ASSIGNMENT 1
(MANUAL PART PROGRAMMING)

Due: February 26, 2024 by 4:00 p.m. (late penalties are 20% off per day)

You are required to submit in OWL the following:

1) The scanned/digitized handwritten part of your assignment solution (*i.e.* filled in Table 1, please see below). This should also include detailed trigonometric calculations for all profile locations requiring their use, such as points 10, 6, 7, etc. (Figure 1).

2) The two NC-codes of your assignment solution in OWL. The code should be submitted as **text** only (*.txt) files, both archived in a *.zip or *.rar file.

Task:

Write two word address programs (NC codes) in *absolute coordinates*:

a) **without** cutter compensation on;

b) **with** cutter compensation on; and

to machine the part shown in Figure 1. Assume that all dimensions in inches and all unspecified part radii are equal to tool radius (0.25 inches).
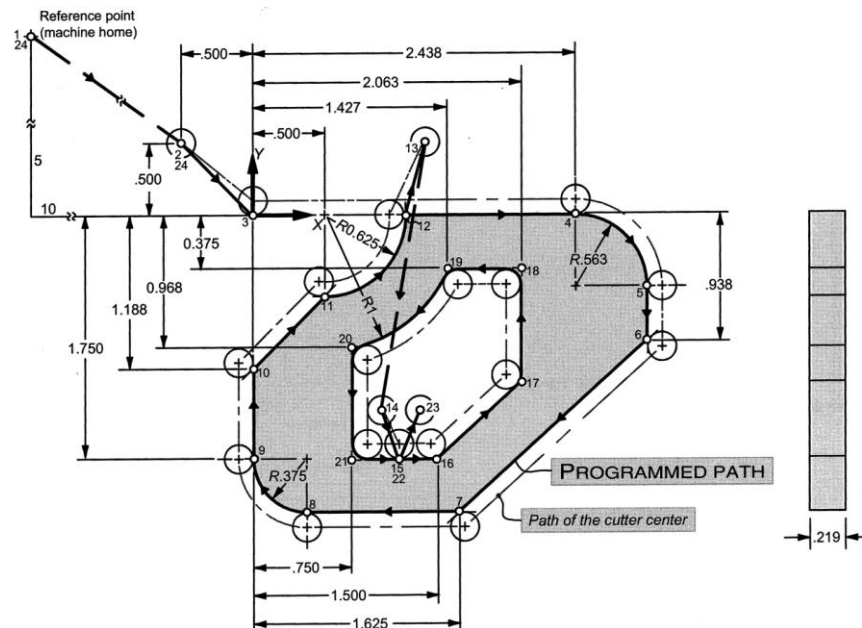

Figure 1

Ancillary Machining Information:

1. Setup notes:

a) Set X0 and Y0 at upper left hand corner and Z0 at the top of the part (as shown in Figure 1, above).

2. CNC Tool and Operation Sheet:

Tool	Operation	Tooling	Speed (rpm)	Feed (ipm)	D*
1	Finish outside and inside pro-files as shown	0.5D end mill	1200	8	D22 = .25

Solving Directions and Hints:

1. Before writing the NC code, fill in Table 1 (add extra lines, if required) as an aid in determining cutter locations around part profile (**mandatory step worth of 50% of your assignment mark**). Use additional pages or space to detail your calculations for positions involving trigonometric functions. **Non-detailed trigonometric calculations will attract penalties worth up to 20% of your total assignment mark**. Please do not submit solutions in which the location of the CL (cutter location - i.e. tool center) points is determined by means of the CAD software. However, you are definitely allowed/encouraged to use CAD to verify your handwritten calculations.

2. For each of the points located around the profile of the part, calculate and indicate in the table only the coordinates which are relevant to that particular tool location (*e.g. X, Y, ΔX, ΔY, I, J*).

3. Please fill for each of the points in the table to become part of your solution either *X* and *Y* or *ΔX* and *ΔY*, depending on whether you are using absolute or incremental coordinates to position it.

4. You are allowed to use *R* instead of *I* and *J* to define a circle. If that is your preference, then please add a new column ("*R*") to your table. Obviously, redundancy (both *I/J* and *R*) is not necessary, same as indicated at point 2, above.

5. Although it might not be entirely clear from the figure, the side of the inner pocket determined by points 16 and 17 is parallel with the side of outer contour determined by points 6 and 7. This information should suffice to establish the position of point 17.

6. The blanks are provided at final thickness (no machining required on top and bottom faces).

7. **Check syntax and relevant examples for all unfamiliar NC commands!**

8. For simplicity, use a *single pass* at *full depth* to machine the contour of the part.

9. The tool should be sent to machine zero (G28) at *the beginning* and *the end of the program* as well as *before a tool change* operation. You can switch to *incremental coordinates* for certain G-code commands like this one (if so desired).

10. Use H registers to retrieve previously stored tool lengths (G43).

11. Use the absolute part zero shift (G92) to set the position of the part origin with respect of machine zero. Point 1 (machine zero) is assumed to be 10" away on *X* and 5" away on *Y* with respect to part zero. Assume a part zero shift of 12" on *Z*-axis.

12. The coolant should be used appropriately.

13. Make extensive use of bracketed comments to explain your intentions for each NC block!

14. When programming with cutter compensation on, make sure that you indicate in one of the first comments of your NC code the value to be stored in D register of the controller (*e.g.* cutter compensation value). Assume that D register loads tool radius.

15. Refer to the lecture notes posted in OWL, textbook and other sources for additional information and/or solved/annotated examples.

16. **It is highly recommended** to verify your NC program with a CNC simulator/backplotting software (like virtual PathPilot) before submission.

Consultations

For questions regarding the assignment, please contact the course instructor.

Table 1

Position	ΔX	ΔY	X	Y	I	J
A						
B						
C						
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						