Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

FIFTH SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION
NOV/DEC 2015
SUBJECT: COMPUTER VISION (ECE - 333)

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

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. Define histogram of an image. Give one example of a dark image, bright image, low contrast image and high contrast image. Sketch the histogram for each of these four images assuming them to be a 8-bit grayscale image. Given an 8 x 8 3-bit grayscale image shown below, compute the normalized histogram of this image.

4	5	4	4	4	4	4	4
4	4	4	4	4	4	4	4
4	4	4	4	4	4	4	4
5	4	4	4	4	4	4	4
5	4	4	4	4	4	4	4
5	4	4	4	4	4	4	4
5	4	4	4	4	4	4	4
5	4	4	4	4	4	4	4

1B.

Draw RGB color cube. Consider the following RGB image shown in Figure 1B composed of solid (pure) color squares. Identify the R,G,B component/matrices for this image

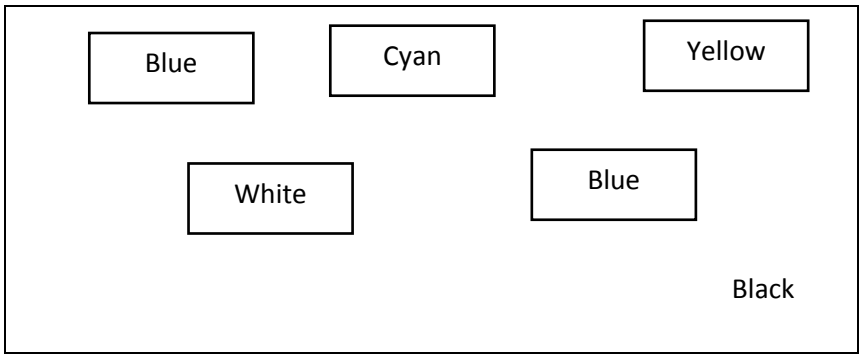

Figure 1B.

1C. Differentiate between distant point light source and area source. Give example of each.

(5+3+2)

2A. Given an image consisting texture (eg: bricks etc), describe the different steps of the algorithm (in detail) to represent the texture using filters.

2B. State the Hessian matrix H used in Harris corner detector. Describe the characteristics of this matrix in a window containing a) edge only b) a corner only and c) flat/uniform region. Discuss the Harris corner detector algorithm.

2C. Describe two application areas/images where the user would want to synthesize textures.

(5+3+2)

3A. Given an image of size 256 x 256 consisting of textures only and we wish to create an output texture image of larger size (i.e. greater than 257 x 257). Describe the algorithm for texture synthesis by sampling local models (non-parametric texture synthesis) in order to obtain the desired output image. Clearly discuss the similarity function used and the effect of increasing the size of the neighbourhood.

3B. Differentiate between specular reflection and diffuse reflection. Give examples of surfaces that exhibits specular and diffuse reflection. In an indoor environment with white walls (eg: MIT classroom), explain the absence of any visible shadows.

3C. With the help of a diagram, define the following terms: Epipolar plane, Epipolar line, Epipoles.

(5+3+2)

4A. Discuss in detail the different steps of background subtraction algorithm used in image segmentation. Give at least two example application/images where background subtraction can be used for segmentation.

4B. Given the observed data $(x_i,y_i), i = 1,\ldots,N$ we wish to fit 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.

4C. Define superpixels. List at least one application where superpixels are particularly useful.

(5+3+2)

5A. Assume that $L(i->j)$ is the loss incurred when an object of class i is classified as having class j. For a two class classifier with class 1 and class 2, show that the we select class 1 if $p(1|x)L(1->2) > p(2 | x) L(2 ->1)$; where $p(k|x)$ is the posterior probability of class k given feature vector x. Describe the multi class Bayes classifier that minimizes total risk.

5B. Given two image pair of a scene, describe the process of computing the rectified images. Discuss the advantage(s) of using the rectified image pair in 3D reconstruction of the scene.

5C. With the help of a diagram, define the normalized image plane. Give a 3 x 4 matrix M, state the necessary and sufficient condition for the M to be a perspective projection matrix.

(5+3+2)

6A. Given data points 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 mean shift vector.

6B. Describe two different approaches to build multi-class classifier from a binary classifier. Discuss the disadvantage(s) of each approaches.

6C. With the help of a suitable example/diagram, describe the phenomena of over-fitting in classification. List one possible solution to avoid over-fitting.

(5+3+2)