1) A machined block is resting on a ramp feeder on a small table in a robot work cell as shown below. Determine the location and attitude of block 8 with respect to global coordinate frame 1. Ensure that your attitude matrix is positive orthonormal.



y1’

x8’

y8’

30 cm

15 cm

60°

20 cm

x8’

z8’

90 cm

# RAMP

# TABLE

Side view of table (not to scale)

# TABLE

# RAMP

y8’

x8’

z8’

Block 8 (not to scale)

45°

60 cm

z1’ OUT

out

x1’

100 cm

Top view of work cell (not to scale)

2) Extract Euler parameters from 



Download and run “make\_ega.m” from our class web page to check your work.

3) Perform the following cross product by hand.



Download “skew\_sym.m” from our class web page and calculate  to check your work.

**EXTRA CREDIT**

Local coordinates of five landmarks A,B,C,D,E on rigid body 7 are given below. Unfortunately, landmark labeling was scrambled when global pose of this object was measured, and the five global locations 1,2,3,4,5 shown below cannot be associated sequentially with the landmarks (i.e. global location 2 may refer to landmark D). Further, there was a measurement error, and one of the global locations is completely wrong.

LANDMARK local x7’ local y7’ local z7’

A 0 0 0

B 0 0 3

C 2 0 0

D 0 1 0

E 0 0 -4

LOCATION global x1’ global y1’ global z1’

1 2.574 -3.482 2.146

2 2.000 -3.000 4.000

3 2.510 -2.142 3.935

4 -1.244 -1.184 2.524

5 4.433 -4.362 1.107

a) Match the global locations to their respective landmarks.

local landmark A B C D E

global location \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_

b) Identify the incorrect global location and state why.

c) Using the correct global locations, describe the pose of object 7 in global coordinates.

