IP Lab Test-1

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1) Quantisation

2) $150 \times 150 \times 8$ bits $= 22500$ bytes
$\simeq 21.972$ kilobytes

3) For $\Delta t = 0.1$, we can get 11 samples $(0, 0.1, \ldots 0.9, 1)$
For $\Delta t = 0.5$, we can get 3 samples $(0, 0.5, 1)$

4) TRUE, $\langle b_k b_l \rangle = \sum_{n=0}^{N-1} e^{j2\pi(k-l)n/N}$

$$= \frac{1 - e^{j2\pi(k-l)}}{1 - e^{j2\pi(k-l)/N}}$$

$\forall\ k \neq l$, numerator $= 0$ while denominator $\neq 0$

When phase $= 0$ i.e $k = l$, they have no effect on orthogonality

5) TRUE, following question 1, $\hat{b}_k(n) = \frac{e^{j2\pi kn/N}}{\sqrt{N}}$, $\langle \hat{b}_k, \hat{b}_k \rangle = 1$

being unit basis of a 1D DFT, we can say that
$\Rightarrow$ Basis of 1D DFT can be orthonormal.

6) $e^{-2j\pi(3x+3y)/4} = e^{-\frac{j3\pi}{2}(x+y)}$

$$b_{(x,y)}_{\langle 3,3 \rangle} = \begin{bmatrix} 1 & j & -1 & -j \\ j & -1 & -j & 1 \\ -1 & -j & 1 & j \\ -j & 1 & j & -1 \end{bmatrix}$$

7) Inverse DFT (F) = $\begin{bmatrix} 16 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 16 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$

$f(x,y) = 16\, e^{-2\pi j\,(0)/4} + 16\, e^{-2\pi j\,(y)/4}$

8) M, N = 4

Basis : $e^{j2\pi\left(\frac{ux+vy}{4}\right)}$

$F = \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 3 & 2 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix}$

$f(x,y) = \begin{bmatrix} 5 & -2+3j & -1 & -2-3j \\ +5j & -3-2j & -j & 3-2j \\ -5 & 2-3j & 1 & 2+3j \\ -5j & 3+2j & j & -3+2j \end{bmatrix}$

9)
```
import cv2
import numpy as np
img = cv2.imread("Image Path")
print(img)
```

10) The program prints the no. of pixels with intensity 255 (
& no. of pixels with intensity 0 (b)