[Gr.G] The general graphics section (20 points)

Problem 1. Color (5 points) Sketch the locus of spectral colors on the 2D chromaticity diagram and indicate the location of magenta.

Problem 2. Antialiasing (5 points)

Under what conditions on polygon geometry is scan-conversion of two sets of polygons to form an image equivalent to scan-converting each set separately and then digitally compositing the two images? Assume that the polygon sets are disjoint in depth, and that scan-conversion is performed using analytic antialiasing. State any other assumptions you make.

Problem 3. Coordinates (5 points)

What are the motivations behind the use of homogeneous coordinates in computer graphics (as compared to the use of non-homogeneous coordinates)? Write down as many answers as you can think of. A terse list is fine.

Problem 4. Projection (5 points)

Does the depth of field of a camera increase or decrease with the size of the aperture? Defend your answer.

[Gr.S] The specialized graphics section (40 points)

Problem 1. Color (10 points)

Sketch the locus of spectral colors in 3D rho-gamma-beta space and indicate the location of magenta. Rho, gamma, and beta give the responses of the human visual system to long, medium, and short wavelengths, respectively.

Problem 2. Convolution (10 points)

Draw and label a sketch of the function obtained by convolving two 2D rect functions, i.e. $\pi(x,y) * \pi(x,y)$. Make the sketch clear enough to convey all salient aspects of the function.

Problem 3. Digital Compositing (10 points)

Industrial Light and Magic, the special effects group at Lucasfilm, wishes to use plastic models, an optical scanner, and digital compositing to construct sequences showing X-wing fighters flying against the backdrop of a Death Star. Their procedure consists of scanning each plastic model against a black background and, without moving the camera or model, against a white background, producing images B and W respectively. This process is repeated for each model and for each frame in the sequence. Assume a grayscale scanner (as opposed to color), and assume that all backgrounds are perfectly homogeneous. Derive equations for converting images B and W into intensity image I and coverage image $alpha$ as required for digital compositing. Your $alpha$ image should contain values between 0 and 1 in pixels lying on the silhouette of the X-wing fighter.

Problem 4. Reflection (10 points)

Suppose the moon is rising over a pond where all the waves are moving from left to right (i.e. think of the surface as being made of cylinders whose axis is in the direction from you to the moon). What does the reflection of the moon on the surface look like? How is it different than the reflection off a surface with randomly oriented waves?