Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)
END SEMESTER EXAMINATIONS, NOVEMBER 2019

APPLICATIONS OF DSP [ELE 4014]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 26 November 2019** **Max. Marks: 50**

Instructions to Candidates:

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

1A. (i) What is a multiplicatively separable discrete space 2D function?

(ii) Fourier transform of a separable function is separable? Prove or disprove it.

(iii) Give one example each for low-pass and high-pass filtering separable kernels. ***(03)***

1B. Perform the linear convolution between the following sequences:

$$f(x,y) = \begin{bmatrix} 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix}; h(x,y) = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}.$$

(03)

1C. State and prove the continuous space Fourier transform of the rotated image $\boldsymbol{f}(\mathbf{A}\bar{\mathbf{x}})$, where, $\mathbf{A}$ is a (2×2) rotation matrix and $\boldsymbol{x}$ is the argument vector of the function $\boldsymbol{f}$ in 2D. ***(04)***

2A. It is desired to perform image smoothing using a (5×5) Bartlett (triangular) filter.

(i) How to perform it using only box (square-sized) filters? Comment on the number and dimension of the box kernels to be used.

(ii) What is the resulting function of convolving multiple box kernels in the spatial domain? What is the resulting function of this operation in the frequency domain? ***(03)***

2B. Perform histogram equalization of the 3-bit image given below (Do not roundoff the computational results):

4	4	4	4	4
3	4	5	4	3
3	5	5	5	3
3	4	5	4	3
4	4	4	4	4

(04)

2C. Derive the Sobel edge detector. Explain the compass operator based on Sobel edge detector. ***(03)***

3A. Identify the salt and pepper noise location in the 8-bit image given below (Do not roundoff the computational results):

124	122	133	125	132	124
134	255	124	000	126	123
123	121	132	131	128	126

Perform the (3×3) weighted median filtering on the image assuming pixel replication on the boundary of the image. ***(03)***

3B. Derive an expression for the 2D Laplacian operator. Extend it to derive an expression for 2D Laplacian-of-Gaussian (LoG) for a unit valued, zero mean and constant variance Gaussian. Draw waveforms for the Gaussian and its first and second derivatives. ***(04)***

3C. With a neat block diagram explain the image restoration model. ***(03)***

4A. What is matched filtering? Explain *cosine similarity measure* to detect the region of interest in an image. ***(03)***

4B. With a neat flow-chart explain the automatic thresholding algorithm. ***(02)***

4C. What is image segmentation? Explain mathematical modeling of the cost function of the circular shape-template based image segmentation. ***(05)***

5A. Write short notes on geometric transformations of an image such as translation, scaling, and shearing. ***(03)***

5B. Explain the following morphological operations:

(i) Closing (ii) Opening (iii) Hit-or-miss transform. ***(03)***

5C. Derive expressions for 1D-DCT using DFTs. Use the same to write expression for 2D-DCT. List the uses of DCTs. ***(04)***