Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent institution of MAHE, Manipal)

VI SEMESTER B.TECH. (MECHATRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, APRIL 2018

SUBJECT: MACHINE VISION AND IMAGE PROCESSING [MTE 4006]

(26/04/2018)

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

- Answer **All** the questions.
- Data not provided may be suitably assumed with justification.

1A. An automatic fruit plucker plucks olives from tree. The plucked things are put on a processing line for separation of olives from leafs and other unwanted materials. For this, the dealer wants to use image processing technique to identify the edges of olives and other materials. So he decides to use Canny edge detection technique. Help him to find the edges from the given images by describing the steps involved in canny edge detection. **04**

1B. Consider a one-dimensional signal that constitutes some edges and variations depicted in Fig.Q1B. Obtain the responses when the gradient (1st order derivative) and Laplacian (2nd order derivative) operations are applied to this signal. Write the inferences made from these operations. **03**

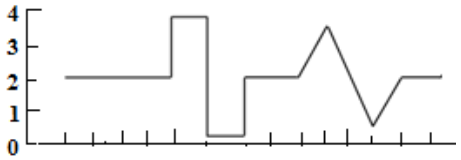

Fig.Q1B

1C. Describe the circular Hough transform for identifying the wheels shown in Fig.Q1C. Assume the radius of the circular component is given. **03**

Fig.Q1C

2A. Discuss the intrinsic and extrinsic camera parameters which are needed to reconstruct the 3D structure of a scene from the pixel coordinates of its image points. **05**

2B. Imagine there is crossing D and a car C is approaching the crossing. There is a 6 km and 2 km sign board at point A and B as shown in the Fig.Q2B (i). However when an image is captured from the satellite it looks as shown in Fig. Q2B(ii) which is the perspective projection of the roads. Consider point A' is at 6 km sign and B' at 2 km sign board. In Fig. Q2B(ii), C' and D' are the points of car and crossing respectively. The coordinates of the pixels in the image are observed and the distance in pixels are given as A'D' =500 pixels, A'C' =475 pixels, B'C'=100 pixels. Using the data provided calculate the distance of the car C from the crossing D in kilometers. **03**

Also describe the technique used to calculate the distance.

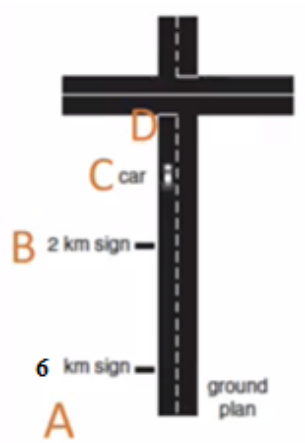

Fig. Q2B(i)

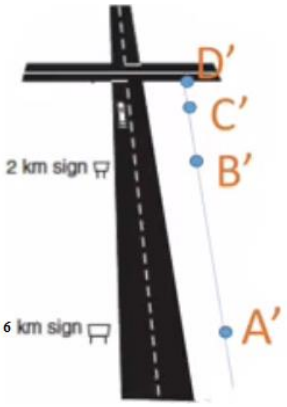

Fig. Q2B(ii)

2C. A skilled medical technician is charged with the job of inspecting a certain class of images generated by an electron microscope. In order to simplify the inspection task, the technician decides to use digital image enhancement and, to this end, examines a set of representative images and finds the following problems: **02**

(i) Bright, isolated dots that are of no interest; (ii) lack of sharpness; (iii) not enough contrast in some images. (iv)The technician wants to correct these problems and then display in white all grey levels in band between I_1 and I_2, while keeping normal tonality in the remaining grey levels.

Propose a sequence of processing steps that the technician can follow to achieve the desired goal.

3A. To be a good photographer, one must know how to control the exposure of a picture. Describe the various camera settings which determines how dark or how bright an image is when it is captured by a camera. **04**

3B. The image shown in Fig.Q3B is corrupted by Gaussian noise. List the reasons for this kind of noise in an image. Describe the probability density function (PDF) of the noise using histogram plot. **03**

With the help of mathematical expressions, propose a frequency domain image enhancement technique to remove noise present in this image.

Fig.Q3B

3C. With reference to the image shown in Fig.Q3C (i), identify the structuring element and morphological operations that produced each of the results shown in Fig.Q3C (ii), Fig.Q3C (iii), Fig.Q3C (iv), and Fig.Q3C (v). **03**

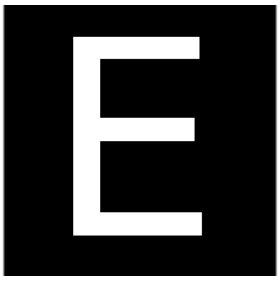

Fig.Q3C (i)

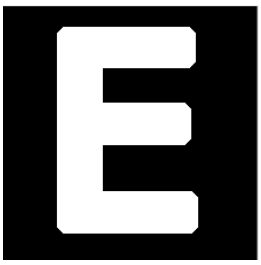

Fig.Q3C (ii)

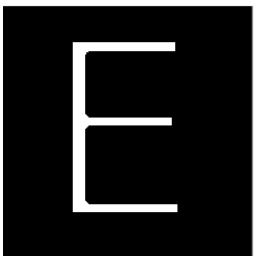

Fig.Q3C (iii)

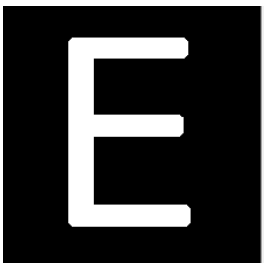

Fig.Q3C (iv)

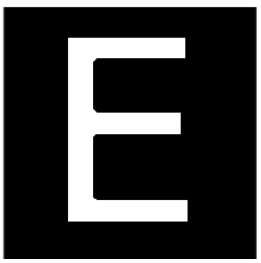

Fig.Q3C (v)

4A. Define tracking. A robot is being developed to play football. The robot needs to track the motion of the ball. For this, the designer decides to use Kalman filtering. With help of mathematical equations describe Kalman filtering and the advantages of kalman filtering. **05**

4B. A photo of Mr. XYZ which was captured during his childhood days in given in Fig.Q4B. Due to some reason the photo has blurred and he wants to reconstruct the image to get a better appearance. The camera in which this image was captured is not available now. As an image processing expert, elucidate an image restoration technique which will help Mr.XYZ to get a better image from this degraded image. **03**

Fig.Q4B

4C. In character recognition application, text pages are reduced to binary form using a thresholding transformation function. This is followed by a procedure that thins the characters until they become strings of binary 1's on a background of 0's. Due to noise, the binarization and thinning processes result in broken strings of characters with gaps ranging from 1 to 3 pixels. One way to "repair" the gaps is to run an averaging mask over the binary image to blur it, and thus create bridges of non-zero pixels between gaps. Describe the averaging mask and give the size of the smallest averaging mask capable of performing this task. **02**

5A. With the help of mathematical expression explain basic morphological operations: Dilation and Erosion. **06**

Let A denote the set shown shaded in the Fig.Q5A(i). Refer to the structure elements B and C are shown in Fig.Q5A(ii) and Fig.Q5A(iii) respectively (the black dot denote origin). Sketch the result of following morphological operations: (Draw the intermediate stage also).

(i) $(A \ominus B) \oplus C$

(ii) $(A \oplus B) \oplus C$

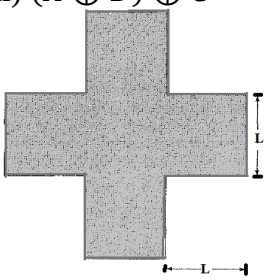

Fig.Q5A(i)

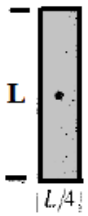

Fig.Q5A(ii)

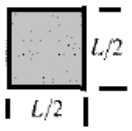

Fig.Q5A(iii)

5B. Define histogram of a grey scale image. The histogram plot of image shown in Fig.Q5B (i) is given in Fig.Q5B (ii). With respect to this, plot the histograms of the images shown in Fig.Q5B(iii), Fig.Q5B (iv), Fig.Q5B(v), and comment on the contrast of these images. **04**

Fig.Q5B(i)

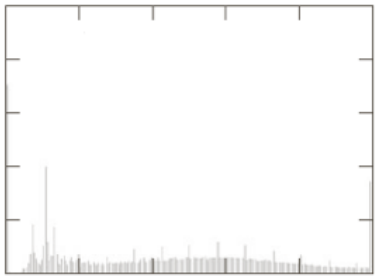

Fig.Q5B(ii)

Fig.Q5B(iii)

Fig.Q5B(iv)

Fig.Q5B(v)