Ex/ET/PE/B/T/2022

BACHELOR OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING EXAMINATION, 2022

(4th Year, 2nd Semester)

DIGITAL IMAGE PROCESSING

Time : Four hours | Full Marks : 70

PART I (20 Marks)

All questions carry 2 marks

Answer any **10** questions

1. State the range of electromagnetic spectrum in the visible range.
2. What is bilinear interpolation with respect to digital images?
3. Give the expression for reversing the intensity levels of an image.
4. What is a box filter?
5. Give another name for impulse noise.
6. Define an isotropic filter.
7. State the equation showing the sifting property of a 2D impulse function located at coordinates (t_0, z_0).
8. What kind of components in an image represents low frequency components?
9. Give the expression for an image restored using a geometric mean filter.
10. The mean square error in Wiener filter is measured between which terms?
11. State the advantage of Huffman coding?
12. What is the run length coding scheme?
13. Why is an image 'smoothed' before the edge detection operation?
14. What is the gradient operator in segmentation method?
15. State Otsu's method.
16. What is the function of the first derivative w.r.t. edge detection?

Part II

Full Marks: 50. All questions carry 10 marks. Answer any five questions.

1. (i)What is histogram of an image?
   (ii)After histogram equalization has already been applied to a digital image show that results will not vary if histogram equalization is again applied to that image.
2. 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. Explain what would happen if the two operations are reversed.

3. Write an expression for 2D continuous convolution. Prove that both the 2 D continuous and discrete Fourier Transform are linear operations.
4. Apply a mean filter and a max filter on the following image. Use a 3x3 neighbourhood.

5	1	2	6	7
4	*4*	*7*	*5*	*8*
2	6	20	6	7
3	1	2	4	5
10	2	1	2	3

5. Find the equivalent filter H(u,v) that implements in the frequency domain the spatial operation performed by the Laplacian mask as shown

0	1	0
1	-4	1
0	1	0

6. State the steps of Adaptive Median filter and explain how it works to remove noise.
7. (i)How many unique Huffman codes are there for a three-symbol source? Construct them.
   (ii) Encode arithmetically the sequence *bbadc* for a four-symbol source {a,b,c,d} with source probabilities {0.1,0.4,0.3,0.2}.
8. (i)Can variable-length coding procedures be used to compress a histogram equalized image with 2^n intensity levels? Explain.
   (ii)Can such an image contain spatial or temporal redundancies that could be exploited for data compression.
9. Illustrate the role of the Sobel mask for detecting edges in an image. Hence show that the edges so detected are useful in image segmentation.
10. With reference to this equation $\nabla^2 h(r) = [(r^2 - 2\sigma^2)/\sigma^4]e^{-r^2/2\sigma^2}$, where, $r^2=x^2+y^2$,
    (i)Show that the average value of the Laplacian operator $\nabla^2 h$ is zero.
    (ii)Prove that the average value of any image convolved with this operator also is zero.
11. Restate the basic global thresholding algorithm so that it uses the histogram of an image instead of the image itself.
12. Use the LZW coding algorithm to encode the 7-bit ASCII string "aaaaaaaaaaa".