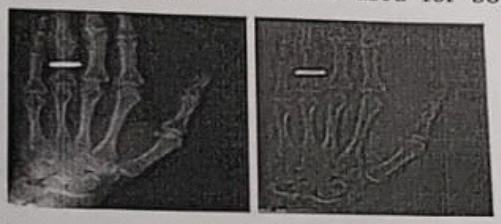
VIT
Vellore Institute of Technology
Chennai

Continuous Assessment Test (CAT) – II - MAR 2025

Programme	:	B.Tech (Computer Science and Engineering and its specialization)	Semester	:	Winter 2024-2025
Course Code & Course Title	:	BCSE403L - Digital Image Processing	Class Numbers	:	CH202425 0502019 CH202425 0502021
Faculty(s)	:	Dr. Joshan Athanesious J Dr. Geetha S	Slot	:	A2+TA2
Duration	:	1 hour 30 Minutes	Max. Mark		50

Answer all questions

Q. No	Description	Marks
1	Consider the hand X-ray images shown below. The image on the right was obtained by low-pass filtering the image on the left with a Gaussian lowpass filter, and then high-pass filtering the result with a Gaussian high-pass filter. The images are of size 420 × 344 pixels and $D_0 = 25$ were used for both filter transfer functions.  **Fig. 1** a. Explain why the centre part of the finger ring in the figure on the right appears so bright and solid, considering that the dominant characteristic of the filtered image consists of edges of the fingers and wrist bones, with darker areas in between. In other words, would you not expect the high-pass filter to render the constant area inside the ring as dark, since a high-pass filter eliminates the dc term and reduces low frequencies? [5M] b. Do you think the result would have been different if the order of the filtering process had been reversed? [2.5M]	7.5
2	A skilled medical technician is assigned the job of inspecting a set of images generated by an electron microscope experiment. In order to simplify the inspection task, the technician decides to use digital image restoration techniques and, to this end, examines a set of representative images and finds the following problems: (1) bright, isolated dots that are of no interest; (2) lack of sharpness; (3) not enough contrast in some images; and (4) shifts in the average intensity to values other than A_0, which is the average value required to perform correctly certain intensity measurements. The technician wants to correct these problems and then display in white all intensities in a band between intensities $I1$ and $I2$, while keeping normal tonality in the remaining intensities. Propose a sequence of processing steps that the technician can follow to achieve the desired goal. Explain the input and output at each step and the rationale for the choice of the respective restoration technique.	7.5
3	A digital imaging laboratory has recently processed a set of images captured in a challenging environment, where various types of noise have been introduced during data acquisition and transmission. The original image, resulting noisy image and its corresponding noise distributions are shown in Fig. 2 and Fig. 3	

below.

a. As a member of the image processing team, you are tasked with analysing the effects of this noise on image quality.
b. Based on the noise distributions provided, identify the type of noise present in each noisy image.
c. For each identified noise type, describe its characteristics. Explain how these types of noise typically affect image quality, such as their impact on detail preservation and visual clarity. 5

Recommend the most effective filtering techniques for each type of noise you have identified. Justify your choices, explaining how each filter will help restore the image quality. [2.5 mark for each noise type]

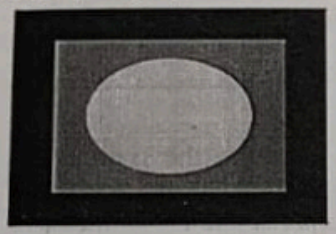


Fig. 2 Original Image

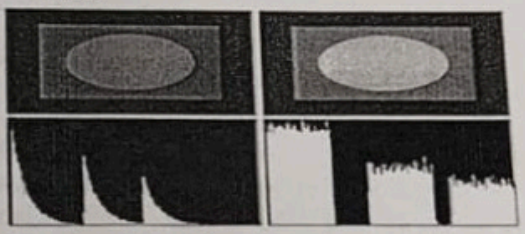
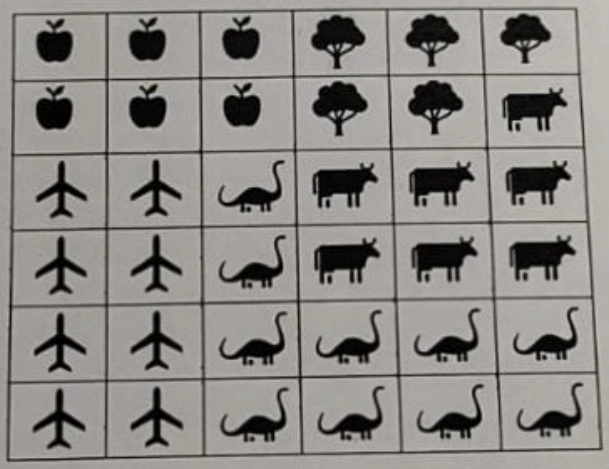


Fig. 3 Noisy Images and their noise distribution

3 Each grid in the below table is occupied by one object. Suggest a suitable algorithm to identify the optimal threshold to minimize the intra-class variance to separate the foreground from background region. 10



4 a. Find the DFT of the sequence [1 0 0 1] using the Matrix method. [3M]
b. Find the IDFT of the signal [2, 1+j, 0,1-j] using the Matrix method. [3M]
c. Prove that "2-D Fourier transform and its inverse are infinitely periodic in the u and v directions." [4M] 10

5 a. AI based company is developing a website for analysing the behaviour of the animals using the web camera with resolution 420*380 pixels. Since lighting conditions can vary, suggest a suitable colour model for the developer to process the sample pixel value (30, 50, 50) (6M)
b. Why is the HSI Model preferred over RGB in Skin color Consistency and Lighting Sensitivity? (4M) 10

**********All the best **********