Assignment 3

1. You have difficulty in reading very small text on the screen. However, this difficulty reduces as you increase the size of the fonts. Explain this using CSF.

2. You are working in your office which receives good sunlight in the day time. Around dusk when it is getting dark, you find that it is difficult to read the text on the book. You light your table lamp and the text is again legible again. Explain this phenomenon with CSF.

3. Assume a gray scale projector which shows no spatial variation in luminance. The contrast of the projector is defined by the ratio of the maximum and the minimum luminance that can be projected by the projector. For an ideal projector, no light is projected for black and hence infinite contrast can be achieved. However, in this practical projector, black offset is present. What is the effect of this black offset on the contrast of the projector? Based on CSF, which range of intensities (low range, high range or mid range) will be more adversely affected perceptually by the presence of this black offset and why?

4. You are going on a train. The track is lined by electric poles placed regularly along the track so that it is just a few feet away when you look out of the window. When the train just starts you can make out these poles clearly as they keep moving away from you. As the train increases speed, slowly the poles become blurred as they move away from you. Can you explain this phenomenon with CSF?

5. Let us consider a linear display with no spatial variation in color and no black offset. The chromaticity coordinates of the red, green and blue channel of this display are given by \((0.5, 0.4)\), \((0.2, 0.6)\) and \((0.1, 0.2)\) respectively. The maximum brightnesses of the red, green and blue channel are 100, 200 and 80cd/m² respectively. Generate the matrix that converts the RGB coordinates for this device to the XYZ coordinates. What is the XYZ coordinates of the color generated by the RGB input \((0.5, 0.75, 0.2)\) on this device?

6. Let the maximum spatial frequency detected by a human at luminance \(L\) be 30 cycles/degree of the angle subtended on the human eye. Nyquist sampling condition says that to generate a spatial pattern of a certain frequency \(f\) on a display, at least \(2f\) number of pixels are required. From this find out the minimum display resolution needed for a person at a distance \(d\), so that he can see all the different spatial frequencies he is sensitive to. Plot the \(r\) with respect to \(d\) to find how the minimum required resolution changes with the distance of the observer.

7. An audio signal of bandwidth 200 MHz, centered at 700 MHz is being transmitted. There are several kinds of noise in the system. It is found that if the noise has a bandwidth of 140 MHz and is also centered at 700 MHz, a noise of large amplitude large amplitude can be tolerated without being audible. However, as the frequency at
which the noise is centered reduces or increases, the noise becomes more and more audible. This phenomenon in audio is analogous to which visual phenomenon? How does that explain these phenomena? If the frequency at which the noise is centered reduces or increase, the noise can still be made inaudible, but this time by reducing its amplitude significantly. What phenomenon describes the noise being inaudible in this case? If both the noise and the signal are centered at 300MHz, it is found that the bandwidth of the noise needs to be reduced to 100 MHz to be inaudible. What does this tell you?

8. In a movie auditorium, the projection system is used with mean luminance of 12-22 foot Lamberts for refresh rates of 48 Hz. However, it is said that a refresh rate has to be increased to 60 Hz for higher luminance projection system. Explain this with CSF.

9. A sinusoidal grating has a mean of 100cd/m² and contrast (defined by the range of the luminance in the grating) of 50cd/m². It is projected on a screen of width 20 inch with resolution of 50pixels/inch. The number of cycles of the grating made over the whole screen is 10. What is the distance from the screen where the user should be placed so that this grating subtends 3cycles per degree of the eye?

10. In the image on the right, one X looks yellow and the other looks gray though they are the same color as you can see from the place where they are connected. What is this phenomenon and why does this happen?