Total number of printed pages: **UG/6TH/UECE616A**

2023

DIGITAL IMAGE PROCESSING

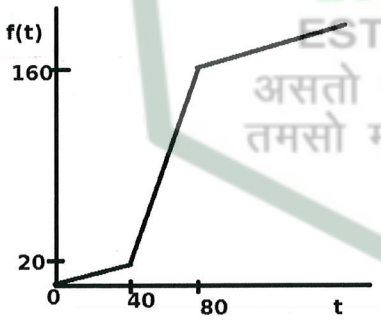
Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1.	a)	State application of image processing in automation industry and medical industries.	4
	b)	Briefly describe the utility of the following image processing technologies a) Image enhancement b) Denoising c) Image restoration d) Image compression	4x4
2	a)	State sampling theorem for 2D image processing. Draw he neat diagram of the frequency domain characteristic of the spectrum of the sampled signal.	3+9
	c)	State Aliasing effect in 2D sampling. State how to reconstruct the original signal from the sampled signal.	3+5
3	a)	State the formula of 2D convolution. Perform 2D convolution of the following sequences: i) $x_1=[1,2,3,4], x_2=[3,2,4,1]$ ii) $x_1=\begin{bmatrix}2 & 3\\ 3 & 4\end{bmatrix}, x_2=\begin{bmatrix}3 & 1\\ 4 & 2\end{bmatrix}$	2+5+5
	b)	A filter mask $h=\begin{bmatrix}0 & 1 & 0\\ 1 & -4 & 1\\ 0 & 1 & 0\end{bmatrix}$ is applied on a 4 x4 image B at the center position marked in bold letter. Find the filtered image intensity at that position.	8

		$h=\begin{bmatrix} 68 & 47 & 68 & 64 \\ 64 & 64 & 64 & 66 \\ 22 & 24 & 24 & 24 \\ 24 & 24 & 26 & 24 \end{bmatrix}$	
4	a)	State the forward and inverse equation for DFT and DCT.	1x4
	b)	State the advantages of DCT over DFT	4
	c)	Find 4 point Kernal matrix for DFT and DCT.	8
	d)	Perform the 4-point FFT for the following sequence x=[3 2 4 6]	4
5	a)	State a few techniques for image enhancements. The image $A=\begin{bmatrix} 68 & 47 & 68 & 64 \\ 64 & 64 & 64 & 66 \\ 22 & 24 & 24 & 24 \\ 24 & 24 & 26 & 24 \end{bmatrix}$ undergoes a contrast stretching operation as shown in the following figure. Find the intensity values at A(2,2), A(2,3) and A(3,2)  	6+6
	b)	State the difference between histogram equalization and histogram specification. An image has a given histogram in the following table. Find the equalized histogram.	8

		<table><tr><td>s=0</td><td>s=1</td><td>s=2</td><td>s=3</td><td>s=4</td><td>s=5</td><td>s=6</td><td>s=7</td></tr><tr><td>.25</td><td>.2</td><td>.05</td><td>0</td><td>.05</td><td>.05</td><td>.2</td><td>.25</td></tr></table>	
6	a)	What do you mean by image degradation and restoration? What is inverse filtering. State its limitations.	3+3
	b)	State least square error(LSE) approach for image restoration.	6
	c)	Model mathematically the motion blur caused due to the large shutter speed of the camera. State how you can compensate the motion blur using a reconstruction filter?	8
7		Write short notes (Any two) a) Homomorphic filtering b) FFT c) JPEG d) K-L transform	10x2