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B.Tech. DEGREE EXAMINATION, NOVEMBER 2023
Sixth and Seventh Semester

18ECE243J – DIGITAL IMAGE AND VIDEO PROCESSING
(For the candidates admitted from the academic year 2020-2021 to 2021-2022)

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 & Part - C** should be answered in answer booklet.

Time: 3 hours

Max. Marks: 100

PART – A (20 × 1 = 20 Marks)

Answer **ALL** Questions

- | | Marks | BL | CO | PO |
|--|-------|----|----|----|
| 1. Which of the pair is orthogonal pair?
(A) $\sin(2\pi ft)$, $\sin(\sqrt{2} ft)$ (B) $\cos(2\pi ft)$, $\cos(4\pi ft)$
(C) $\tan(2\pi ft)$, $\cot(\sqrt{4\pi} t)$ (D) $\cos(\sqrt{3}\pi ft)$, $\tan(\sqrt{5\pi} t)$ | 1 | 1 | 1 | 1 |
| 2. Which of the following represents diagonal neighbors of P(x,y)?
(A) (x+1,y) (x-1,y) (x,y+1) (x,y-1) (B) (x+2,y) (x-2,y) (x-3,y+1) (x+2,y-6)
(C) (x+1,y-6) (x-6,y+2) (x-1,y+2) (D) (x+1,y+1) (x+1,y-1) (x-1,y+1) (x+3,y+2) (x-1,y-1) | 1 | 1 | 1 | 1 |
| 3. An image is 2800 pixels wide and 2400 pixels height. The image was scanned at 200 dpi. What is the physical size of the image?
(A) 9.33 inches × 8 inches (B) 4 inches × 7 inches
(C) 5.2 inches × 7.4 inches (D) 6 inches × 8 inches | 1 | 3 | 1 | 1 |
| 4. What is the discretizing pixel intensifies of an image?
(A) Sampling (B) Thresholding
(C) Quantization (D) Scaling | 1 | 1 | 1 | 1 |
| 5. Choose the one that best describes the two statements.
S1: FIR filtering is an application of convolution
S2: Median filtering is an application of convolution
(A) S1 is true and S2 is false (B) S1 is false S2 is true
(C) S1 is true and S2 is true (D) S1 is false S2 is false | 1 | 1 | 2 | 1 |
| 6. Which of the following are true about image negative in image enhancement operation?
S1: It produces an equivalent photographic negative image.
S2: $L - \gamma - 1$
(A) S1 is true and S2 is false (B) S2 is true and S2 is false
(C) Both S1 & S2 are false (D) Both S1 & S2 are true | 1 | 1 | 2 | 1 |

7. Which one is not correct in the following statements? 1 1 2 1
- (A) If the aperture is too small, the motion estimate may be poor to very wrong
- (B) If the aperture is too large, then we will get exact measure of the movement of object in our scene.
- (C) If the motion of the uniform dark region is parallel to the edge, then only motion can be detected.
- (D) Relation between aperture and motion should be studied.
8. Degraded image is produced using degradation process and _____ 1 1 2 1
- (A) Additive noise
- (B) Pixels
- (C) Noiseless image
- (D) Original image
9. Choose the best one. 1 1 3 12
- S1: DCT satisfies separability & symmetry
- S2: DCT has maximum energy compaction in the transformed domain
- (A) S1 & S2 are true
- (B) S1 & S2 are false
- (C) S1 is true & S2 is false
- (D) S2 is true & S1 is false
10. In thresholding, if threshold T depends on the spatial coordinates x and y, the threshold is called _____ 1 1 3 12
- (A) Adaptive
- (B) Gray Level
- (C) Dynamic
- (D) Global
11. _____ is used to extract the most appropriate location of an edge when there is a gradual change in intensity levels. 1 1 3 12
- (A) Laplacian Operation
- (B) Sobel Operator
- (C) Prewitt Operation
- (D) Gaussian Operator
12. _____ derivatives of a digital image are based on various approximation of the 2D gradient. 1 1 3 12
- (A) Second Order
- (B) Third Order
- (C) Fourth Order
- (D) First Order
13. What is the period of one scanning line in composite video signals? 1 1 4 4
- (A) 52 μ s
- (B) 64 μ s
- (C) 36 μ s
- (D) 24 μ s
14. What will be the voltage if the picture is darker in composite video signal? 1 1 4 4
- (A) Higher
- (B) Lower
- (C) Constant
- (D) Varying
15. How many cameras are required to find 3D point using image coordinates of camera? 1 1 4 4
- (A) Atleast 1
- (B) Atleast 2
- (C) Atleast 3
- (D) Atleast 4
16. _____ refers to the projection of 3D motion on to the image plane. 1 1 4 1
- (A) 3D motion
- (B) 4D motion
- (C) 2D motion
- (D) 1D motion

17. The displacement of the image plane coordinator x from time t to t' based on the variations of $s'_c(x, t)$ is called _____
- (A) Optical Vector (B) Dependent Vector
(C) Independent Vector (D) Correspondence Vector
18. _____ problem is a special case of the correspondence problem where the two frames are globally shifted with respect to each other?
- (A) Noise (B) Occlusion
(C) Registration (D) Blurring
19. The gradient of $f(x, y)$ is the vector pointing in the _____
- (A) Direction of the steepest slope (B) Direction opposite to the steepest slope
(C) Direction inclined at 45° to the steepest slope (D) Direction inclined at 125° to the steepest slope
20. _____ is based on eliminating the interpixel redundancies of closely spaced pixels by extracting and coding only the new information in each pixel.
- (A) Lossless Predictive Coding (B) Lossy Predictive Coding
(C) Lossless Run length Coding (D) Lossy Run Length Coding

PART – B ($5 \times 4 = 20$ Marks)

Answer ANY FIVE Questions

21. Find the Kronecker product of the matrix A & B, where

$$A = \begin{bmatrix} 1 & 2 \\ -2 & -1 \end{bmatrix} \quad B = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$$

22. State and prove the periodicity property of 2D – DFT.

23. Differentiate image enhancement and image restoration.

24. Draw the 3×3 Kernel Matrix for Sobel and Prewitt Operators.

25. Encode the given image using run length coding.

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 & 2 & 2 & 2 & 2 & 2 & 2 & 1 & 1 & 1 & 1 & 1 \\ 5 & 5 & 5 & 5 & 5 & 5 & 5 & 5 & 2 & 2 & 2 & 2 & 6 & 6 & 6 \end{bmatrix}$$

26. Express the zooming of the homogeneous coordinate in matrix form.

27. What is occlusion problem in Video Processing?

PART – C ($5 \times 12 = 60$ Marks)

Answer ALL Questions

28. a. Compute the DCT matrix for $N = 4$. Also prove that DCT matrix satisfies real and orthogonality principle such that $AA^T = I$.

(OR)

Marks	BL	CO	PO
4	2	1	1

4	1	1	1
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4	2	2	1
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4	1	3	1
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4	3	3	2
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4	2	4	4
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4	1	5	1
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Marks	BL	CO	PO
12	3	1	1

- b. i. With the help of a block diagram explain the fundamental steps in digital image processing. 8 2 1 1
- ii. Analyse how the weber ratio quantifies the perception of change in given stimulus. 4 4 1 1
29. a. Perform the histogram equalization on the given image and show that the equalization attempts to spread out the gray level. 12 3 2 3

1	2	2	2
4	4	4	3
3	3	5	5
1	1	3	5
1	3	3	4

(OR)

- b. Explain a model of image degradation / restoration process and derive the equation for inverse filtering from $g(m,n) = f(m,n) * h(m,n) + \eta(m,n)$, where $g(m,n)$ = original image, $h(m,n)$ = degradation system, η = additive noise 12 2 2 1
30. a. Relate local property $p(x,y)$ with gray level of point $f(x,y)$ using thresholding function. Also explain basic global thresholding operation. 12 2 3 12

(OR)

- b. Calculate the efficiency of Huffman code for the following symbol whose probability of occurrence is given below. 12 3 3 2

Symbol	Probability
a1	0.9
a2	0.06
a3	0.02
a4	0.02

31. a. Discuss the 4D space to a 3D space mapping using geometric image formation perspective projection model with neat sketches. 12 2 4 4

(OR)

- b. Write short notes on 2 4 4
- i. NTSC 4
- ii. PAL and SECAM 4
- iii. Composite, Component & S Video 4
32. a. In detail, discuss the block motion model with overlapping and non-overlapping blocks. Also illustrate few spatial transformation models. 12 2 5 1

(OR)

- b. Write short notes on. 2 5 1
- i. 2D motion 6
- ii. Aperture Problem 6

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