Answer THREE questions only

The figures in brackets indicate the provisional allocation of maximum marks per sub-section of a question.

1.   Explain the significance of the connectivity paradox in digitised binary images, and explain how it can be overcome, using a clear diagram to illustrate your answer.   **[10 marks]**

In digitised grey-level images, the grey-level histogram is of considerable significance. Explain how it is generated, and describe two of its possible uses.   Calculate the results of using each of the techniques you describe on the pixel array given below.   **[10 marks]**

2	3	4	3	2
3	7	8	5	3
4	8	15	8	4
3	6	8	7	3
1	2	3	3	2

2.   Image processing requires specialised hardware.   List, and give brief descriptions of, the major hardware components of an image processing system, explain the purpose of each component and show how they are connected.   **[9 marks]**

Suggest some alternative specialised means of processing image data.   **[1 mark]**

Select one of the specialised devices you have listed, and give a full description of its structure, operation, advantages and disadvantages.   **[10 marks]**

3.   State the circumstances in which second-order statistics can be a useful tool in image segmentation.   **[1 mark]**

To apply second-order statistics, it is necessary to construct one or more co-occurrence matrices.   Describe how such a matrix is constructed from a grey-level image.   **[4 marks]**

Use sketches to indicate how the parameters of such a matrix might be chosen.   **[4 marks]**

Draw and describe a flow chart of the sequence of operations required to use the co-occurrence matrix technique for image segmentation.   Include in your answer considerations of window size and segmentation measure.   **[11 marks]**

4. State the main purpose of applying Fourier analysis to images, and give an example of when the technique might prove effective. What are the characteristics of the transform which make it suitable for the purpose? **[4 marks]**

Give a flowchart of the main operations needed to carry out the purpose you have stated, and give an explanation of each operation, including diagrams where necessary. Illustrate your answer by reference to the transform of a square wave in one dimension. **[12 marks]**

How are Fourier transforms of two-dimensional images usually plotted? Illustrate your answer by sketching the transforms of the following images. **[4 marks]**
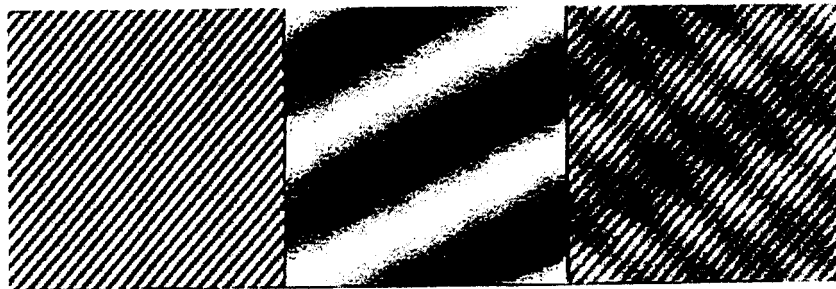
5. Illustrate the differences between Statistical and Syntactic pattern recognition by defining and describing each of the two techniques. **[10 marks]**

Explain the statistical technique known as '1-nearest-neighbour classification', and suggest how the technique can be extended to 'k-nearest-neighbour classification'. **[6 marks]**

Explain the technique known as 'hierarchical image analysis', and describe how it differs from scale space filtering. **[4 marks]**