(3 hours) Marks: 80

Note: 1) Question No. 1 is compulsory.
2) Out of remaining questions, attempt any 3 questions.
3) In all 4 questions to be attempted.
4) All questions carry equal marks.
5) Figures in brackets on the right hand side indicate full marks.
6) Assume Suitable data if necessary

Q.1 Answer any Four of the following.

a. Chain codes can be made invariant to rotation. Justify. [5]
b. Briefly explain fundamental steps in image processing. [5]
c. Briefly explain image enhancement in frequency domain. [5]
d. List different types of data redundancies present in Digital Image. Explain them. [5]
e. The principal function of median filter is to force points with distinct intensities to be more like neighbours. State TRUE or FALSE and Justify. [5]

Q.2. a. Given below 5×5 image. Operate on the central 3×3 pixels by low pass and high pass masks and obtain 3×3 images as output. [10]

6	**5**	**12**	**12**	**3**
14	**12**	**13**	**10**	**9**
10	**15**	**4**	**10**	**6**
8	**3**	**7**	**4**	**7**
8	**3**	**10**	**8**	**5**

Using these outputs verify

Original Image=Low Pass Output + High Pass Output

In case of discrepancy explain the reason.

b. Explain any three point processing techniques with the help of transformation graphs. [10]

Q.3. a. Perform histogram equalization and plot the histogram before and after equalization. [10]

6	**4**	**3**	**0**	**7**
2	**1**	**5**	**3**	**0**
4	**2**	**7**	**0**	**7**
1	**5**	**4**	**0**	**6**
4	**7**	**5**	**4**	**1**

b. A source emits four symbols **(a,b,c,d)** with the probabilities **0.4, 0.2, 0.1, and 0.3** respectively. Construct **arithmetic coding** to encode and decode the word **"cab".** [10]

Q.4. a. How edges are detected in digital image using gradient and Laplace operators. [10]

b. Explain following methods of image segmentation by giving appropriate illustrations: (i) region growing (ii) Splitting and merging. [10]

Q.5. a. For a 2x2 transform **A** and the image **U**, Compute the transformed image **V**, and the basis image. Also reconstruct the original image **U** from the transformed image **V**. [10]

$$A=\frac{1}{\sqrt{2}}\begin{bmatrix}1 & 1\\ 1 & -1\end{bmatrix} \quad \textbf{and} \quad U=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}$$

b. Apply Fast Hadamard algorithm to the rows and columns of the 2-D image segment shown below. Show the butterfly diagrams. [10]

0	**1**	**2**	**1**
1	**2**	**3**	**2**
2	**3**	**4**	**3**
1	**2**	**3**	**2**

Q.6. Write short notes on (any Four)

a. Homomorphic Filtering. [5]
b. Opening and Closing. [5]
c. Colour Models. [5]
d. Region Filling [5]
e. Image Compression Models. [5]
