UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 6 Examination in Engineering: December 2015

Module Number: ME 6317 **Module Name: Computer Aided Manufacturing (O.C.)**

[Three Hours]

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

Q1. a) What do you mean by "6-sided complete machining"?

[2 Marks]

b) i) Describe the capabilities of 5-axis machining over 3-axis machining.

ii) With aid of a suitable sketch illustrate the motion and coordinate system of a five axis milling machine. Clearly label the axes and indicate the positive and negative directions of motion.

[4 Marks]

c) A die and mold manufacturing firm is planning to purchase a suitable CAM software package for their company. Suppose you are the manufacturing engineer who is responsible for the selection.

i) What are the factors that you would consider?

ii) What would be the CAM software package that you recommend? Compare the capabilities and limitations of your selection with other CAM packages.

[4 Marks]

Q2. a) i) Why adaptive controlling is important for machining operations?

ii) What are the three basic functions of a typical Adaptive Control System?

[2 Marks]

b) i) List down the basic hardware components of an adaptive control system.

ii) With the aid of a block diagram explain the general configuration and the operation of an adaptive control machining system.

[4 Marks]

c) i) Differentiate the variant approach and generative approach used in Computer Aided Process Planning (CAPP)?

ii) What would be the future trends in CAPP and how those developments will advance the manufacturing engineering?

[4 Marks]

Q3. a) Briefly explain the concept of grouping parts in to families based on the design attributes and manufacturing attributes.

[2 Marks]

b) Factory Flow Analysis (FFA) is a concept which the parts are assigned to groups that require the same routing through the machine shop. As shown in ***Table Q3 (a)***, in a footwear manufacturing factory, typical ten parts have been identified which carry different operations in fifteen machine stations. Give the best possible machine arrangement for the parts, by rearranging and rebuilding the matrix.

[4 Marks]

c) As it is shown in ***Table Q3. (b)***, five hundred different parts are processed in a GT machine cell which contains eight dissimilar machines. Find an effective logical machine arrangement and draw the flow diagram.

[4 Marks]

Q4. a) Briefly explain the significance of tool path generation available in commercial CAM packages.

[2 Marks]

b) i) You are required to machine a rectangular pocket on a 30mm thick steel plate. The length, width and depth of the pocket are 150mm, 100mm and 15mm respectively. The all four corners of the pocket must be filleted to 20mm. Write the part program for the milling operation to machine the pocket to the given dimensions. You may refer to ***Table Q4*** for relevant G codes and M codes.

ii) State the type of tool that you would use to perform the operation. Sketch the geometry of the selected tool and show the dimensions.

[5 Marks]

c) Explain how you would adopt the above part program to machine three more similar pockets unevenly located on the same steel plate.

[3 Marks]

Q5. a) i) CMM is an equipment which plays a significant role in any CAM system. What does CMM stand for?

ii) Briefly explain the importance and functions of a CMM.

[3 Marks]

b) CNC Milling and Turning are dominant manufacturing operations discussed under CAM. Name and briefly discuss the advantages of **four** CAM processes other than Milling and Turning

[4 Marks]

c) i) What are the capabilities of Machine Control Unit (MCU) of a NC machine?

ii) Differentiate the Open loop control and Close loop control of a NC control system.

[3 Marks]

Table Q3. (a)

Part No	Machine														
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1		1								1	1	1			
2			1		1			1					1		1
3	1					1			1					1	
4	1			1					1					1	
5			1		1			1					1		1
6	1			1		1			1					1	
7		1					1			1	1	1			
8			1		1			1					1		1
9				1		1			1					1	
10		1					1			1	1	1			

Table Q3. (b)

From:	*To:*							
	1	2	3	4	5	6	7	8
1		10		20	10	15		
2								30
3	50				20	20	10	
4		50						35
5	40						30	
6		20	35		45			
7	20			10				
8		20			10			

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		