CMR
INSTITUTE OF
TECHNOLOGY

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Internal Assesment Test – I

| Sub: | DIP | | | | | | | Code: | 15ECE72 |
|---|---|---|---|---|---|---|---|---|---|
| Date: | / 09 / 2019 | Duration: | 90 mins | Max Marks: | 50 | Sem: | VII | Branch: | ECE |

Answer all Questions

| | | Marks | OBE | |
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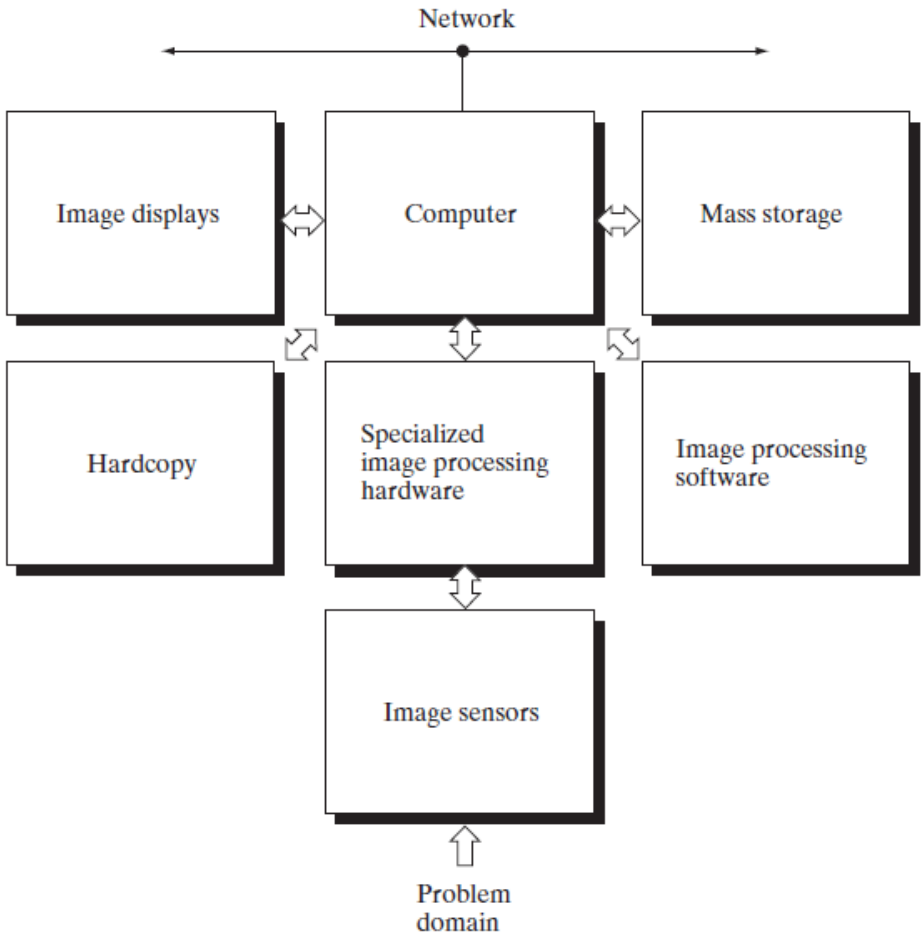
| | | | CO | RBT |
| 1 | Explain the components of digital image processing.<br>**Solution:-** | [10] | CO1 | L1 |




**Block diagram [ 5 marks]**

a typical *general-purpose* system used for digital image processing. The function of each component is discussed in the following paragraphs, starting with image sensing. With reference to *sensing*, two elements are required to acquire digital images. The first is a physical device that is sensitive to the energy radiated by the object we wish to image. The second, called a *digitizer*, is a device for converting the output of the physical sensing device into digital form. For instance, in a digital video camera, the sensors produce an electrical output proportional to light intensity. The digitizer converts these outputs to digital data.

*Specialized image processing hardware* usually consists of the digitizer just mentioned, plus hardware that performs other primitive operations, such as an arithmetic logic unit (ALU), that performs arithmetic and logical operations in parallel on entire images. One example of how an ALU is used is in averaging images as quickly as they are digitized, for the purpose of noise reduction. This type of hardware sometimes is called a *front-end subsystem*, and its most distinguishing characteristic is speed. In other words, this unit performs functions that require fast data throughputs (e.g., digitizing and averaging video images at 30 frames/s) that the typical main computer cannot handle. The *computer* in an image processing system is a general-purpose computer and can range from a PC to a supercomputer. In dedicated applications, sometimes custom computers are used to achieve a required level of performance, but our interest here is on general-purpose image processing systems. In these systems, almost any well-

| | | | | |
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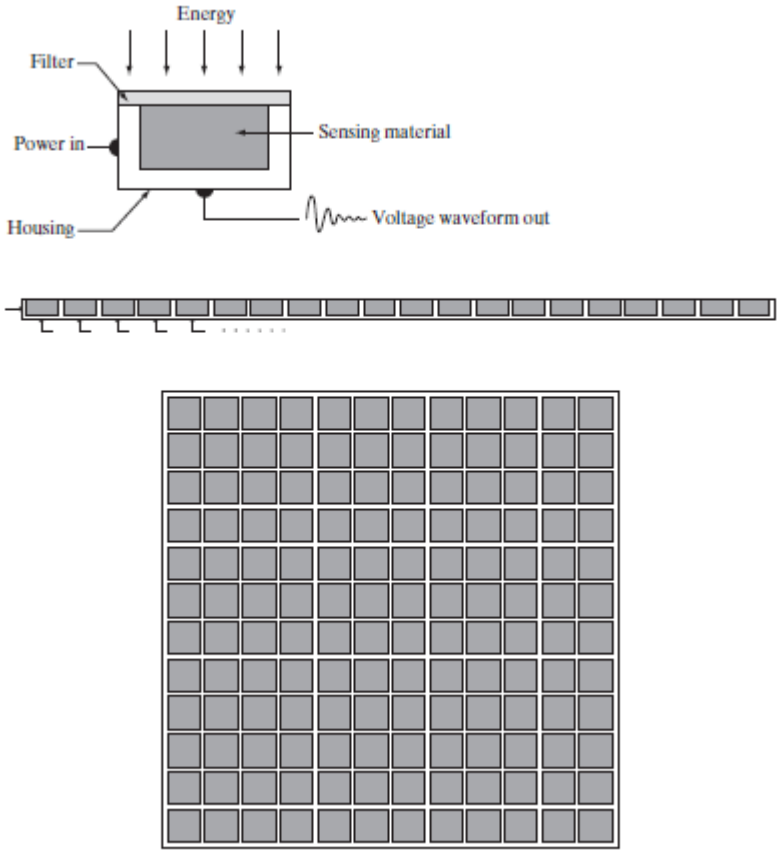
| | equipped PC-type machine is suitable for off-line image processing tasks. *Software* for image processing consists of specialized modules that perform specific tasks. A well-designed package also includes the capability for the user to write code that, as a minimum, utilizes the specialized modules. More sophisticated software packages allow the integration of those modules and general-purpose software commands from at least one computer language.<br>*Mass storage* capability is a must in image processing applications. An image of size pixels, in which the intensity of each pixel is an 8-bit quantity, requires one megabyte of storage space if the image is not compressed. When dealing with thousands, or even millions, of images, providing adequate storage in an image processing system can be a challenge.<br>*Image displays* in use today are mainly color (preferably flat screen) TV monitors. Monitors are driven by the outputs of image and graphics display cards that are an integral part of the computer system. Seldom are there requirements for image display applications that cannot be met by display cards available commercially as part of the computer system. In some cases, it is necessary to have stereo displays, and these are implemented in the form of headgear containing two small displays embedded in goggles worn by the user.<br>*Hardcopy* devices for recording images include laser printers, film cameras, heat-sensitive devices, inkjet units, and digital units, such as optical and CDROM disks. Film provides the highest possible resolution, but paper is the obvious medium of choice for written material. For presentations, images are displayed on film transparencies or in a digital medium if image projection equipment is used. The latter approach is gaining acceptance as the standard for image presentations.<br>*Networking* is almost a default function in any computer system in use today. Because of the large amount of data inherent in image processing applications, the key consideration in image transmission is bandwidth. In dedicated networks, this typically is not a problem, but communications with remote sites via the Internet are not always as efficient. Fortunately, this situation is improving quickly as a result of optical fiber and other broadband technologies.<br>**Explanation 5 Marks** | | | |
| 2 | Explain Image sensing and Acquisition. Explain how digital image is formed<br>**Solutions:-**<br>the three principal sensor arrangements used to transform illumination energy into digital images. The idea is simple: Incoming energy is transformed into a voltage by the combination of input electrical power and sensor material that is responsive to the particular type of energy being detected. The output voltage waveform is the response of the sensor(s), and a digital quantity is obtained from each sensor by digitizing its response. In this section, we look at the principal modalities for image sensing and generation.<br>Image digitizing is discussed<br>  <br><br>**FIG 1** | [10] | CO1 | L1 |

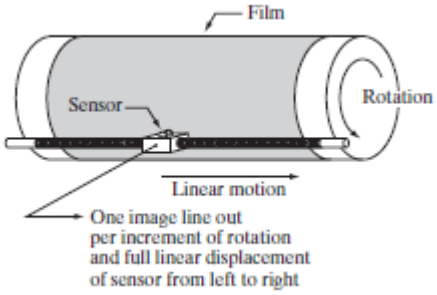
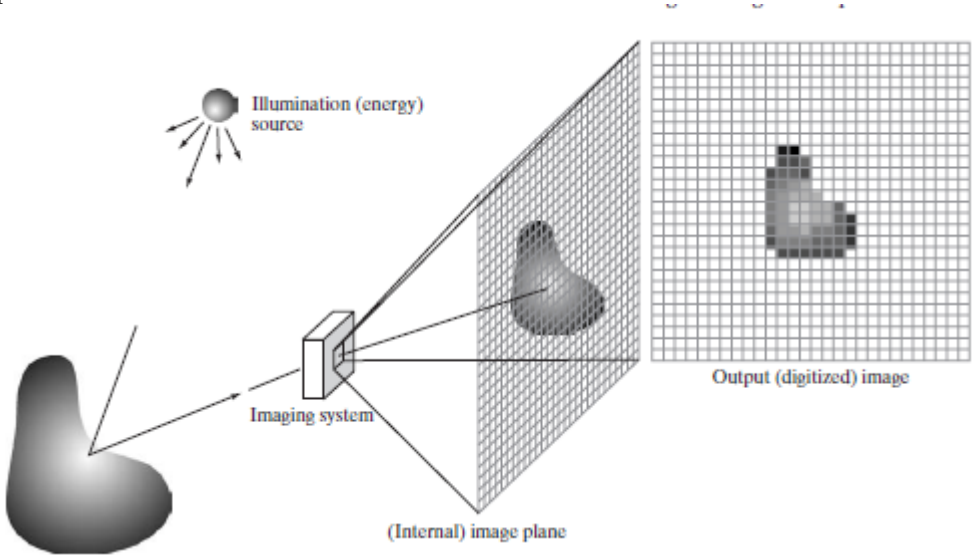



**FIG 2**

**Figures 5 Marks**

**Image Acquisition Using a Single Sensor**

Figure 2 shows the components of a single sensor. Perhaps the most familiar sensor of this type is the photodiode, which is constructed of silicon materials and whose output voltage waveform is proportional to light.The use of a filter in front of a sensor improves selectivity. For example, a green (pass) filter in front of a light sensor favors light in the green band of the color spectrum. As a consequence, the sensor output will be stronger for green light than for other components in the visible spectrum. In order to generate a 2-D image using a single sensor, there has to be relative displacements in both the *x*- and *y*-directions between the sensor and the area to be imaged. Figure 2 shows an arrangement used in high-precision scanning, where a film negative is mounted onto a drum whose mechanical rotation provides displacement in one dimension. The single sensor is mounted on a lead screw that provides motion in the perpendicular direction




Above figure shows image formation from sensor and digital image formed by sampling and quantiazation.

**Explanation of Image forming 5 Marks**

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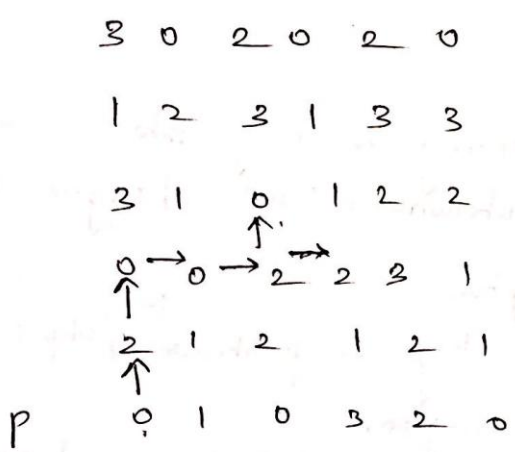
| 3 | For the given Image matrix, obtain short path 4 Adjacency, 8 Adjacency, and M Adjacency, for i) [0,2] ii) [0 1 3] also note the distance calculation between pixel p and q<br><br>3 0 2 0 2 0 q<br>1 2 3 1 3 3<br>3 1 0 1 2 2<br>0 0 2 2 3 1<br>2 1 2 1 2 1<br>p 0 1 0 3 2 0<br><br>**Solutions:-** | [10] | CO1 | L2 |

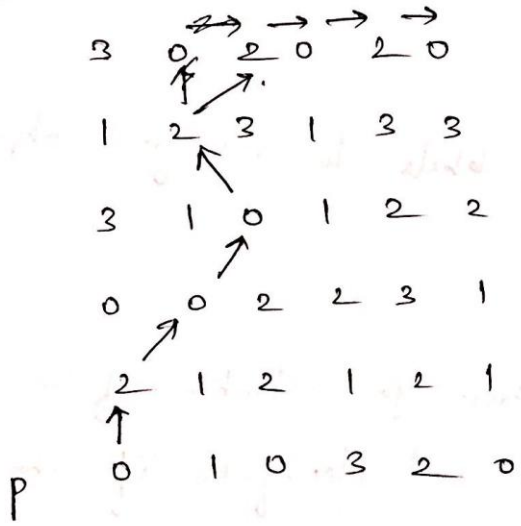
i) V = (0, 2).

4 adjacency.



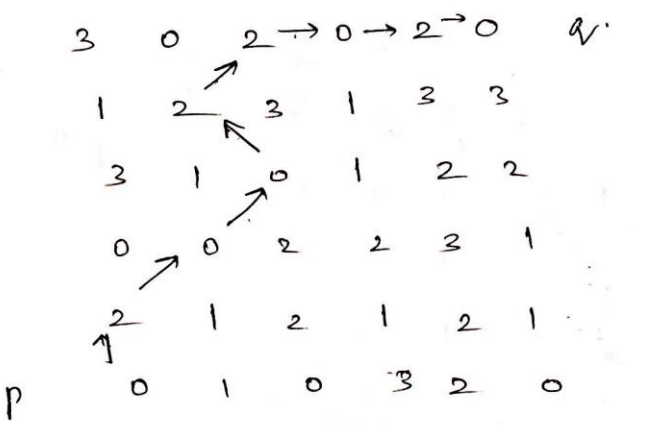

The path cannot be completed.

8- adjacency.



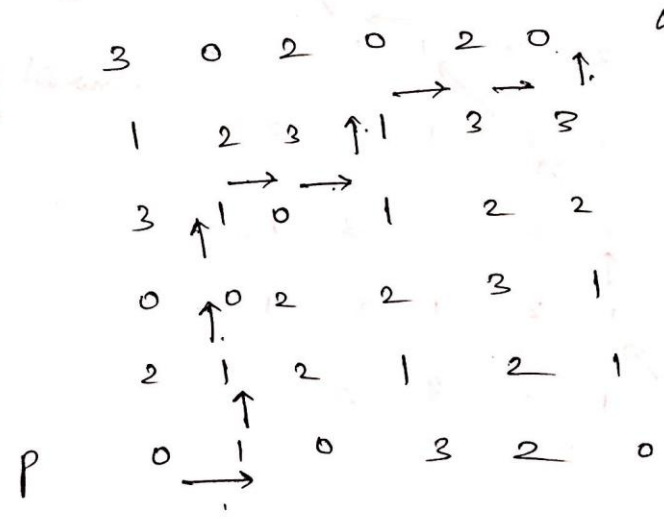

Shortest path = 8

M- adjacency.

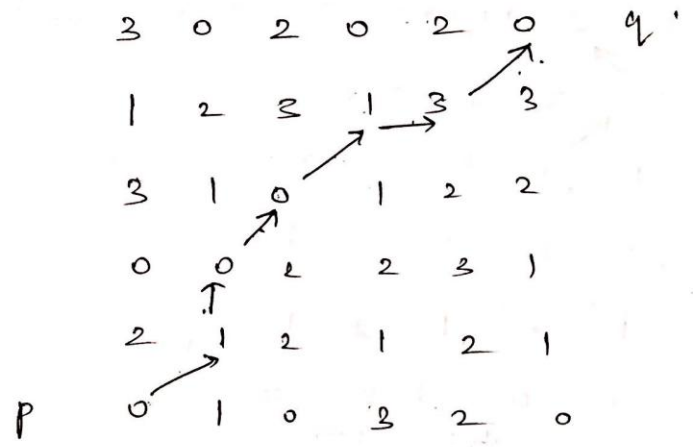



V = [0, 1, 3]

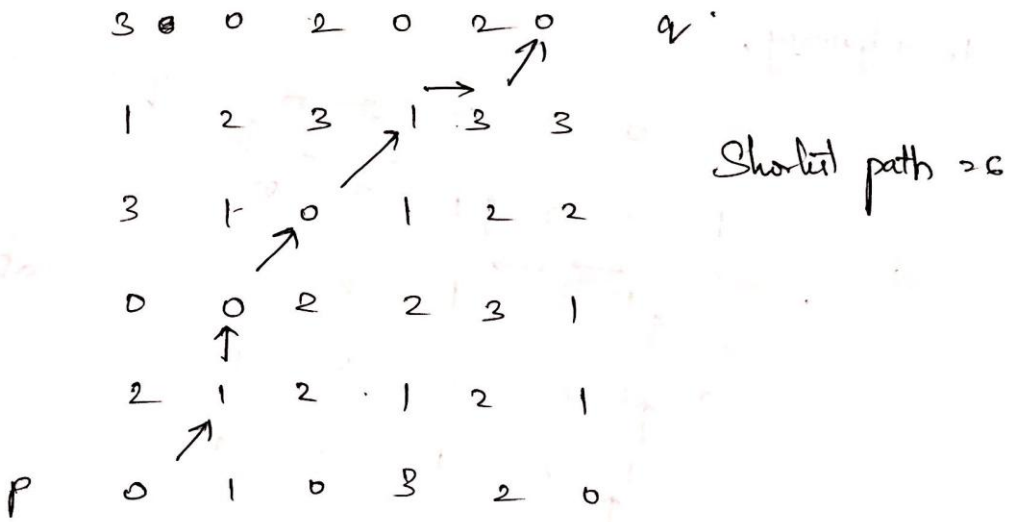
4- adjacency.



8 – adjacency.




M – adjacency.




**Each Adjacent solution 3 Marks, Distance calculation 1 Marks**

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| 4 | What is Interpolation technique, Explain different Interpolation technique with example<br><br>➢ Solution :- Interpolation is the process of using known data to estimate values at unknown locations.<br>➢ Interpolation is the process of determining the values of a function at positions lying between its samples.<br>☐ It is the basic tool used extensively in tasks such as zooming, Shrinking, rotating and geometric corrections.<br><br>The process of interpolation is one of the fundamental operations in image processing. The image quality highly depends on the used interpolation technique.<br>• Nearest neighbor interpolation,<br>• Pixel Replication, | [10] | CO2 | L1 |

- Bilinear interpolation
- Bicubic Interpolation

**Definition 2 Marks**

**Nearest neighbor interpolation:**
Suppose that we have an image of size 500 × 500 pixels and we want to enlarge it 1.5 times to 750 × 750 pixels. Conceptually, one of the easiest ways to visualize zooming is laying an imaginary 750 × 750 grid over the original image. Obviously, the spacing in the grid would be less than one pixel because we are fitting it over a smaller image. In order to perform gray-level assignment for any point in the overlay, we look for the closest pixel in the original image and assign its gray level to the new pixel in the grid. When we are done with all points in the overlay grid, we simply expand it to the original specified size to obtain the zoomed image. This method of gray-level assignment is called nearest neighbor interpolation.

**Pixel replication**,
Pixel replication is applicable when we want to increase the size of an image an integer number of times. For instance, to double the size of an image, we can duplicate each column. This doubles the image size in the horizontal direction. Then, we duplicate each row of the enlarged image to double the size in the vertical direction. The same procedure is used to enlarge the image by any integer number of times (triple, quadruple, and so on). Duplication is just done the required number of times to achieve the desired size. The gray-level assignment of each pixel is predetermined by the fact that new locations are exact duplicates of old locations. Although nearest neighbor interpolation is fast, it has the undesirable feature that it produces a checkerboard effect that is particularly objectionable at high factors of magnification,

**Bilinear interpolation:**
A slightly more sophisticated way of accomplishing gray-level assignments is bilinear interpolation using the four nearest neighbors of a point. Let (x', y') denote the coordinates of a point in the zoomed image and let v(x', y') denote the gray level assigned to it. For bilinear interpolation, the assigned gray level is given by: $v(x', y') = ax' + by' + cx'y' + d$ where; the four co-efficients are determined from the four equations in four unknowns that can be written using the four nearest neighbors of point $(x', y')$It is possible to use more neighbors for interpolation. Using more neighbors implies fitting the points with a more complex surface, which generally gives smoother results. This is an exceptionally important consideration in image generation for 3-D graphics and in medical image processing, but the extra computational burden seldom is justifiable for general-purpose digital image zooming and shrinking, where bilinear interpolation generally is the method of choice.

**Bi cubic Interpolation**
Involves sixteen neighbors to estimate intensity $V(x, y) = \sum\sum a_{ij} x^i y^j$ ( i, j = 0 to 3) Need to solve sixteen equations Gives better results than other methods More complexUsed in Adobe Photoshop, and Corel Photopaint

**Each explanation 2 Marks**

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| 5 | Mention any 5 fields that use digital image processing<br><br>**Solution :-**<br>1. **Gamma-Ray Imaging**<br>Major uses of Uses of **Gamma-Ray Imaging include** nuclear medicine, astronomical observations.<br>•Nuclear medicine: patient is injected with radioactive isotope that emits gamma rays as it decays. Images are produced from emissions collected by detectors. | [10] | CO2 | L2 |

**2. X-Ray Imaging**

Oldest source of EM radiation for imaging
•Used for CAT scans
•Used for angiograms where X-ray contrast medium is injected through catheter to enhance contrast at site to be studied.
•Industrial inspection
CT Image: Computed Tomography(good for hard tissues such as bones.
In CT each slice of human body is imaged by means of X-ray and then a number of such images are piled up to form a volumetric representation of a body or specific part.

**3. Imaging in the Microwave Band:**
The dominant application of imaging in the microwave band is radar.
The imaging radar has the ability to collect data over any region at any time regardless of weather or ambient lighting conditions.

**4. Imaging in the Radio Band.**
The major application is in the field of medicine which includes MRI.
MRI: Magnetic Resonance Imaging very similar to CT Imaging, provides more detailed images of the soft tissues of the body. It can be used to study both structure and function of a body.
Difference between CT and MRI is the imaging radiation. Ct uses ionizing radiation such as X-ray whereas MRI uses a powerful magnetic field.
Thermal Image: Thermographic camera used to capture images in night vision.

**5. Imaging in the Visible band and infrared band:**

Infraband applications:
Industrial inspection
-inspect for missing parts
-missing pills
-unacceptable bottle fill
-unacceptable air pockets
-anomalies in cereal color
-incorrectly manufactured replacement lens for eyes
Imaging in visible band

- Face detection &recognition
- Iris Recognition
- Number Plate recognition

**2 Marks Each**