Reg. No.									

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent Institution of MAHE, Manipal)

VII SEMESTER B.TECH (ELECTRICAL & ELECTRONICS ENGINEERING)

END SEMESTER EXAMINATIONS, NOVEMBER 2018

SUBJECT: APPLICATIONS OF DSP [ELE 4014]

REVISED CREDIT SYSTEM

Time: 3 Hours **Date: 29 November 2018** **Max. Marks: 50**

Instructions to Candidates:

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

1A. State and prove the energy preservation property for 2D discrete space Fourier transforms. ***(02)***

1B. State and prove the continuous space Fourier transform of the rotated and translated image $f(A\bar{x} + \bar{b})$, where, A is a (2×2) rotation matrix and b is the spatial shift vector in 2D. ***(04)***

1C. Derive relevant expressions for 2D sampling and its effect in the frequency domain. Give the reconstruction formula using 2D-Sinc interpolators. (Hint: Derive 1D expressions and map them to 2D). ***(04)***

2A. Given an image of size (3×3) as $f(x,y)=\begin{pmatrix} 128 & 212 & 255 \\ 54 & 62 & 124 \\ 140 & 152 & 156 \end{pmatrix}$. Determine the output image $g(x,y)$ using logarithmic transformation. Choose the weight for the log function as one. ***(02)***

2B. Explain bit plane slicing technique of an image?

(i) What would be the effect on the histogram if we set to zero the higher-order bit plane?

(ii) What would be the effect of setting to zero the lower-order (up to four) bit planes on the histogram of an image in general? ***(03)***

2C. Derive an expression for 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 given Gaussian and its first and second derivatives. ***(05)***

3A. Using (3×3) mask, perform weighted median filtering on the image given below:

18	22	33	25	32	24
34	128	24	172	26	23
22	19	32	31	28	26

Assuming mirror boundary conditions, obtain a (3×6) output image. ***(04)***

3B. (i) Explain the image degradation and restoration model.

(ii) Write short notes on impulse and Gaussian noise models. ***(04)***

3C. What is a bilateral filter? Explain. Mention its applications. ***(02)***

4A. (i) An (8×8) image $f(x, y)$ has gray levels given by the following equation:

$$f(x, y) = |x - y|; \qquad x, y = 0, 1, 2, 3, 4, 5, 6, 7.$$

Find the output image obtained by applying a (3×3) mean filter on the image $f(x, y)$; keep the border pixels unchanged.

(ii) Prove that the mean filter kernel behaves like a low-pass filter by deriving its Fourier transform. Assume that the filter kernel's hot spot (center pixel) is at the origin. ***(05)***

4B. Write short notes on 2D Butterworth low pass filter. Is it possible to construct a band pass filter using high pass and low pass filters? If yes, how? If no, why? ***(02)***

4C. With relevant (3×3) filter masks, explain:

(i) Sobel (ii) High-boost, and (iii) Gaussian filtering ***(03)***

5A. Derive expressions for 1D-DCT using DFTs. Use the same to write expression for 2D-DCT. List the uses of DCTs. ***(03)***

5B. Perform the hit-or-miss operation using the structuring elements B_1 and B_2 in Fig. (5B1) on the image given in Fig. (5B2).

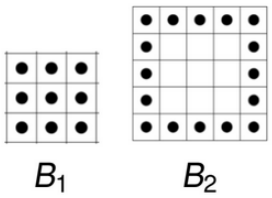

Fig. (5B1)

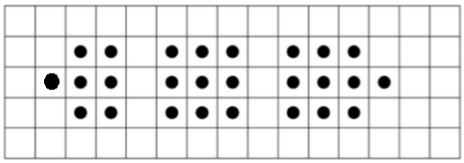

Fig. (5B2)

(03)

5C. Explain the following morphological operations:

(i) Dilation (ii) Erosion (iii) Closing (iv) Opening ***(04)***