Roll No: --------------------------

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: M.Tech ASE- UAV	**Semester – III**
Subject (Course): Digital Image Processing	**Max. Marks : 100**
Course Code : MAEG 841	**Duration : 3 Hrs**
No. of page/s: 3	

Section A

(All the questions in this section are compulsory)

(5X4=20 Marks)

1. When you enter a dark theater on a bright day, it takes an appreciable interval of time before you can see well enough to find an empty seat. Which of the visual processes play in this situation?

2. Let *g (x, y)* be the output image and *f (x, y)* be the input image and *T* is the intensity transformation function with respect to contrast stretching and thresholding. Discuss in detail about both the functions with neat sketch.

3. What is meant by image enhancement and explain three basic type of functions used frequently for image enhancement with a neat sketch.

4. Suppose that a flat area with center at (x_0,y_0) is illuminated by a light source with intensity distribution

$$i(x, y) = ke^{-[(x-x_0)^2+(y-y_0)^2]}$$

Assume for simplicity that the reflectance of the area is constant and equal to 1 and let *k=255*. If the resulting image is digitized with *k* bits of intensity resolution, and the eye can detect an abrupt change of four shades of intensity between adjacent pixels, what value of *k* will cause false contouring.

5. List and explain the four basic types of images and their representation.

Section B

(All the questions in this section are compulsory)

(4X10=40 Marks)

6. Explain why discrete histogram equalization technique does not, in general yield a flat histogram? Suppose that a digital image is subjected to histogram equalization. Show that

a second pass of histogram equalization (on the histogram equalized image) will produce exactly the same result as the first pass**.** Develop a MATLAB program for the problem discussed.

7. The implementation of linear spatial filters requires moving the center of a mask throughout an image and, at each location, computing the sum of products of the mask coefficients with the corresponding pixels at that location. A low pass filter can be implemented by setting all coefficients to 1, allowing use of a so called box filter or moving average algorithm, which consists of updating only the part of the computation that changes from one location to the next. Formulate such an algorithm for an *m x n* filter, showing the nature of the computations involved and the scanning sequence used for moving the mask around the image.
8. How does the intensity of an image affect the storage space of the image? What is the storage requirement for an 8 bit digital image of size 1024X1024? How the intensity of an image is represented? The upper limit of the dynamic range is represented as saturation and the lower limit as noise, explain.
9. Consider the two image subsets, s1 and s2, shown in figure below. For V = {1}, determine whether these two subsets are 4- adjacent, 8-adjacent or m- adjacent.

			S1		S2				
0	0	0	0	0	0	0	1	1	0
1	0	0	1	0	0	1	0	0	1
1	0	0	1	0	1	1	0	0	0
0	0	1	1	1	0	0	0	0	0
0	0	1	1	1	0	0	1	1	1

Section C

(Answer all the questions in this section are compulsory)

(2X20=40 Marks)

10. An UAV pilot working for a remote sensing application on a disaster prone area observes that the images obtained through the UAV are little blurry. The pilot realizes that the camera lenses focus images into high resolution, CCD imaging array, and the images are then converted into digital images. Trying to improve the situation by conducting different flight tests with the different camera lenses is not possible due to the hostile environment. The UAV pilot having heard about your success as an image-processing expert calls you to help the pilot to formulate a digital image processing solution for removing the noise and sharpening the images for the better clarity and understating of the aftermath of the disaster. How would you go about solving the problem and help the pilot in developing an algorithm to remove the spatial noises characterized by a probability density function (PDF) and remove the blurry. What are the most common PDFs found in image processing applications? Sketch the PDFs.

11. List out the images obtained from electromagnetic spectrum; explain what types of images are obtained in visible and radio range of electromagnetic spectrum. How are these images captured by the electro optic payloads attached to the UAVs?

Explain the following after the image is captured

a. Explain the sampling and quantization process used for digitization of an image captured by the electro optic payload of an UAV.

b. Let the value of the captured image at any coordinates (x,y) is denoted by f(x,y), where x and y are integers, then how do you define a spatial domain and what are the spatial variables? Neatly sketch and explain three basic ways to represent f(x,y) in any image. How are images represented in the matrix and what is each element of this matrix called?

OR

12. The implementation of linear spatial filters requires moving the center of the mask throughout an image and, at each location, computing the sum of products of the mask coefficients with the corresponding pixels at that location. A low pass filter can be implemented by setting all coefficients to 1, allowing use of so called moving-average algorithm, which consists of updating only the part of the computation that changes from one location to the next. Formulate such an algorithm for *n x n* filter, showing the nature of the computations involved and the scanning sequence used for moving the mask around the image.

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Section A

(All the questions in this section are compulsory)

(5X4=20 Marks)

1. Develop a procedure for computing the median of an *n x n* neighborhood. Propose a technique for updating the median as the center of the neighborhood is moved from pixel to pixel.
2. Image enhancement is a process of manipulating an image so that the result is more suitable than the original for specific application, what are the three types of piecewise-linear functions most widely used for image enhancement.

3. Consider two 8- bit images whose intensity levels span the full range from 0 to 255.
   a. Discuss the limiting effect of repeatedly subtracting image 2 with the image 1
   b. Assume that the result is represented also in eight bits.

4. The median ξ of a set of numbers is such that half the values in the set are below ξ and the other half are above it. For example, the median of the set of values {2, 3, 8, 20, 21, 25, 30} is 20. Show that an operator that computes the median of a sub image area, *S* is nonlinear.
5. What is the difference between frequency and spatial domain?

Section B

(Answer all the questions in this section are compulsory)

(4X10=40 Marks)

6. Assume that you have to process a digital Image. List the step wise process to do the processing. What will be the different tools and components of image processing system? Explain with the help of example and diagram.

7. Discuss the limiting effect of repeatedly applying 3x3 low pass spatial filters to a digital image. You may ignore border effects. Is this effect different from applying a 5x5 filter? Develop a MATLAB program for creating a Low pass filter where the masks can be extended upto 32 X 32.

8. In a given application an averaging mask is applied to input images to reduce noise, and then a laplacian mask is applied to enhance small details. Would the result be the same if the order of these operations were reversed?
9. (A) Consider the image segment shown

	3	1	2	1	(q)
	2	2	0	2	
	1	2	1	1	
(p)	1	0	1	2	

Let V= {0, 1} and compute the lengths of the shortest 4-,8- and m-path between p and q. If a particular path does not exist between these two points, explain why?

OR

(B) Give the condition(s) under which the D4 distance between two points p and q is equal to the shortest 4-path between these points.

Section C

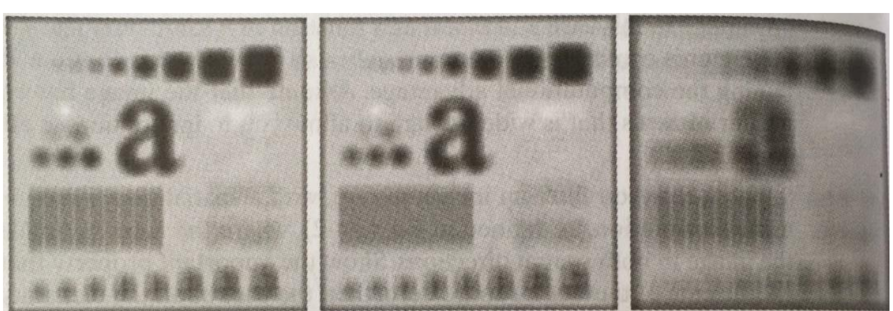
(Answer all the questions in this section are compulsory)

(2X20=40 Marks)

10. An Automobile manufacturer is automating the placement of certain components on the bumpers of the limited-edition line of sports cars. The components are color coordinated, so the robots need to know the color of each car in order to select the appropriate bumper component. Models come only in four colors: blue, green, red and white. You are hired to propose a solution based on imaging. How would you solve the problem of automatically determining the color of each car., keeping in mind the cost is the most important consideration in your choice of components?

OR

The three images shown below were blurred using square averaging masks of sizes n = 23, 25 and 45 respectively. The vertical bars on the left lower part of (a) and (c) are blurred, but a clear separation exists between them. However, the bars have merged in image (b), in spite of the fact that the mask and that produced this image is significantly smaller than the mask that produced image (c). Explain the reason for this.



(a) (b) (c)

11. Two images f(x,y) and g(x,y) have histograms h_f and h_g. Give the conditions under which you can determine the histograms of

a) f(x,y)+g(x,y)
b) f(x,y)-g(x,y)
c) f(x,y)Xg(x,y)
d) f(x,y)/g(x,y)