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B.Tech. DEGREE EXAMINATION, MAY 2022
Sixth Semester

18CSE353T – DIGITAL IMAGE PROCESSING

(For the candidates admitted from the academic year 2018-2019 to 2019-2020)

Note:

- (i) **Part - A** should be answered in OMR sheet within first 40 minutes and OMR sheet should be handed over to hall invigilator at the end of 40th minute.
- (ii) **Part - B** should be answered in answer booklet.

Time: 2½ Hours

Max. Marks: 75

PART – A (25 × 1 = 25 Marks)

Answer **ALL** Questions

| | Marks | BL | CO | PO |
|--|-------|----|----|----|
| 1. The function $f(x, y)$ is characterized by (A) Brightness and contrast (B) Illumination and reflectance (C) Imaging strips and sensors (D) Objects and scene element | 1 | 1 | 1 | 1 |
| 2. Consider an image pixel $f(x, y)$, where f represents. (A) Location of the image (B) Reflectance of the image (C) Height of the image (D) Intensity of the image | 1 | 1 | 1 | 1 |
| 3. Consider a continuous image $f(x, y)$, how could be sampling and quantization be done? (A) Digitizing the coordinate values and digitizing the amplitude values (B) Digitizing the amplitude values and digitizing the coordinate values (C) Only digitizing the coordinate values (D) Only digitizing the amplitude values | 1 | 1 | 1 | 1 |
| 4. The digitization process in the digital image with M rows and N columns requires decision about values for M , N and L , max number of grey levels. Then the number of grey levels typically is (A) An integer power of 3 i.e, $L=3^k$ (B) An integer power of 2 i.e, $L=2^k$ (C) An integer power of 4 i.e, $L=4^k$ (D) An integer power of 5 i.e, $L=5^k$ | 1 | 2 | 1 | 1 |
| 5. In digital image of M rows and N columns and L discrete gray levels, calculate the bits required to store a digitized image for $M = N = 32$ and $L = 16$. (A) 6553 (B) 2621 (C) 4096 (D) 1024 | 1 | 2 | 1 | 1 |
| 6. Which of the following in an image can be removed by using smoothing filter? (A) Smooth transitions of gray levels (B) Smooth transitions of brightness levels (C) Sharp transitions of gray levels (D) Sharp transitions of brightness levels | 1 | 2 | 2 | 1 |

7. PDF in histogram stands for 1 1 2 1
 (A) Probability dual function (B) Probability density function
 (C) Partial density function (D) Parametric density function
8. In linear spatial filtering, what is the pixel of the image under mask 1 2 2 1
 corresponding to the mask coefficient $w(1, -1)$, assuming a 3×3 mask
 (A) $f(x, -y)$ (B) $f(x+1, -y)$
 (C) $f(x, y-1)$ (D) $f(x+1, y-1)$
9. Convolution in spatial domain is multiplication in 1 1 2 1
 (A) Frequency domain (B) Spatial domain
 (C) Time domain (D) Plane
10. Applying second derivative of an image is called as 1 1 2 1
 (A) Guassian (B) Prewitt
 (C) Laplacian (D) Sobel
11. Salt and pepper noise also referred to the term 1 1 3 1
 (A) Rayleigh noise (B) Spike noise
 (C) Black noise (D) Exponential noise
12. The edges and abrupt changes in the gray level of an image are associated 1 1 3 1
 with _____.
 (A) High frequency components (B) Low frequency components
 (C) Edges with high frequency (D) Edges with low frequency and
 and other abrupt changes with other abrupt
 low frequency
13. For a image having smaller objects and having D_0 as the cutoff distance 1 1 3 1
 measured from origin of frequency rectangle, which filter would you prefer
 for a comparable smoother results?
 (A) IHPF with D_0 15 (B) BHPF with D_0 15 and order 2
 (C) GHPF with D_0 15 and order 2 (D) HPF with D_0 15 and order 15
14. The contra harmonic filter is suitable for removing _____ noise, for 1 1 3 1
 positive values of 'Q' it eliminates _____ noise and for negative values
 of 'Q' it eliminates _____ noise.
 (A) Salt and pepper, salt, pepper (B) Rayleigh, salt, Gaussian
 (C) Gamma, pepper, Gaussian (D) Gaussian, Rayleigh, pepper
15. How can you represent noisy image? 1 2 3 1
 (A) $g(x, y) = f(x, y) + n(x, y)$ (B) $g(x, y) = f(x, y) + n(x, y) + t(x, y)$
 (C) $g(u, v) = F(X, Y) + n(x, y)$ (D) $g(u, v) = f(x, y) + n(x, y)$
16. Two significant factors which affect computational complexity and transform 1 1 4 1
 coding error are
 (A) Sub image size selection, transform selection
 (B) Image pixels, DCT coefficients
 (C) Zonal coding implementation, threshold coding implementation
 (D) Quantizer, normalization

17. LZW coding technique requires _____, and it does not require _____.
 (A) Codebook or dictionary (B) Probability of symbols, codebooks probability of symbols
 (C) Dictionary, sequence of (D) Sequence of symbols, dictionary symbols
18. Which of the following is true in Huffman coding?
 (A) Huffman coding may become lossy in some cases (B) Huffman codes may not be optimal lossless codes in some cases
 (C) In Huffman coding, no code is prefix of any other code (D) Huffman codes requires lot of storage space
19. An image compression system is composed of two distinct functional components.
 (A) A quantizer and a dequantizer (B) A sampler and a digitizer
 (C) Erosion and dilation (D) An encoder and a decoder
20. Bit-Plane coding is a _____.
 (A) Lossless compression technique (B) Lossy compression technique
 (C) Edge detection technique (D) Segmentation technique
21. The simple boundary descriptor, 'diameter' for a boundary 'Y' is defined as _____.
 (A) $\text{Diam}(Y) = \min_{i,j} \{D(p_i, p_j)\}$ (B) $\text{Diam}(Y) = \sum_{i,j} \{D(p_i, p_j)\}$
 (C) $\text{Diam}(Y) = \max_{i,j} \{D(p_i, p_j)\}$ (D) $\text{Diam}(Y) = \sum_{i,j} \{D(p_i, p_j)\}$
22. Eccentricity of a boundary is defined as _____.
 (A) Major axis + minor axis (B) Ratio of major axis to minor axis
 (C) Major axis – minor axis (D) Rate of change of slope
23. Shape number of a chain – coded boundary is defined as _____.
 (A) Number of directional line segments (B) Sum of convex and concave vertices
 (C) Minimum perimeter polygonal approximation (D) First difference of smallest magnitude
24. Statistical moment used for boundary descriptors are _____, _____ and _____.
 (A) Area, perimeters, compactness (B) Mean, variance, higher order moments
 (C) Circuitry ratio, topology, texture (D) Boundary descriptors, regional descriptors, edge descriptors
25. In fourier descriptor, the boundary is represented as _____.
 (A) The sequence of intensity values and each intensity value is represented as a complex number
 (B) The sequence of gray levels
 (C) The sequence of coordinates and each coordinate is represented as a complex number
 (D) Concatenated sequence of directional line segments

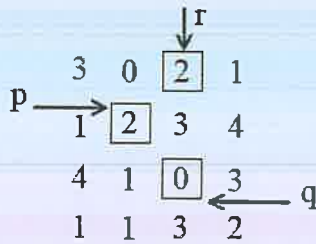
PART – B (5 × 10 = 50 Marks)

Answer ALL Questions

Marks BL CO PO

26. a. Consider an image segment given below.

10 3 1 4



Let $V = \{1, 2, 3\}$

- (i) Check whether the points p and q are
 - (1) 4 adjacent,
 - (2) 8-adjacent
- (ii) See if the points p and r are
 - (1) 4 adjacent,
 - (2) 8-adjacent and
 - (3) m-adjacent.

(OR)

b. Consider the two image subsets, S_1 and S_2 as shown below image. For $V = \{1\}$.

10 3 1 4

| | S_1 | | | | | S_2 | | | | |
|---|-------|---|---|---|---|-------|---|---|---|---|
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 | 1 |

- (i) Determine how many 4-connected, 8-connected and m-connected components are in S_1 and S_2 .
- (ii) Are S_1 and S_2 4-adjacent?

27. a.i. Write the steps involved in histogram equalization.

2 1 2 1

ii. Apply histogram equalization on the 64*64, 3-bit image with the following intensity distribution.

8 3 2 4

| | | | | | | | | |
|-------|-----|------|-----|-----|-----|-----|-----|----|
| r_k | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| n_k | 790 | 1023 | 850 | 656 | 329 | 245 | 122 | 81 |

(OR)

b. Describe in detail the various spatial domain filters used for image smoothing and image sharpening.

10 2 2 1

28. a. Consider the following image $f(x,y)$, what will be the new values of the pixel (2,2) if smoothing is done using the following a 3×3 neighborhood filters.

10 3 3 4

- (i) Mean filter
- (ii) Weighted average filter
- (iii) Median filter
- (iv) Min filter
- (v) Max filter

| | | | | |
|---|---|---|---|---|
| 0 | 1 | 0 | 2 | 7 |
| 2 | 7 | 7 | 4 | 0 |
| 5 | 6 | 4 | 3 | 3 |
| 1 | 1 | 0 | 7 | 5 |
| 5 | 4 | 2 | 2 | 5 |

(OR)

- b. Detect the edge in the following image using strength (magnitude) and direction of gradient. Use Prewitt operator. 10 3 3 4

$$image = \begin{bmatrix} 0 & 30 & 60 \\ 5 & 32 & 62 \\ 10 & 38 & 64 \end{bmatrix}$$

29. a. Construct the Huffman code for the set of symbols given. 10 3 4 4

| Symbol | a ₁ | a ₂ | a ₃ | a ₄ | a ₅ | a ₆ |
|-------------|----------------|----------------|----------------|----------------|----------------|----------------|
| Probability | 0.4 | 0.3 | 0.1 | 0.1 | 0.06 | 0.04 |

- (i) Compute the average length of the code and entropy
- (ii) Compute the compression ratio and efficiency

(OR)

- b.i. With an example, explain how bit-plane encoding is done. 5 2 4 1

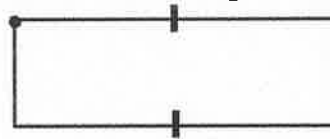
- ii. Elaborate how compression is achieved in JPEG 2000 standard. 5 1 4 1

30. a. Explain the polygon approximation using minimum perimeter polygon, merging and splitting methods with neat sketches. 10 1 5 1

(OR)

- b.i. Write the steps involved in boundary following algorithm. 5 1 5 1

- ii. Obtain the 4-chain code, difference and shape number for the given boundary. 5 3 5 4



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