MMTE-003

ASSIGNMENT BOOKLET

(Valid from 1st January, 2022 to 31st December, 2022)

M.Sc. (Mathematics with Applications in Computer Science)

Pattern Recognition and Image Processing

School of Sciences
Indira Gandhi National Open University
Maidan Garhi, New Delhi-110068

2022

Dear Student,

Please read the section on assignments and evaluation in the Programme Guide for Elective courses that we sent you after your enrolment. A weightage of 20 per cent, as you are aware, has been assigned for continuous evaluation of this course, **which would consist of one tutor-marked assignment**. The assignment is in this booklet.

Instructions for Formatting Your Assignments

Before attempting the assignment please read the following instructions carefully.

1) On top of the first page of your answer sheet, please write the details exactly in the following format:

ROLL NO :……

NAME :……

ADDRESS :……

……

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COURSE CODE: ……

COURSE TITLE : ……

ASSIGNMENT NO. ……

STUDY CENTRE: ……..….. DATE:

…….……...

PLEASE FOLLOW THE ABOVE FORMAT STRICTLY TO FACILITATE EVALUATION AND TO AVOID DELAY.

2) Use only foolscap size writing paper (but not of very thin variety) for writing your answers.

3) Leave 4 cm margin on the left, top and bottom of your answer sheet.

4) Your answers should be precise.

5) While solving problems, clearly indicate which part of which question is being solved.

6) This assignment is to be submitted to the Programme Centre as per the schedule made by the programme centre. Answer sheets received after the due date shall not be accepted.
We strongly suggest that you retain a copy of your answer sheets.

7) This assignment is valid only upto 31st December, 2022. For submission schedule please read the section on assignments in the programme guide. If you have failed in this assignment or fail to submit it by 31st December, 2022, then you need to get the assignment for the session 2023 and submit it as per the instructions given in the programme guide.

We wish you good luck.

Assignment

Course Code: MMTE-003
Assignment Code: MMTE-003/TMA/2022
Maximum Marks: 100

1. a) Define the following with suitable examples (6)

   i) Unsharp marking
   ii) High boost filtering
   iii) High frequency filtering.

   b) Given an image f(x,y) with Fourier transform F(u,v) obtain the fourier transform of $(-1)^{x+y}.f(x,y)$. (2)

   c) Given that the 2-D Fourier Tranform is real and even, obtain the constraints on the image characteristics. (2)

2. a) Show that Sobel masks can be implemented by one pass of differencing mask of the form $[-1\ 0\ 1]$ (or its vertical counterpart) followed by a smoothing mask of the form $[1\ 2\ 1]$ (or its vertical counterpart). (5)

   b) Explain the Hough transform for edge linking with suitable example. (5)

3. a) Propose a gray level slicing algorithm capable of producing the 4-bit plane of an 8-bit monochrome image. (6)

   b) Explain the functioning of an adaptive, local noise reduction filter. (4)

4. a) In image restoration, how are the noise parameters estimated? (6)

   b) Assume that the noise is estimated as exponential, with mean μ Variance σ^2. How will you estimate the parameter 'a' of pdf of exponential Noise? (4)

5. Given an image with uniform histogram. Explain the effect of applying following compression techniques:

   i) Huffman,
   ii) Golomb,
   iii) LZW,
   iv) Prediction coding, and
   v) Optimal Quantization (10)

6. a) Given that

$$g(x,y) = \frac{1}{MN}\sum_{m=0}^{M-1}\sum_{n=0}^{N-1}\{f(m,n)h(x+m,y+n)\}$$

where f and g are real images and h is a spatial filter.
Obtain G(u,v), in terms of F(u,v), and H(u,v), the 2–D Fourier transform of g(x,y). (5)

b) Describe the homographic filtering. Explain why the filtering scheme is effective for the applications it is used. (5)

7. a) Suppose a low-pass spatial filter is formed by averaging the four immediate neighbours of a point (x, y) but excluding the point itself. Find the equivalent filter H(u,v) in the frequency domain. (5)

b) Apply the perception algorithm to the following pattern classes:

$$W_1 = \{(0,0,0)^T, (1,0,0)^T, (1,0,1)^T, (1,1,0)^T\},$$
$$W_2 = \{(0,0,1)^T, (0,1,1)^T, (0,1,0)^T, (1,1,1)^T\}.$$

Let $C = 1$ and $W(1) = [-1,-2,-2,0]^T$

Also, Sketch the decision surface. (5)

8. a) Explain in detail the adaptive mean and median filters. (4)

b) Obtain mean and variance of the following noise pdfs: (6)

i) $$p(Z) = \begin{cases} ae^{-az} & ; z \geq 0 \\ 0 & ; z < 0 \end{cases}$$

ii) $$p(Z) = \begin{cases} \dfrac{1}{b-a} & ; a \leq Z \leq b \\ 0 & ; \text{otherwise} \end{cases}$$

iii) $$p(Z) = \begin{cases} P_a & ; Z = a \\ P_b & ; Z = b \\ 0 & ; \text{otherwise} \end{cases}$$

9. Filter the given 4×4 gray level image with (10)

$$\begin{bmatrix} 1 & 2 & 4 & 5 \\ 5 & 2 & 5 & 2 \\ 1 & 1 & 3 & 6 \\ 1 & 4 & 6 & 7 \end{bmatrix}$$

i) 3×3 mean filter using zero padding

ii) 3×3 weighted mean filter using zero padding with mask

$$w_0 = \frac{1}{16}\begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$$

iii) 3×3median filter processing only such pixels that have all the needed neighbours.

iv) Laplacian filter with the given mask and reflecting the border pixels.

$$w_d = \begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

10. a) Perform histogram equalization for the following histogram. (5)

Gray level	0	1/7	2/7	3/7	4/7	5/7	6/7	7/7
Number of occurances	400	700	800	900	500	400	196	200

b) A bullet is 2.5 cm long, 1cm wide and its range of speed is $750 \pm 250 m/s$. The bullet is flight is captured by a camera that exposes the scene for k sec and the bullet occupies 10% of the horizontal resolution of 250×260 frames. Find

i) Automatic segmentation of the bullet.
ii) Automatic determination of speed of the bullet. (5)