Total number of printed pages: **Programme(UG)/UECE616A**

2024

DIGITAL IMAGE PROCESSING

Full Marks : 100

Time : Three hours

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

*Answer Q-1 and **any four** questions.*

1.	A	Select the correct alternative	10x1
	a)	a) Which of the following is Nyquist criteria for sampling of an image i) $f_{xs}=2f_x; f_{ys}=2f_y$ ii) $f_{xs}\geq 2f_x; f_{ys}\geq 2f_y$ c) $f_{xs}\leq 2f_x; f_{ys}\geq 2f_y$ iv) $f_{xs}\geq 2f_x$	
	b)	Which of the following transformation is a Non-Kernal based transformation: i) DFT, ii) DHT iii) DWT iv) K-L transform	
	c)	f and g are two discrete sequence of length 4 and 5 respectively. The length of $f * g$ will be: i) 10 ii) 8 iii) 9 iv) 5	
	d)	if $x(n)=[1234]$ and its Fourier transform is X(k). Find X (0) ..... i) 10 ii) 22 iii) 3+4j iv) 4-3j	
	e)	How many intensity levels are present in an 8 bit image i) 8 ii) 16 iii) 128 iv) 256	
	f)	Which of the following transformation is used in JPEG i) DCT ii) FFT iii) DHT iv) K-L transform	
	g)	Which of the following in not an image enhancement algorithm	
		i) Histogram equalization, ii) Histogram specification, iii) Contrast stretching iv) JPEG	
	h)	Which filter can be used for edge sharpening of a digital image	
		i)Mean filter, ii) Median filter iii) Wiener filter iv) High-boost filter	

	i)	Wiener filter uses …….. approach	
		i)MMSE, ii) LSE iii) constrained LSE iv) None of the above	
	j)	Examples of entropy coding is	
		I) Run length coding ii) DPCM iii) LZW-coding iv) Huffman coding	
B		Answer the following questions	2x5
	a)	The resulting intensity of the 3x3 image after applying averaging filter is…… $I = \begin{bmatrix} 4 & 2 & 6 \\ 8 & \otimes 4 & 0 \\ 2 & 6 & 4 \end{bmatrix}$	
	b)	Laplacian of I in the above question at the marked point is.....	
	c)	x-[2 3 4] and y=[0 1 2]; Find cross correlation matrix R_{xy} .	
	d)	A pixel (4,8) is translated by (6,-2) and rotated by 180 degree. Find its new coordinate.	
	e)	Let, X=[-1 1 1 -1] and Y=[-1 1 -1 1]. Are X and Y mutually orthogonal?	
2)	a)	A band limited continuous image is sampled with sampling frequency ω_x and ω_y. Write the mathematical expression of the sampled image. Draw the frequency domain representation of the image and explain the effect of Aliasing. How the continuous image can be reconstructed from the sampled image?	5+5+4
	b)	Perform one dimensional convolution of the following sequences x1(n)=[1 7 3 4]; x2(n)=[2 3 1 4]	6
3)	a)	Name any five image enhancement algorithms and write their intensity transformation equations.	3
	b)	An image with the pdf shown in Fig(3.a) is needed to be converted in an image with pdf as shown in Fig.(3.b). Find the transformation function.	10

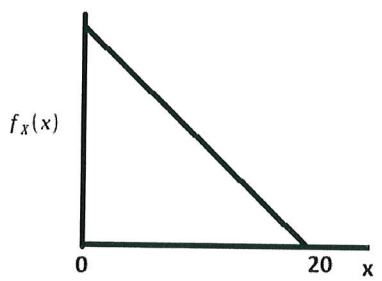

Fig.3(a)

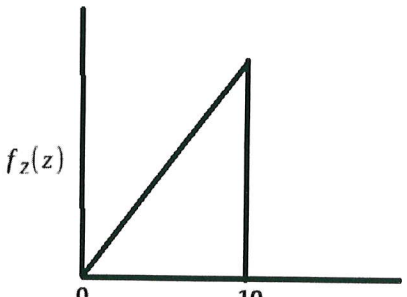

Fig.3(b)

	c)	State what is unsharp masking? How it is different from low pass filtering?	5+2
4)	a)	What do you mean by kernel-based and non-kernel-based image transformation? Give examples for each of them.	2+2
	b)	What is separability property of a kernel. How it helps in reducing complexity of the image transformation? Explain with examples	2+3
	c)	Write the forward and inverse transformation equation for Discrete Fourier transform and Discrete cosine transform.	6
	d)	Derive the 4x4 kernel for DCT.	5
5)	a)	What are the different types of redundancies present in an image. Give one example of image compression technique for each redundancy types.	3+3
	b)	An 8 bit image has the following probability distribution function for each symbol. Apply Huffman coding technique for binary coding of these symbols. Find redundancy and efficiency of the coding technique.	12

S_0	S_1	S_2	S_3	S_4	S_5	S_6	S_7
0.2	0.3	0.1	0.05	0.05	0.2	0.08	0.02

	c)	Write any four applications of image compression	2
6)	a)	State the drawback of inverse filtering of image restoration.	3
	b)	Derive the expression for restoration filter using MMSE approach. What is the limitation of MMSE approach	10
	c)	Mention how motion blur degradation can be mathematically modelled.	7
7		Write short notes (Any two)	10x2
	a)	Image Interpolation	
	b)	Histogram equalization and specification	

	c)	Homomorphic filtering	
	d)	JPEG	