Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SIXTH SEMESTER B.TECH. (E & C) DEGREE END SEMESTER EXAMINATION
APRIL/MAY 2019
SUBJECT: COMPUTER VISION (ECE - 4038)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates

- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. Describe textons in the context of images with textures. List three kinds of texture representations. Define a gray scale co-occurrence matrix used for texture representation. Given the 2-bit grayscale image shown in **Fig. 1A**, calculate the following grayscale co-occurrence matrices: $C_{(0,1)}$, $C_{(1,0)}$, $C_{(1,1)}$.

1B. With the help of a suitable diagram, derive the perspective projection equation. Describe optical axis and image center with the help of a suitable diagram.

(6+4)

2A. Consider the following RGB image shown in **Fig. 2A** composed of solid (pure) color squares. Identify the Hue and Saturation (HS) component/matrices for this color image.

2B. Describe the algorithm to compute Histogram of Oriented gradient feature.

2C Explain in detail the Harris corner detector algorithm. Describe whether the Harris corner detector is invariant to translation and rotation.

(4+3+3)

3A. Given data points x_i drawn from the probability density $p(x) = \sum_i c_i e^{\frac{-(x-x_i)^2}{2\sigma^2}}$

where x_i is the i^{th} data point, σ is the standard deviation of the Gaussian and c_i is a constant. Show that the mean shift vector has the direction of the gradient of the density estimate. Describe in detail each step of finding the densest region in the given data using the mean shift vector.

3B. Explain the epipolar constraint. With the help of a diagram, describe the following terms: Epipolar Plane, Epipolar line, Epipoles. Given two image points *p, p'* corresponding to the 3D scene point *P*. Suppose the image points *p, p'* and camera projection matrices *M, Q* are known. Discuss two different approaches to estimate the 3D scene point *P*.

(5+5)

4A. Explain agglomerative clustering and divisive clustering. Discuss the similarities between watershed segmentation and agglomerative clustering.

4B. In the topographical interpretation of the image used in watershed segmentation, explain the three different types of points present in the image with a help of a suitable figure. Identify the points that we obtain using the watershed segmentation.

4C. Given the observed data $(x_i,y_i), i = 1,\ldots,N$ for fitting a line using probabilistic models. Assume the following model: x coordinate is generated from a uniform distribution, and y coordinate is generated by finding the point ax_i+b on the line corresponding to the x coordinate then adding a zero mean normally distributed random variable. Show that maximizing the likelihood of the data is equivalent to least square line fitting.

(4+3+3)

5A. Given a labeled dataset containing images acquired from the dashboard camera of a car. This dataset will be utilized for designing a classifier to detect the presence of a person (pedestrian) in the image. The classifier labels would be Pedestrian and Non-Pedestrian. Suggest an appropriate feature vector for this pedestrian detection classifier. Justify your choice. Select the preferred classification strategy among the k-nearest neighbor classifier and SVM classifier for this pedestrian detection task. Justify your answer. Describe cross-validation used in classification.

5B. Describe two different approaches to build multi-class classifier from a binary classifier. Discuss the shortcomings of each approach. Describe hard negative mining and bootstrapping used in classification.

(5+5)

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

Fig. 1A

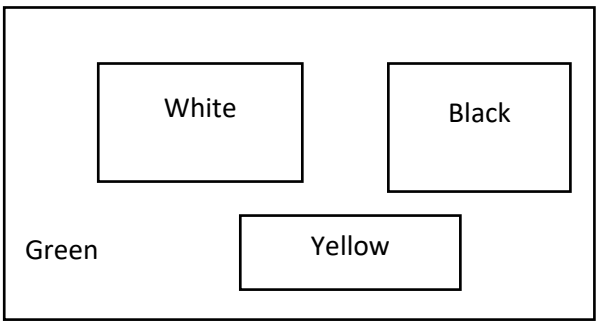

Fig. 2A