

Digital Signal & Image Processing

C C Sh-Sche

University of Mumbai
Examinations Summer 2022

Time: 2 hour 30 minutes

Max. Marks: 80

	Choose the correct option for following questions. All the Questions carry equal marks
1.	If $x(n)$ is a discrete-time signal, then the value of $x(n)$ at non integer value of 'n' is:
Option A:	Zero
Option B:	Positive
Option C:	Negative
Option D:	Not defined
2.	The function given by the equation $x(n)=1$, for $n=0$; and $x(n)=0$, for $n \neq 0$ is
Option A:	Step function
Option B:	Ramp function
Option C:	Triangular function
Option D:	Impulse function
3.	Which of the following should be done in order to convert a continuous-time signal to a discrete-time signal?
Option A:	Sampling
Option B:	Differentiating
Option C:	Integrating
Option D:	None of the mentioned
4.	What is output signal when a signal $x(t)=\cos(2\pi \cdot 40 \cdot t)$ is sampled with a sampling frequency of 20Hz?
Option A:	$\cos(\pi \cdot n)$
Option B:	$\cos(2\pi \cdot n)$
Option C:	$\cos(4\pi \cdot n)$
Option D:	$\cos(8\pi \cdot n)$
5.	Which of the following is true regarding the number of computations requires to compute an N-point DFT?
Option A:	N^2 complex multiplications and $N(N-1)$ complex additions
Option B:	N^2 complex additions and $N(N-1)$ complex multiplications
Option C:	N^2 complex multiplications and $N(N+1)$ complex additions
Option D:	N^2 complex additions and $N(N+1)$ complex multiplications
6.	Robert, Sobel, Prewitt masks are used for
Option A:	line detection
Option B:	point detection
Option C:	Low pass filtering
Option D:	Median filters
7.	For $N=8$ Complex multiplications required using FFT are
Option A:	32
Option B:	12
Option C:	2
Option D:	96

8.	Image negative can be obtained by
Option A:	$f_2(x,y) = L-1 - f_1(x,y)$
Option B:	$f_2(x,y) = L+1 - f_1(x,y)$
Option C:	$f_2(x,y) = L - f_1(x,y)$
Option D:	$f_2(x,y) = (L/2) - f_1(x,y)$
9.	Piecewise linear transformation is used to
Option A:	adjust lighting effects of the scene during image acquisition
Option B:	improve contrast of the image
Option C:	increase resolution of the image
Option D:	rotate the image
10.	Median filtering is a
Option A:	Nonlinear filter
Option B:	Laplacian filter
Option C:	Mean filter
Option D:	Linear filter

Q2 (20 Marks Each)	Solve any Four out of Six 5 marks each																
A	For the given image perform low pass filtering without considering the boundary pixels (no padding). Apply 3by3 mask. <table><tr><td>0</td><td>5</td><td>5</td><td>3</td></tr><tr><td>2</td><td>3</td><td>2</td><td>5</td></tr><tr><td>6</td><td>4</td><td>3</td><td>6</td></tr><tr><td>5</td><td>3</td><td>4</td><td>7</td></tr></table>	0	5	5	3	2	3	2	5	6	4	3	6	5	3	4	7
0	5	5	3														
2	3	2	5														
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5	3	4	7														
B	Write the masks for line detection.																
C	Define and explain any two properties of DFT																
D	Define with examples types of 3 systems in DSP																
E	Justify that two images can have same histograms.																
F	Which filter is suitable for salt and pepper noise? Explain with an example																

Q3 (20 Marks Each)	Solve any Two Questions out of Three 10 marks each																
A	Compute DFT for given causal 8-point sequence using DIT-FFT flow graph for $x(n) = \{ 2, 1, 2, 1, 1, 2, 1, 2 \}$																
B	Apply the following operations for the 3 bit 4X4 size image: 1. Negation 2. Thresholding with $T=4$ 3. Intensity level slicing with background $r_1=2$ and $r_2=5$ 4. Bit level slicing for MSB and LSB planes <table border="1"><tr><td>1</td><td>2</td><td>3</td><td>0</td></tr><tr><td>2</td><td>4</td><td>6</td><td>7</td></tr><tr><td>5</td><td>2</td><td>4</td><td>3</td></tr><tr><td>3</td><td>2</td><td>6</td><td>1</td></tr></table>	1	2	3	0	2	4	6	7	5	2	4	3	3	2	6	1
1	2	3	0														
2	4	6	7														
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3	2	6	1														
C	Write short notes on a) Overlap add and save method of convolution Or b) 4, 8 and m adjacency in image processing																

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Q4 (20 Marks Each)	Solve any Two Questions out of Three		10 marks each						
A	Find linear convolution of $x(n)=\{1,2,2,1,1\}$ and $h(n)=\{3,2,1\}$								
B	Explain with steps whether $x(n)=u(n)$ is a power signal or energy signal								
C	Apply Histogram Equalization on given histogram								
	Grey Level	0	1	2	3	4	5	6	7
	Number of pixels	790	1023	850	656	329	245	122	81

The Impulse response of DT- LTI system $h(n) = n (1/2)^n u(n)$. Determine whether the system is stable and casual?																				
A system has unit impulse response $h(n) = (1/3)^{n+1} u(n+1)$.Find the response for unit step input?																				
Find the output $y(n)$ of a filter whose impulse response is $h(n) = \{1, 1, 1\}$ and input signal $x(n) = \{3, -1, 0, 1, 3, 2, 0, 1, 2, 1\}$ using overlap save method?																				
Perform bit plane slicing and obtain all bit planes of following image																				
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7	3	5	4																	
6	2	4	3																	
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6	7	4	3																	
Show that a high pass filter can be obtained as High Pass = Original - Low Pass																				
What is zero padding? What are its uses?																				
List and explain any four properties of DFT.																				
How many multiplications and additions are required to compute N point DFT using Radix-2 FFT?																				
Explain the procedure of neighborhood processing technique?																				
Distinguish between linear convolution and circular convolution of two sequences.																				
Let $x(n) = \cos(n.\pi/2) u(n)$. Find D.F.T. of $x(n)$.																				
Compare the high pass and low pass filtering in spatial domain.																				
What are different applicators of DSP?																				
Distinguish between Discrete Signal and Analog signals.																				
What are different signals used for analysis of discrete time signals?																				
Obtain the autocorrelation of sequence $x(n) = a^n u(n)$, $0 < a < 1$																				
Find the signal energy of $(1/2)^n u(n)$?																				
Obtain the digital negative of the 8 bpp image																				
<table><tr><td>23</td><td>206</td><td>244</td><td>72</td><td>130</td></tr><tr><td>163</td><td>79</td><td>47</td><td>69</td><td>122</td></tr><tr><td>201</td><td>247</td><td>100</td><td>80</td><td>39</td></tr><tr><td>48</td><td>77</td><td>111</td><td>211</td><td>121</td></tr></table>	23	206	244	72	130	163	79	47	69	122	201	247	100	80	39	48	77	111	211	121
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48	77	111	211	121																
What effect would set to zero the higher-order bit planes have on the histogram of an image in general?																				
The impulse response of a LTI system is $h(n)=\{1,2,1,1\}$. What is the response of the signal to the input $x(n)=\{1,2,3,4\}$?																				