**ECE 439 Sample Test #2 NAME\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Answer all questions in space provided. Use back of the pages for extra work. You have 75 minutes.

#1) a) List the three basic steps in image sharpening. b) Give an example operation for each step.

#2) Find the Huffman code for a 2-bit per pixel image with the following histogram:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Gray Level** | 0 | 1 | 2 | 3 |
| **Number of Pixels** | 400 | 200 | 300 | 100 |

What is the average word length ? \_\_\_\_\_\_\_\_\_

What is the entropy ? \_\_\_\_\_\_\_

#3) What is the best frequency domain restoration filter to use in the absence of noise ? Using our restoration model, derive the equation for this filter.

#4) a) What do *OTF* and *MTF* stand for and what do they mean? b) What does it mean for an image to be stationary? c) Are images typically stationary? Explain.

#5) a) One way to correct for geometric distortion involves using tiepoints. What is a tiepoint?

b) What can be done if the mapping equations return non-integer values? Explain how.

c) List three methods to perform gray level interpolation, along with an advantage and disadvantage of each.

#6) Apply the following filters to the 3x3 (window size is 3x3) subimages below, and find the output for each. a) median, b) minimum, c) midpoint, d) alpha-trimmed mean with T = 2.



#7) Given an image with 3-bits per pixel, with the following histogram, a) find the histogram mapping table, and b) the resulting histogram after histogram equalization.

|  |  |
| --- | --- |
| Gray Level | Number of Pixels |
| 0 | 5 |
| 1 | 5 |
| 2 | 10 |
| 3 | 20 |
| 4 | 5 |
| 5 | 5 |
| 6 | 0 |
| 7 | 0 |

#8) Mark T for true and F for false.

\_\_\_ Quantization is a reversible process

\_\_\_ In the presence of gamma noise, a Wiener filter reduces to an inverse filter.

\_\_\_ Unsharp masking gives images a “softer” look

\_\_\_ In image coding, the mapping process is not reversible

\_\_\_ Order filters are nonlinear filters

\_\_\_ When measuring image quality with a subjective test, the best type is an impairment test.

\_\_\_ Image enhancement methods utilize a mathematical model of the image formation process

\_\_\_ Homomorphic filtering assumes low frequencies are primarily from the lighting

\_\_\_ PSF stands for “Point Space Feature”

\_\_\_ A Huffman code is uniform length code

\_\_\_ In unsharp masking the amount of sharpening is controlled by a histogram shrink

\_\_\_ Using a gray code in preprocessing can improve RLC results

\_\_\_ JPEG2000 uses the wavelet transform

\_\_\_ Objective image quality measures are useful for all applications.

\_\_\_ Notch filters are useful for removing periodic noise caused by engine vibration

\_\_\_ Most real images can be considered to be stationary signals

#9) a) Sketch the histogram of an image with high entropy. b) Sketch the histogram of an image with medium entropy. c) Sketch the histogram of an image with zero entropy

#10) a) Describe the image model used in homomorphic filtering. b) List the assumptions that underlie application of this filter for image improvement. c) Describe an example where the assumptions are not valid.

#11) a) Given the following image, list a sequence of steps that could be used to make the image look better. b) Is the order of operations important? Why or why not?



#12) a) What is the power spectrum ratio and how is it related to the signal-to-noise ratio? b) Sketch the filter response of the Wiener and the inverse filter and explain why the Wiener works better in the presence of noise. c) Why use a constant in place of the power spectrum ratio in the Wiener filter?

#13) a) Briefly describe a method for estimating a noise model for an image. b) Briefly describe a method for estimating the degradation function of an image acquisition system.