1. Discuss the significance of sampling and quantization in processing of digital images.

→ In order to create digital image, we need to convert continuous data into digital form. This process involves Sampling and Quantization processes.

* The sampling is the process of converting a signal, (eg, a function of continuous time & space) into a numeric sequence (eg: a function of discrete time & space.

* The Quantization involved in image processing is a lossy compression technique achieved by compressing a range of values to a single quantum value. When the number of discrete symbols in a given stream is reduced, the stream becomes more compressible

The sampling rate determines the spatial resolution of the digitized image, while the quantization level determines the number of grey levels in the digitized image.

2. Discuss the importance of image pre processing in understanding the digital image data.

→ Pre-processing involves operations on images at the lowest level of abstraction where both input and output images are intensity images. The aim of pre processing is an improvement of the image data that eliminates distortions & enhances some image features suitable for further processing.

Image enhancement is the most appealing preprocessing technique. The idea behind enhancement techniques is to bring out detail that is obscured, & simply to highlight certain features of interest in an image such as changing brightness, changing contrast of the image, etc.

Four categories of image pre-processing methods according to the size of the pixel are, pixel brightness transformations, geometric transformations, pre-processing methods that use a local neighborhood of the processed pixel & image restoration that requires knowledge about the entire image.

3. Justify 'image analysis and understanding is an useful task for better society building'.

→ The image analysis, image processing and computer technology related to image processing is an important and essential area which is very useful in better society building. Several problems can be solved through this. There ~~dist~~ a large number of opportunities and challenges in this technical field which foresees many developments. The advances and wide availability of image processing hardware has further enhanced the usefulness of image processing. Some of the major fields in which digital image processing is widely used are, agriculture, augmented reality, autonomous vehicles, biometrics, forensics, face recognition, robotics, security and surveillance, remote sensing, pollution monitoring and so on.

4. Discuss the importance of biometric technology considering the current applications.

→ In nowadays, the role of image information in biometrics is highly used. Various types of biometric information of a person is used in various fields. In many fields biometrics are used for authentication of a person for secure transactions, banking, airport entry, etc. Various kind of biometrics include face signature, palm-print, ear to speech, etc. In forensic applications, biometric details are used for the crime investigation and identify the victim by using fingerprint enhancement and so on. In defense sectors various kinds of biometric such as iris recognition, fingerprint, face, voice, handshape recognition are used. And also in the field of defence using many of the biometric details are made use of. The biometric recognition also includes retina recognition, 3D face, ear shape, keystroke, dental radiograph, etc.

5. Explain image representation.

→ An image is non textual information that can be displayed and printed.

A digital image is a representation of two-dimensional image as a finite set of digital values, called picture elements & pixels.

The smallest addressable image elements is called PIXEL (picture element). The array is called a bitmap.

Pixel values typically represent gray levels, colors, heights, opacities and so on.

Images can be from real or virtual, and can also be described as spatial arrays of values.

Analog image →

$f(x \in R, y \in R) \rightarrow v \in R = i(x,y) * r(x,y)$

Sampling ↓ ↓ Quantization.

Digital image : $f(x \in Z, y \in Z) \rightarrow v \in Z$