

Master of Computer Applications
MCAE 404: Digital Image Processing
Unique Paper Code: 223402404
Semester IV
May-2023
Year of Admission: 2021

Time: Three Hours

Max. Marks: 70

Attempt all questions.
Parts of a question must be answered together.

1. ✓
- a) ✓
- i) ✓ What is bit plane in reference to digital image processing?
- ii) ✓ What would be the effect on the histogram of an image in general if we set to zero the lower order bit planes?
- iii) ✓ What would be the effect on the histogram of an image if we set to zero the higher-order bit planes instead? [5]
- b) ✓ 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. Would the result be the same if the order of these operations were reversed? Justify your answer with the help of an example. [5]
2. ✓
- a) ✓ How many possible shades of colors are there in a RGB system in which each of red, green and blue image is an 8 bit image? [3]
- b) ✓ What do you understand by Color Complements? What is their use in colored image processing? [3]
- c) ✓ Write in brief about RGB, CMY and HSI color models. [4]
3. ✓
- a) ✓ Design a 3×3 spatial mask/filter that averages the four closest neighbors of a point (x, y) , but excludes the point itself from the average. [2]
- b) ✗ Find the equivalent filter in the frequency domain. [4]
- c) ✗ Show that your result is a lowpass filter. [4]

4. 1/2
- a) Which frequency domain filter is commonly used for Image sharpening?
Represent the filter mathematically. [4]
- b) Prove the validity of the following properties of 2-D DFT
- i) $F^*(-u, -v) = -F(u, v) \Leftrightarrow f(x, y)$ imaginary
- ii) $F^*(-u, -v) = F(u, v) \Leftrightarrow f(x, y)$ real
- where $F^*(u, v)$ represents complex conjugate of $F(u, v)$ and
 $F(u, v)$ is DFT of function $f(x, y)$. [6]
5. 1/2
- a) What are the reasons for redundancy in image data? Describe various types of redundancies present in image data in your own words. [4]
- b) A 1024×1024 8-bit image with 5.3 bits/pixel entropy (computed from its histogram) is to be Huffman coded.
- i) What is the maximum compression that can be expected?
- ii) Is it possible to obtain the maximum compression?
- iii) If a greater level of lossless compression is required, what else can be done? [6]
- 6.
- a) How an image is compressed using JPEG image compression standard? Describe the process with the help of an example. [5]
- b) Given a four-symbol source $\{a, b, c, d\}$ with source probabilities $\{0.1, 0.4, 0.3, 0.2\}$, arithmetically encode the sequence bbadc. [5]
7. Write short notes on the following:
- a) Histogram equalization
- b) Filtering in the Frequency domain
- c) Image restoration
- d) Notch filters [10]