinate system selection	M11	Clamps Off
G54	Work piece Coordinate System	M30	End of Program, Reset to Start
G55	Work piece Coordinate System 2	M98	Call subroutine command
G56	Work piece Coordinate System 3	M99	Return from subroutine command
G57	Work piece Coordinate System 4		
G58	Work piece Coordinate System 5		
G59	Work piece Coordinate System 6		
G70	Inch Units		
G71	Metric Units		