1.   Design a closed loop control system using a DC motor as the axial drive element and an incremental encoder as the feedback device.   The 16 bit computer is used to generate the position commands.   The maximum speed of the motor is 1800 rpm.   The system is equipped with a leadscrew of 1 mm pitch. The maximum required feedrate is 1 m/min and the required BLU is 0.01 mm.

   a. What is the required gear ratio?
   b. What is the encoder gain?
   c. What is the maximum frequency of pulses emitted by the encoder?
   d. What is the maximum travel length this system can provide?

   Hint: Review Koren Chapter 1, if necessary.   "Encoder gain" means the number of transmitted pulses per revolution of the encoder.

2.   The maximum table speed of a CNC table is set at 100 mm/sec. Calculate the approximate cycle time of the following part program (unit in mm) assuming the maximum acceleration achievable is 40 mm/sec^2.   The tool is in the home position (0,0,0) before the cycle starts. Ignore the cutter dimension.

          GG90 G17 XYZ
          X+200 Y+150
          G91 F10
          G1 X+30 Y+20
          G2 X+40 Y+0 R+20
          G2 X-20 Y-20 R+20
          G1 X-50
          G90 G0 X0Y0

3.   Generate a part program using APT for the part shown below. Follow the following steps: i) define the geometry and ii) use MACRO for programming roughing and finishing milling cycles as shown in Table 1. The periphery of this part is to be milled in two passes with a milling cutter of 0.5 in. in diameter. The first pass will be a rough cut to 0.01 in. of the final geometry specification, and the second pass will be to the final periphery specifications.

   Hint: To perform the roughing pass leaving 0.01 in. of stock, assume a larger cutter diameter than the actual.

Table 1: Machining parameters for roughing and finishing

	spindle speed (rpm)	feed rate (in/min)	turret location for the tool
roughing	600	3.0	4
finishing	900	2.0	6
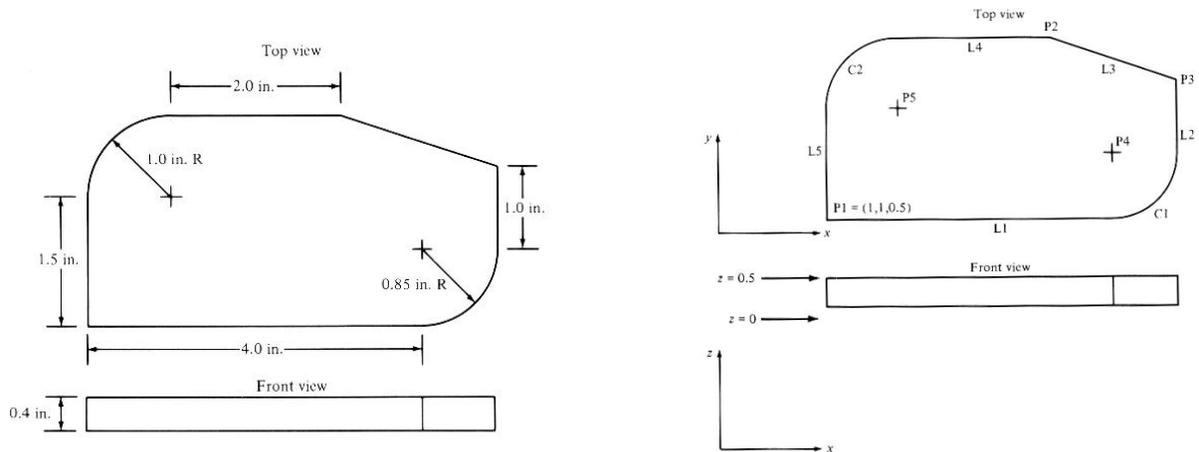
(a) part geometry   (b) geometry definition

Figure 1   Part geometry and definition

Additional commands:

CUTTER/   specifies cutter diameter in inches, e.g., CUTTER/0.6
SPINDL/   gives spindle rotational speed in rpm, e.g., SPINDL/850
FEDRAT/   specifies feedrate in in/min, e.g., FEDRAT/4.5
TURRET/   specifies a tool from the tool magazine, e.g., TURRET/11

Program Heading

PARTNO   P1534
           MACHIN/MILL,4

Macro Heading

MILLS   =MACRO/CUT,SSP,FRT

(CUT= cutter diameter, SSP=spindle speed, FRT=feed rate)