IE 404 – Digital Image Processing
Second In-Sem Examination, March 2024

[Total Marks - 70]

[Time – 2 Hours]

Instructions:

- Question paper contains 3 sections (A, B, and C).
  - Section A contains 10 questions, 1 mark for each question.
  - Section B contains 3 questions, 5 marks for each question.
  - Section C contains 3 question, 15 marks for each question.
- Answer all question. All questions are self-explanatory and understanding of question is a part of evaluation.
- No query regarding questions will be entertained during examination by course instructor or invigilator.
- Calculators are allowed in examination.

Section A

Multiple choice question (Write the most appropriate answer in answer sheet)

1. With reference to sensing, two elements used to acquire digital images are a physical device and _____.
   a) Digitizer
   b) Hardware Bus
   c) Regional Representation
   d) ALU

2. The types of images are generated by the combination of an "illumination" source and _____ of energy from that source by the elements of the "scene" being imaged
   a) Refraction
   b) Reflection
   c) Luminance
   d) Transmittance

3. _____ experiments indicate that a photograph or visual signal with accentuated or crispened edges is often more subjectively pleasing than an exact photometric reproduction.
   a) False color
   b) Enhancement procedures
   c) Histogram modification
   d) Psychophysical

4. To map a narrow range of low Gray-level input image into a wider range of output levels, we use
   a) Log Intensity Transformation Function
   b) Power-law Intensity Transformation Function
   c) Inverse Log Intensity Transformation Function
   d) Identity Intensity Transformation Function

5. MRI Technology used --------- band.
   a) Gamma Rays
   b) CT scan
   c) Visible
   d) Radio waves

6. The colormap array of the indexed image is always of class
   a) uint8
   b) uint16
   c) double
   d) logical

7. Color of an object is determined by light
   a) Refracted
   b) Transmitted
   c) Reflected
   d) Absorbed

8. What are the basic quantities that are used to describe the quality of a chromatic light source?
   a) Radiance, brightness and wavelength
   b) Brightness and luminance
   c) Radiance, brightness and luminance
   d) Luminance and radiance

9. What is the set of pixels of 8-neighbors of pixel p at coordinates (x, y)?
   a) (x+1, y), (x-1, y), (x, y+1), (x, y-1), (x+2, y), (x-2, y), (x, y+2), (x, y-2)
   b) (x+1, y), (x-1, y), (x, y+1), (x, y-1), (x+1, y+1), (x+1, y-1), (x-1, y+1), (x-1, y-1)
   c) (x+1, y+1), (x+1, y-1), (x-1, y+1), (x-1, y-1), (x+2, y+2), (x+2, y-2), (x-2, y+2), (x-2, y-2)
   d) (x+2, y), (x-2, y), (x, y+2), (x, y-2), (x+2, y+2), (x+2, y-2), (x-2, y+2), (x-2, y-2)

10. For noise reduction we use
    a) Image smoothing
    b) Image contouring
    c) Image enhancement
    d) Image recognition

Section B

11. Let the RGB values of a point be (0.3, 05, 0.9). Find the HSV equivalent of RGB. Also verify whether the original point can be obtained by the inverse transform from HSV to RGB.

12. When will a Constrained Least Square Filter (CLS) reduce to an inverse Filter?

13. You have a Digital image that takes up 240kb. The spatial resolution of the image is given by 600 x 200. What is the bit depth?

Section C

14. A 4 x 4, 4 bits/pixel original image is given by

$$\begin{bmatrix} 10 & 12 & 8 & 9 \\ 10 & 12 & 12 & 4 \\ 12 & 13 & 10 & 9 \\ 14 & 12 & 10 & 12 \end{bmatrix}$$

(i). Apply Histogram equalization to the image by rounding the resulting image pixels to integers.
(ii). Sketch the histogram of the original image and the histogram equalized image

15. Derive Mathematical expression for a Wiener filter. Also give the advantage and drawback of a wiener filter over an inverse filter.

16. Consider the following image A, and let the structuring element be B.

$$A = \begin{bmatrix} 23 & 21 & 32 & 31 & 28 & 26 \\ 88 & 45 & 29 & 51 & 67 & 39 \\ 64 & 23 & 33 & 35 & 32 & 24 \\ 15 & 20 & 125 & 190 & 143 & 120 \\ 34 & 255 & 24 & 0 & 26 & 123 \\ 75 & 145 & 29 & 51 & 67 & 39 \end{bmatrix} \qquad B = \begin{bmatrix} 0 & 1 & 0 \\ 1 & 1 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

Perform Following Operations

(i). A^C (ii). $A \oplus B$ (iii). $A \Theta B$ (iv). $A^C \oplus B$

(v). $A^C \Theta B$ (vi). $(A \Theta B) \oplus B$ (vii). $(A \oplus B) \Theta B$

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