M.E. (ETC) 2nd Semester Final Examination, 2013
Digital Image Processing & Computer Vision (ETC-1015)

Full Marks: 70 **Time: 3 hours**

Attempt any five questions from the following
Answer should be brief and to the point
Unnecessary lengthy answer may result in loss of marks

1. What do you understand by an indexed color image? Explain with an example. How many bytes would be required to store an RGB image of dimension 256 x 256 where each of the color components may have at most 512 different levels? Mention some of the applications of digital image processing. What is the difference between intensity processing and color processing of color image? How can the contrast of any image be enhanced?

   4+3+2+2+3

2. What do you mean by bimodal histogram? Produce a histogram given the following image matrix 'A' with the grayscale value ranging from 0 to 7.

$$A = \begin{bmatrix} 0 & 1 & 2 & 2 & 6 \\ 2 & 1 & 1 & 2 & 1 \\ 1 & 3 & 4 & 3 & 3 \\ 0 & 2 & 5 & 1 & 1 \end{bmatrix}$$

   Perform equalization using the obtained histogram and finally plot the histogram for the equalized image. Explain the concept of histogram based image segmentation in brief.

   2+8+4

3. What is meant by resolution of any image? How can this be improved? Is there any relation between the resolution and bandwidth of any image? Explain with example. Why is non-uniform quantization very useful in image processing? Give example of some structural processing techniques. Mention few applications of thresholding in image processing.

   2+2+3+3+2+2

4. Explain the supremacy of median filter over mean filter in reducing the effect of salt and pepper noise from one digital image. How can Gaussian noise be eliminated from any image? Consider the 6 x 6 noise-corrupted digital image in Fig. 1. Extract the inner 4 x 4 image matrix from it using the outlier method by choosing a suitable threshold value.

7	8	11	12	13	9
8	14	0	9	7	10
11	23	10	14	1	8
14	7	11	8	9	11
13	13	18	10	7	12
9	11	14	12	13	10

Fig. 1

3+3+8

5. Show that for any image of size M X N; $\Im(u,v) = \Im^*(-u + pM, -v + qN)$ where p and q are arbitrary integers. Find out the number of complex multiplications required to convolve a 512 X 512 image with a 32 X 32 filter using direct method and FFT algorithm respectively. Hence calculate the speed up. How can periodic noise be eliminated from any image?

5+6+3

6. What do you mean by 'unsharp masking'? Find out the coefficients of unsharp masking filter. For any arbitrary image matrix A and kernel B, show that $(A \circ B) \subseteq A$ and $(A \circ B) \circ B = A \circ B$; where the symbols enjoy their usual significances. What do you understand by internal and external boundary? How can they be detected?

2+2+6+2+2

7. Construct a Huffman code for the probability table given below:

TABLE I

grey value	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**
probability	0.09	0.13	0.15	0.1	0.14	0.12	0.11	0.16

Encode the following 4-bit image in Fig. 2 using Run Length Encoding (RLE):

1	1	3	3	1	1
1	7	10	10	7	1
6	13	15	15	13	6
6	13	15	15	13	6
1	7	10	10	7	1
1	1	3	3	1	1

Fig. 2

6+8