*Instructions: 50 min closed book, notes. Answer all questions in the bluebook provided.*

1. (a) Explain how computation of an epipolar line facilitates stereopsis.

   (b) The Longuet-Higgins Equation for a given camera model is $u^T F u' = 0$ where the fundamental matrix F is

$$F = \begin{bmatrix} 0 & 0 & 6 \\ 0 & 0 & -1 \\ -1 & 1 & 0 \end{bmatrix}$$

The left-eye image, corresponding to the unprimed vector u in the Longuet-Higgins Equation above, is shown below. The visible black object has a straight edge in the image at v=1 which is of length 3. The same straight edge is visible in the right-eye image at v'=4. What is its length?

Left-eye image

Right-eye image
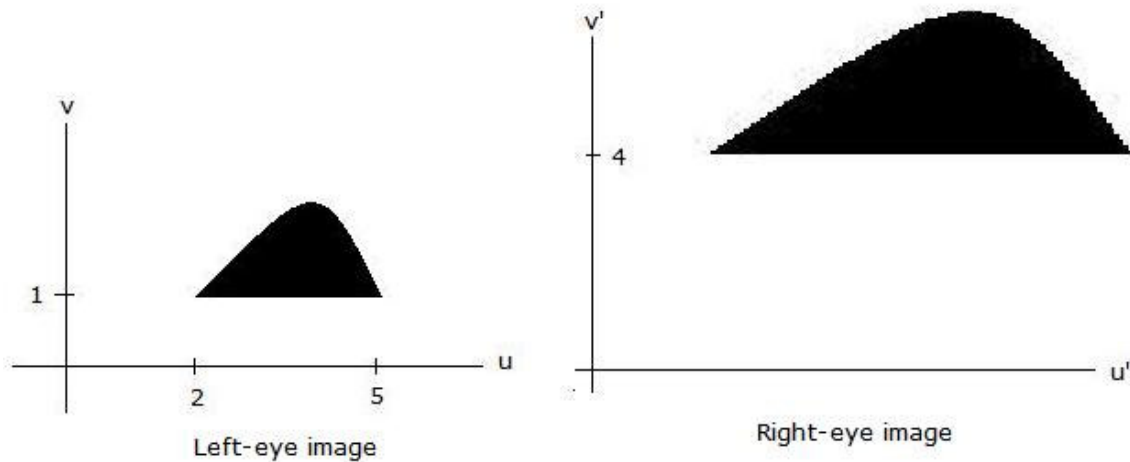
2. Vassallo's navigation scheme has two parts: detection of landmarks, and visual servoing (corridor-following) between landmarks. Suppose you are a bee who needs to find flowers and then return to the hive. Doorways won't work for landmarks, and corridor-following surely will not work for visual servoing since there are no corridors outside. Describe how you could use the available visual cues, including the sun and shadows, to apply Vassalo's two-part navigation scheme to the bee navigation problem. Describe how the bee would behave from the moment it left its hive, to the moment in arrived back. What visual information would it acquire, and how might the bee use it?

3. A cylinder of radius 1 centered at (x,y,z)=(0,0,2) with axis parallel to the y axis (see the diagram) is viewed orthographically in the image plane z=0. A light source at infinity produces rays which make a 45 degree angle to the x-axis as shown.

(a) Does the value of x at which this image is brightest depend on whether the cylinder's reflectance is Lambertian vs. specular? Explain.

(b) Find the value of x in the image which is brightest if the cylinder is pure Lambertian.