Date:

Syllabus - R-2016 Class - BE Sem - VII Sub: DSIP

Reg No - 2017C02 Seat No - 7278650

Q1

1) Option C : Quantization

2) Option C : Low pass average mask

3) Option B : 7

4) Option B : P1 - P3 - P4 - P5 - P7 - P10

5) Option B : [illegible] Time reversal

6) Option C : u(n) - u(n-1)

7) Option A : Low Pass Averaging Filter

8) Option D : 300 Hz

9) Option D : Circular Convolution of Sequence.

10) Option C : ~~24 and 12~~ 64 and 32

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Q2 b Given

$$x(n) = \begin{cases} n^2 & ; 0 \le n \le 3 \\ 10-n & ; 4 \le n \le 6 \\ n & ; 7 \le n \le 9 \\ 0 & ; \text{otherwise} \end{cases}$$

Formula: i) Energy (E) $= \sum_{n=-\infty}^{\infty} |x(n)|^2$

ii) Power (P) $= \lim_{N \to \infty} \frac{1}{2N+1} \sum_{n=-N}^{N} |x(n)|^2$

Solution :

$$\text{Energy}(E) = \sum_{n=-\infty}^{\infty} |x(n)|^2$$

$$= \sum_{n=0}^{3} |n^2|^2 + \sum_{n=4}^{6} |10-n|^2 + \sum_{n=7}^{9} |n|^2$$

$$\cancel{= \sum_{n=0}^{3} n^4 + \sum_{n=4}^{6} (100+n^2-2n)}$$

$$= \sum_{n=0}^{3} n^4 + \sum_{n=4}^{6} (100-20n+n^2) + \sum_{n=7}^{9} n^2$$

$$= 1^4 + 2^4 + 3^4 + |100-20(4)+4^2| + |100-20\times5+5^2| + |100-20(6)+6^2| + 7^2 + 8^2 + 9^2 .$$

$$= 98 + |100-80+16| + |100-100+25| + |100-120+36| + 194$$

Energy (E) = 369

Since, the energy of a signal is a finite value the given signal x(n) is an energy signal

Since, the signal is an energy signal Therefore, the power of signal is zero

$\therefore$ Power (P) = 0

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Q2

C Explain DFT properties.

→ Discrete Fourier transform (DFT)

1. The Discrete Fourier transform (DFT) computes the values of the z-transform for evenly spaced points around the unit circle for given sequence.
2. The sequence to be represented is of finite duration ie. has only a finite number of non-zero values the transform used is Discrete Fourier Transform.
3. The fourier transform method of representing non-periodic discrete time signals as a function of discrete time frequency 'ω' is called. Discrete time fourier transform.

Properties of DFT are.

1. Linearity:

DFT of linear combination of two or more signals is equal to the same linear combination of DFT of individual signals. Therefore, if $X_1(k)$ and $X_2(k)$ represents the DFT of $x_1(n)$ and $x_2(n)$ respectively, then,

$$a_1 x_1(n) + a_2 (x_2)(n) \xrightarrow{DFT} a_1 X_1(k) + a_2 X_2(k)$$

where a_1 and a_2 are constants.

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② Periodicity:

If $X(K)$ represents the DFT of $x(n)$ then both $x(n)$ and $X(K)$ are periodic signals with the fundamental period N. Therefore.

$$x(n+N) = x(n)$$

$$X(K+N) = X(K)$$

③ Circular Time Shift

If $X(K)$ represents the DFT of $x(n)$ with fundamental period N, then shifting the sequence circularly by 'm' samples is equivalent to multiplying its DFT by $e^{-j2\pi Km/N}$

$$x((n-m))_N \xrightarrow{DFT} X(K)e^{-j2\pi Km/N}$$

④ Circular Convolution property:

Circular Convolution of two signals is equivalent to multiplication of the signals in the frequency domain. Therefore if $X_1(K)$ and $X_2(K)$ represents the DFT of $x_1(n)$ and $x_2(n)$ respectively then

$$x_1(n) \circledast x_2(n) \xrightarrow{DFT} X_1(K) \cdot X_2(K)$$

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⑤ Time reversal property:

It means that if the sequence is circularly folded its DFT is also circularly folded. Therefore if $X(k)$ represents the DFT of $x(n)$ with periodicity N, then

$$x((-n))_N = x(N-n) \xrightarrow{DFT} X((-k))_N = X(N-k)$$

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Q3

b Image Segmentation based on Discontinuity.

(1) The image segmentation is the process of partitioning a digital image in to multiple segments (set of pixels).

(2) In this approach, the image is partition based on abrupt changes in gray level.

(3) The principal area of intrest within this category is detection of isolated points and detection of lines and edges in an images.

1) Point detection.

i) The detection of points is done by using following mask.

-1	-1	-1
-1	8	-1
-1	-1	-1

ii) If $|R| > T$ then isolated point is detected.

iii) Where T is non-negative point threshold. ie. weighted difference between the center point and its neighbor.

iv) $R = w_1 z_1 + w_2 z_2 + w_3 z_3 + \cdots + w_9 z_9$.

v) The idea is that the gray level of on isolated image will be quiet different from gray level of its neighbors.

2) Line Detection.

i) The various mask present for the line detection are.

Horizontal

-1	-1	-1
2	2	2
-1	-1	-1

+45°

-1	-1	2
-1	2	-1
2	-1	-1

vertical

-1	2	-1
-1	2	-1
-1	2	-1

-45°

2	-1	-1
-1	2	-1
-1	-1	2

ii) The first mask respond more strongly to line oriented horizontally.

iii) While third mask responds ~~mor~~ more strongly to the line oriented vertically and 2nd and 4th mask respond more strongly to line +45° & -45°.

iv) With constant background maximum response would result when the line is passing through the middle of row of the mask.

3) Edge detection

i) It is the most common approach for detection of discontinuities in gray level.

ii) Edge detection characterizes the objects boundaries.

iii) The edge point can be thought of as pixel location of abrupt gray levels properties.

iv) It is the boundary between two regions with relatively distinct gray levels properties.

v) There are two types of edges step and ramp edge.

vi) Step edges are detected using first order derivative filters like Robert, sobel, frichen and prewit.

vii) Ramp edges are detected using second order derivative line Laplacian filter.

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Q4.

a) Zero memory Operations.

① In zero memory operations, output image pixel value is obtained directly processing input image pixel values. Output pixel value at (x, y) position depends on single input pixel at (x, y).

② For every input image pixel value, transformation function gives corresponding output image pixel value, no memory location is required to store intermidiate results.

③ The various zero memory point operations are
1) Digital negative
2) Contrast streching
3) Thresholding.
4) Grey level slicing
5) Bit plane slicing
6) Dynamic range compression
7) Power Law transformation.

④ Dynamic range Compression

① The dynamic range of an image exceeds the capability of the display device. What happens is that some pixels values are so large that the other low value pixels get obscured.

② Dynamic range is the range of tonal difference between the ~~lightest~~ lightest and darkest of an image. The higher the dynamic range, the more potential shades can be represented, although the dynamic range doesnot

③ Now each pixel will be represented as 8-bits. For black is represented as 00000000 and white is represented as 11111111. and between them 254 grey levels are present.

④ Consider the LSB value of each pixel and plot the image using only LSB. Continue doing this for each bit till we come to MSB. Note that we will get 8 different images and all 8 images will be binary.

Example:

Given a 3x3 image

1	2	0
4	3	2
7	5	2

Sol^n- Since 7 is the maximum grey level, we need only 3-bits to represent the grey ~~level~~ levels

Hence we will have 3bit planes. Converting the image to binary we get

001	010	000
100	011	010
111	101	010

Binary image

1	0	0
0	1	0
1	1	0

LSB Plane

0	1	0
0	1	1
1	0	1

Middle bit Plane

0	0	0
1	0	0
1	1	0

MSB Plane.

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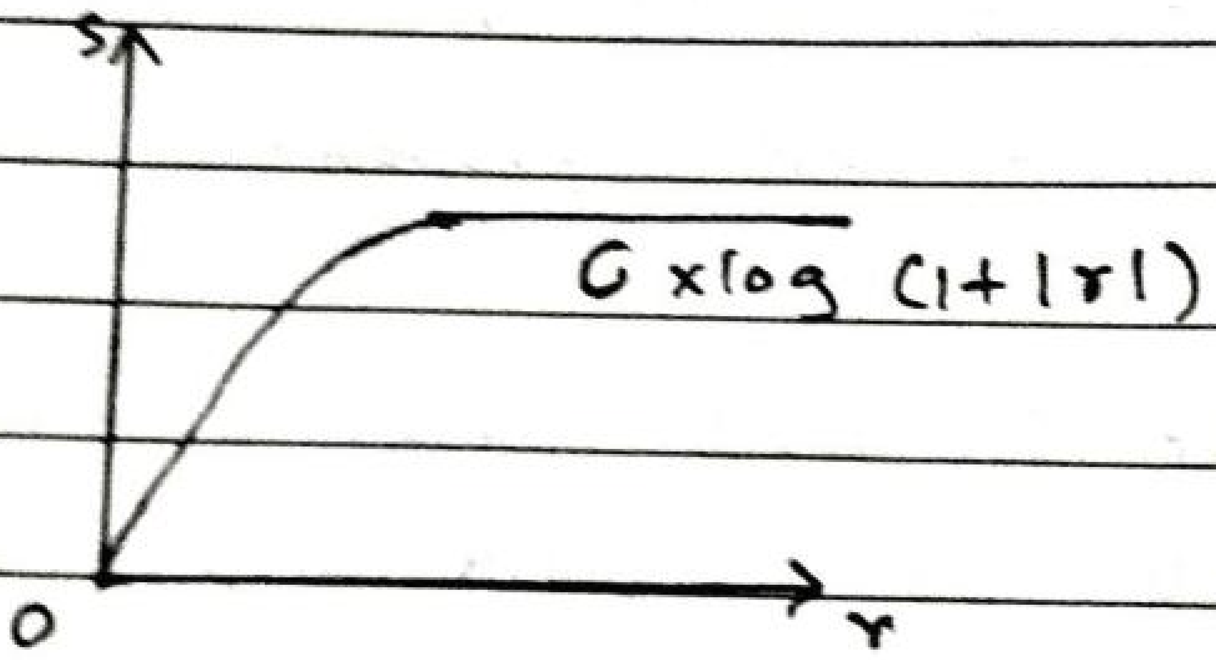
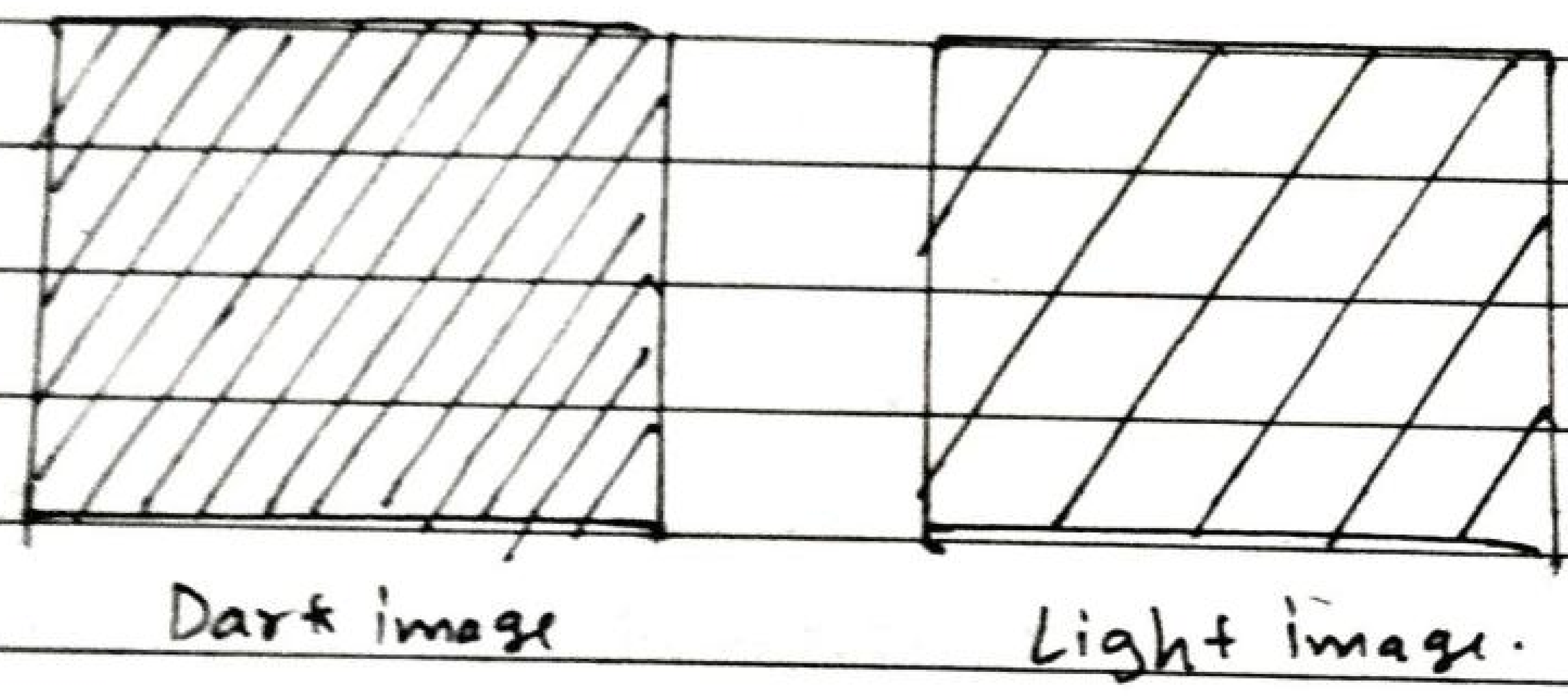
automatically ~~Great~~ correlate to the number of tones reproduced.

③



Dynamic range ~~is~~ Compression is achived by using log operator. 'C' is normalization Constant.



⑤ Bit plane Slicing.

① It is a method of representing an image with one or more bits of the byte used for each pixel. One can use only MSB to represent the pixel, which reduces the original graylevel to a binary image.

② In this technique we find out the contribution made by each bit to the final image. An image is defined as $256 \times 256 \times 8$ image. in this 256×256 is number of Pixels present. and 8 is number of bits required to represent each pixel.

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~~Q4~~

Q4 B

Given

$x(n) = \{1, -2, 3, 2\}$

i) Since $x(n)$ is of length 4

$\therefore N = 4$, we generate a DFT matrix of 4x4.

ii) $\therefore X(k) = [W_4]_{4\times4}\, x(n)$

$$= \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & -j & -1 & +j \\ 1 & -1 & 1 & -1 \\ 1 & j & -1 & -j \end{bmatrix} \begin{bmatrix} 1 \\ -2 \\ 3 \\ 2 \end{bmatrix}$$

$$= \begin{bmatrix} 1-2+3+2 \\ 1+2j-3+2j \\ 1+2+3-2 \\ 1-2j-3-2j \end{bmatrix}$$

$$= \begin{bmatrix} 4 \\ -2+4j \\ 4 \\ -2-4j \end{bmatrix}$$

$\therefore X(k) = \{4, -2+4j, 4, -2-4j\}$

iii) For magnitude and Phase Spectrum

$\because |X(k)| = \sqrt{(\text{Real})^2 + (\text{imaginary})^2}$

$\therefore |X(k)| = \{4, 4.472, 4, 4.472\}$

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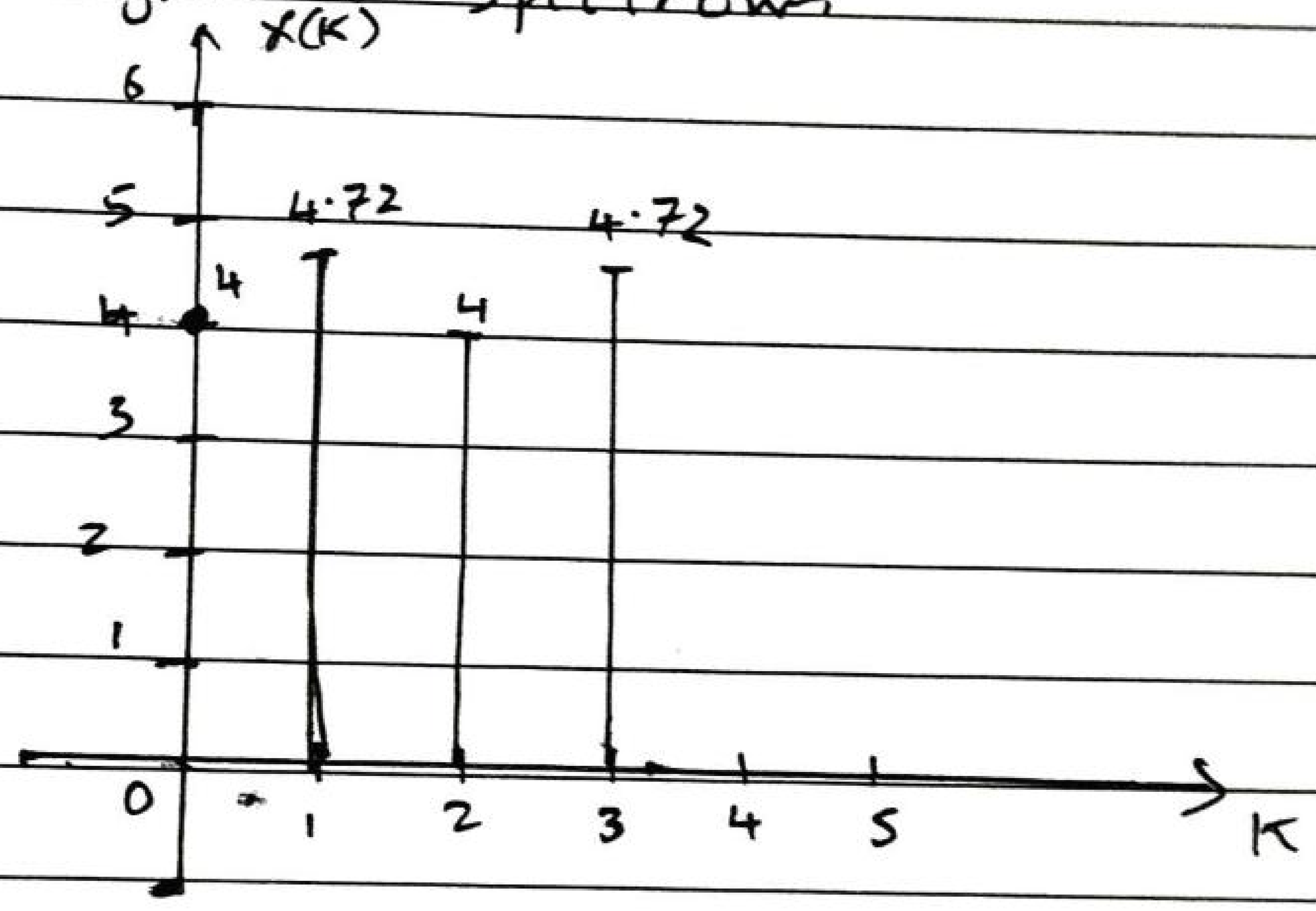
iv) $\therefore \angle X(k) = \tan^{-1}\left[\frac{\text{Imaginary}}{\text{Real}}\right]$

$\therefore \angle X(k) = \{0^\circ, -63.43^\circ, 0^\circ, 63.43^\circ\}$

v) Magnitude Spectrum



vi) Phase Spectrum.