



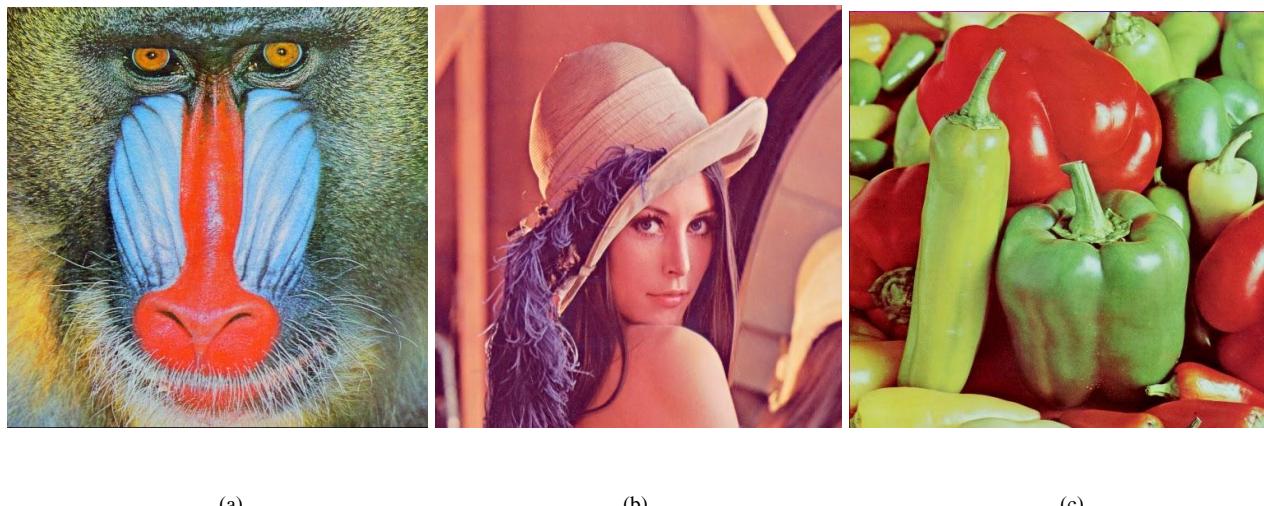
## Cryptography and Cryptanalysis Project

**Comparison Between DCT and DWT for Digital Watermarking in  
Color Images**

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The following figure shows the original samples that used in the work:



**Figure 1. Original Image with Different textures**

**The next table illustre the value for PSNR for the watermarked image after embedding process completed after LOW Frequency DCT.**

Table 1. PSNR, MSE for the Watermarked Image After LOW Frequency DCT.

DCT (db units)	Lena	Baboon	PeppersRGB
PSNR	48.296204157645526	48.708798575013724	48.534229183635595
MSE	0.5729166666666666	0.4895833333333333	0.4479166666666667

**The next table illustre the value for PSNR for the watermarked image after embedding process completed after HIGH Frequency DCT..**

Table 2. PSNR, MSE for the Watermarked Image After HIGH Frequency DCT.

DCT (db units)	Lena	Baboon	PeppersRGB
PSNR	46.618910448639824	46.06333217901305	46.523455659193296
MSE	0.6145833333333334	0.4375	0.4895833333333333

**The next table illustre the value for PSNR for the watermarked image after embedding process completed after DWT.**

Table 3. PSNR, MSE for the Watermarked Image After DWT.

DWT (db units)	Lena	Baboon	PeppersRGB
PSNR	72.46493322184237	71.75223675522267	68.93495945622672
MSE	0.4375	0.39285714285714285	0.4732142857142857

**The next figure shows the original(host) image with its histogram:**

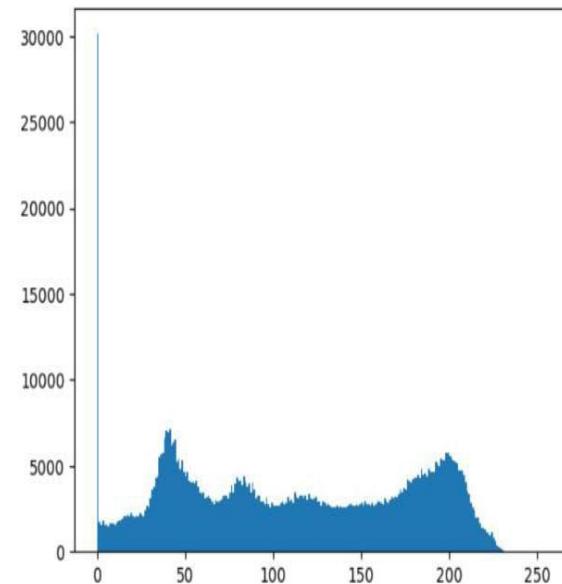
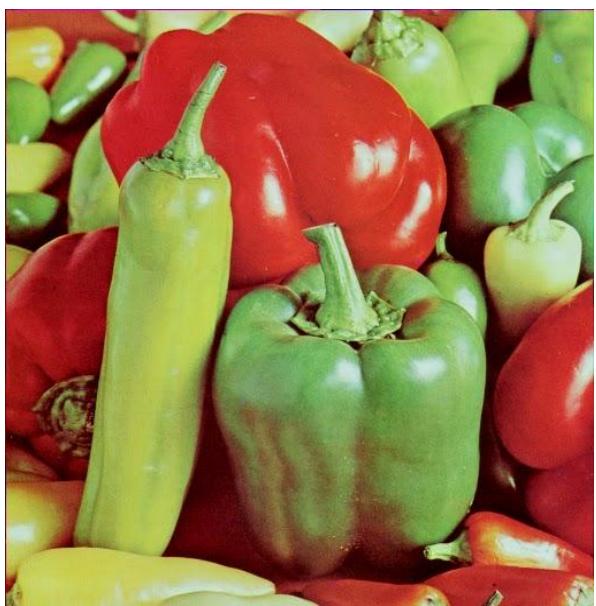
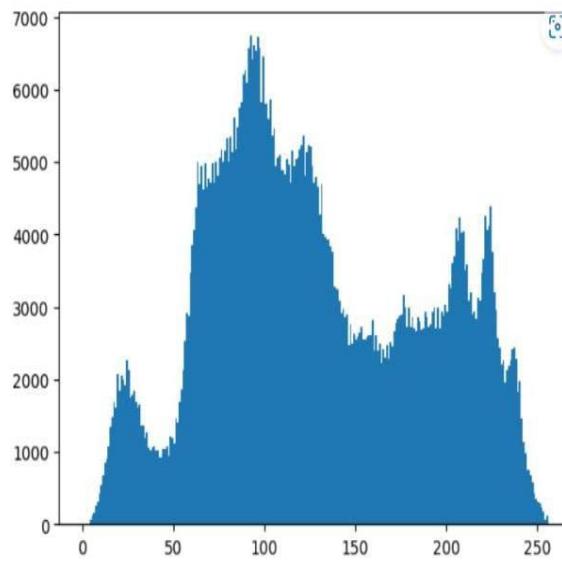
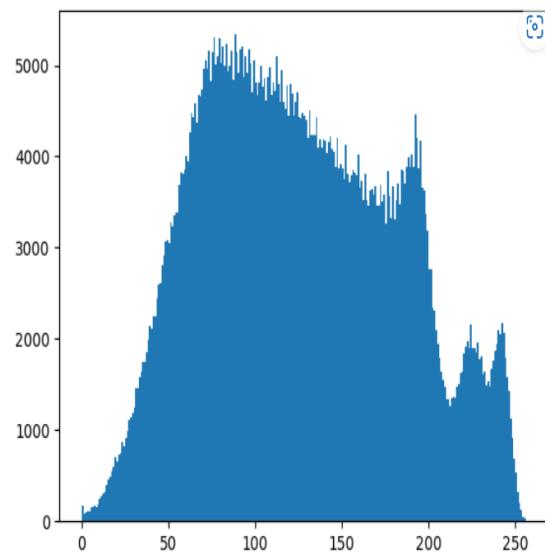
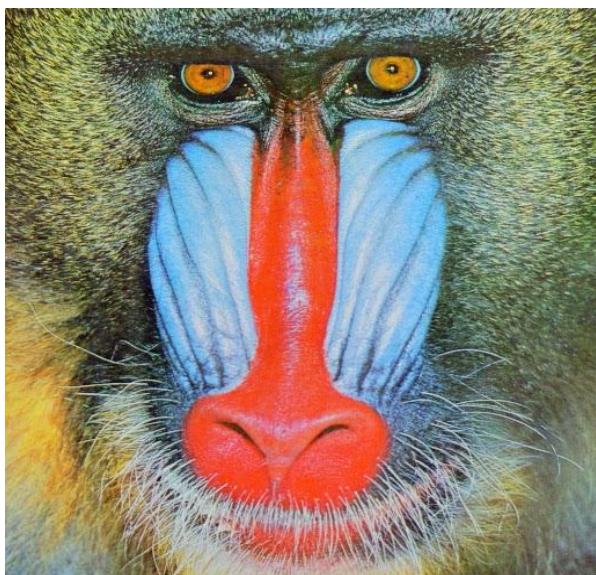


Figure 2. Host Image

The next figure shows the watermarked image with its histogram after Low Frequency DCT transform:

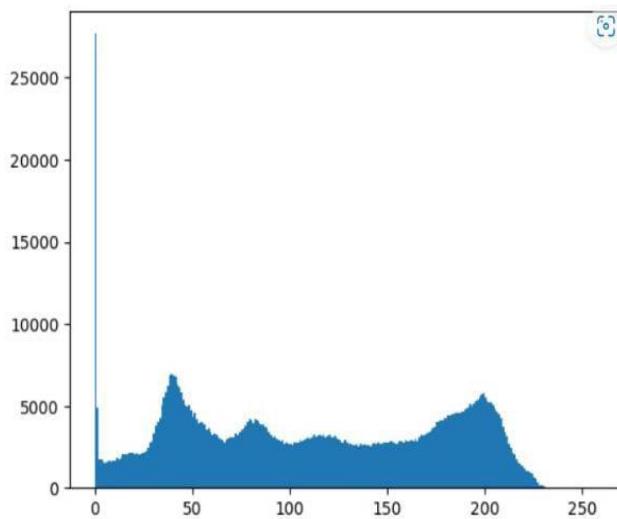
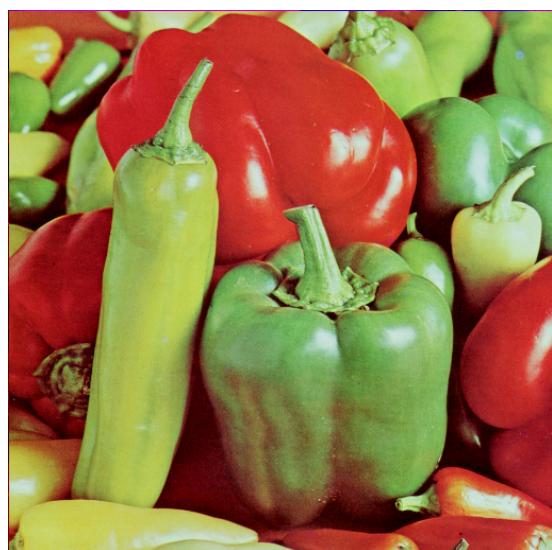
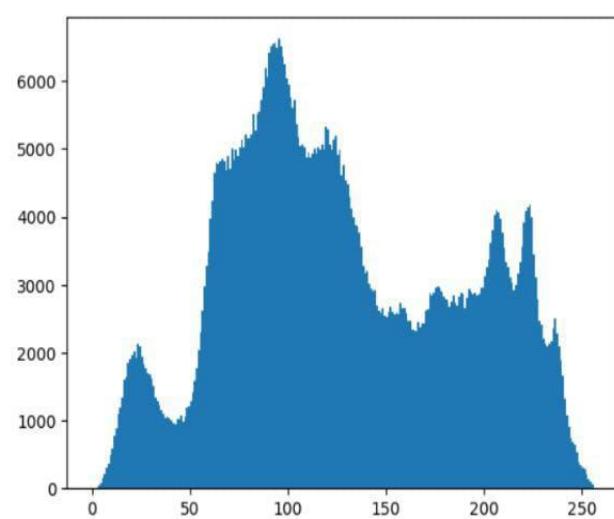
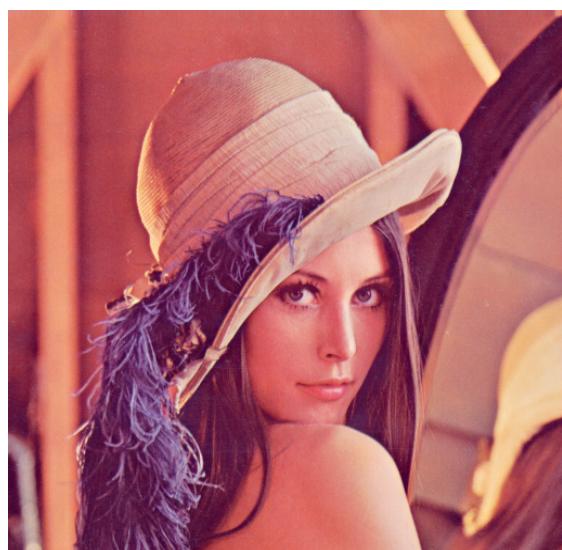
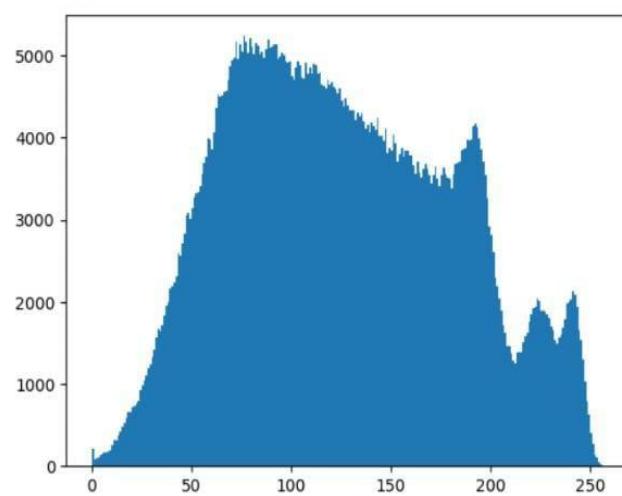
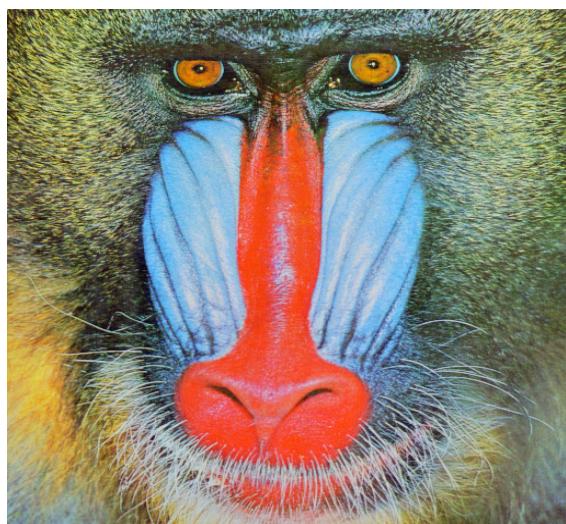


Figure 3. Watermarked Image after Low Frequency DCT with Histogram

The next figure shows the watermarked image with its histogram after High Frequency DCT transform:

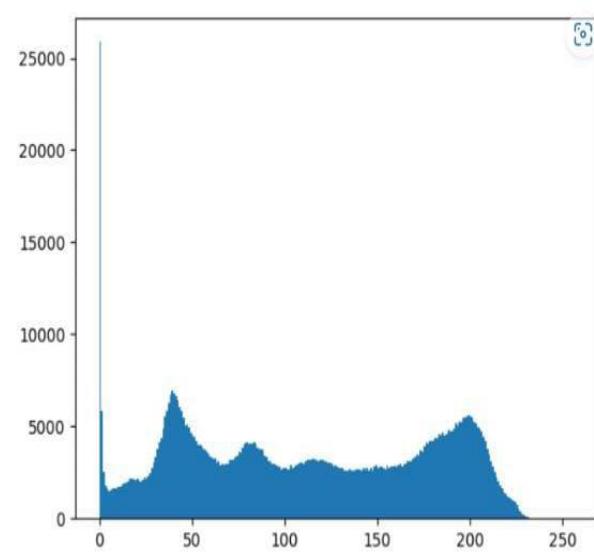
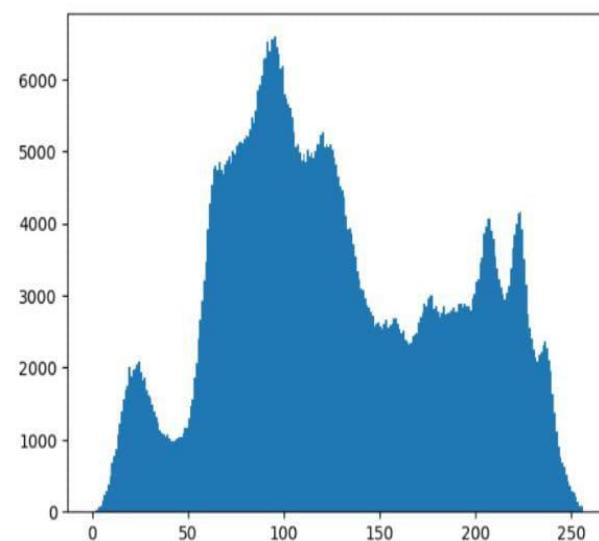
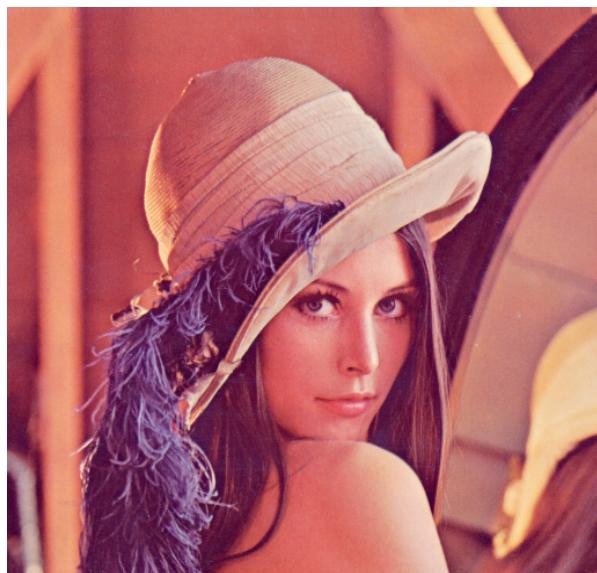
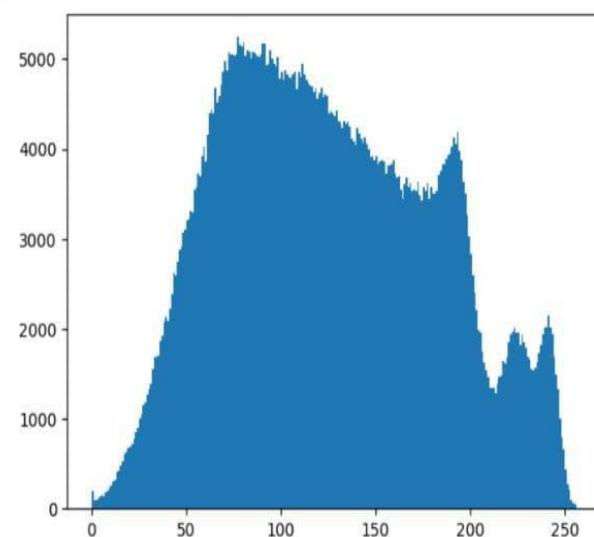
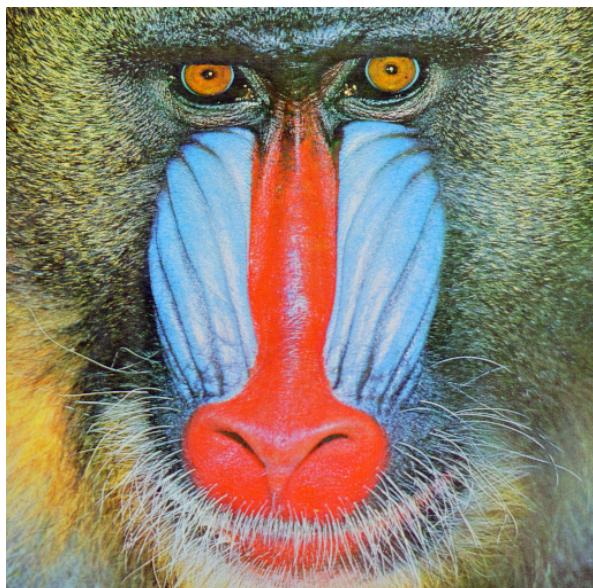


Figure 4. Watermarked Image after High Frequency DCT with Histogram

The next figure shows the watermarked image with its histogram after DWT transform:

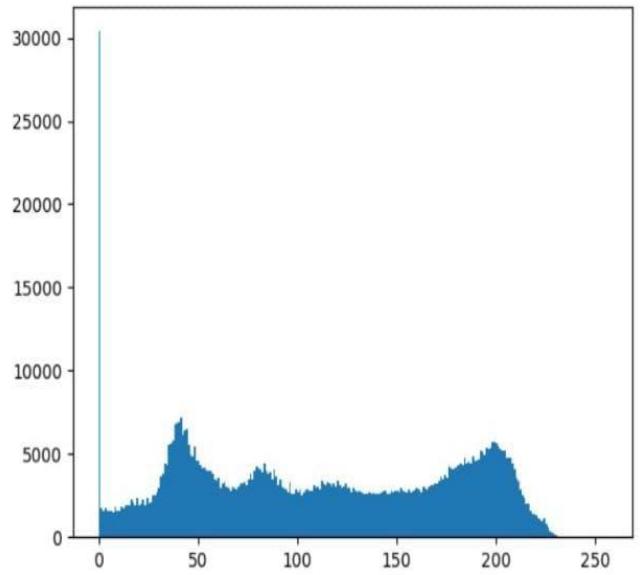
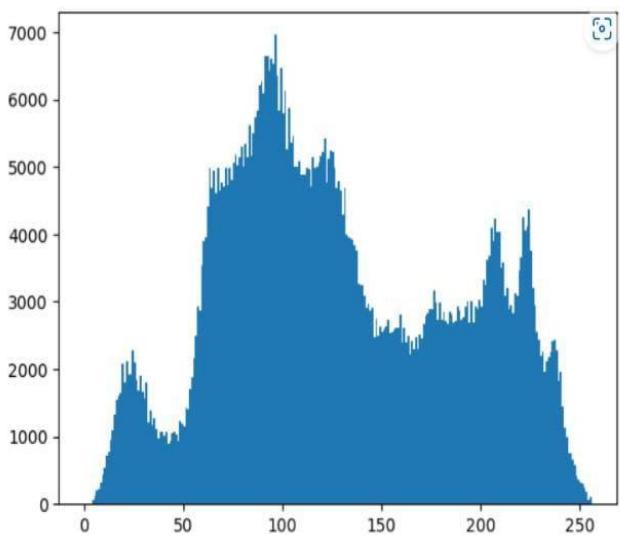
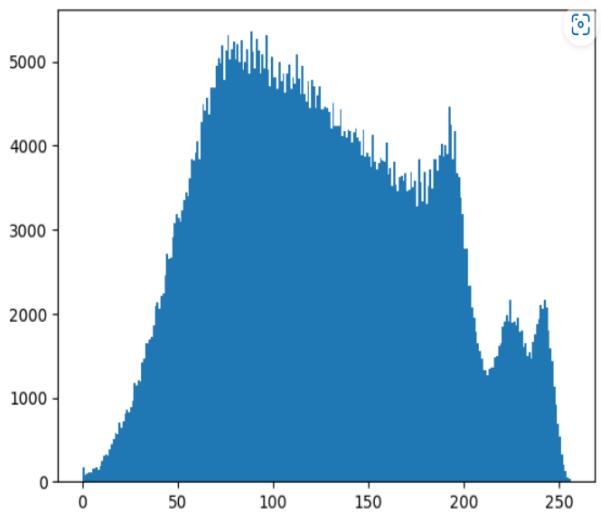
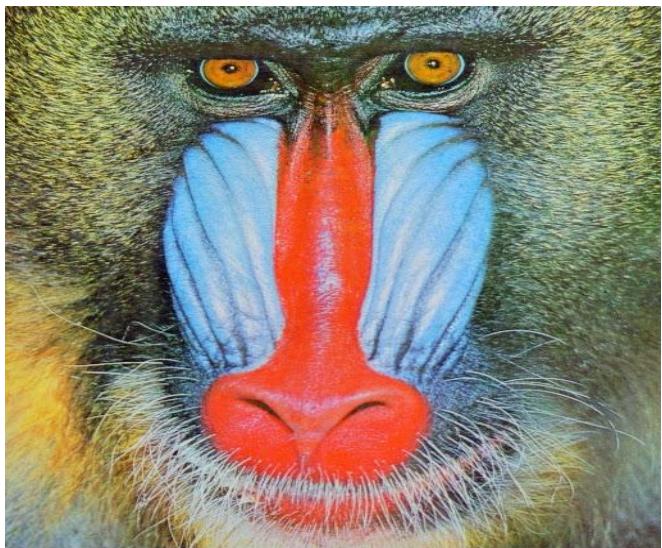


Figure 5. Watermarked Image after DWT with Histogram

```
Watermark [0 1 0 0 1 0 0 0 0 1 1 0 0 0 0 1 0 1 1 1 1 0 0 1 0 1 1 0  
0 0 0 1 0 0 1 0 0  
0 0 0 0 1 0 0 0 0 0 1 0 1 1 0 1 1 1 0 0 1 1 0 0 1 0 0 0 0 1 0 0 0  
0 0 0 1  
0 0 1 1 0 1 0 1 1 0 0 0 0 1 0 1 1 1 0 0 1 0 0 1 1 0 1 0 0 1 0 1 1  
0 0 0 0  
1]
```

The Original Watermark

```
Extracted watermark: [1 1 0 1 1 0 0 1 1 0 1 0 0 1 1 0 1 1 1 0 1 0 1  
0 0 1 1 0 1 1 1 0 0 0 0 0  
0 1 0 1 1 1 0 1 1 1 1 0 0 1 0 1 0 0 1 0 0 0 0 0 1 0 1 0 1 1 1 0 0  
1 0 0 1  
1 0 1 0 0 0 0 1 1 1 0 0 0 1 0 0 0 1 0 0 1 0 1 0 1 0 1 0 1 0 0 1 1  
0 0 1 0  
1]
```

Figure 6. The Recovered Watermark After DWT

Watermark: 010010000110000101111001011000010100000101101110011001000  
10011010110000101110010011010010110001

The Original Watermark

```
Extracted: 01000010001111000110101001101100100010001111111110010  
00000001110111000101111011010110011101
```

Figure 7. The Recovered Watermark After LOW Frequency DCT

```
Extracted: 10010111010110010000000101001101011001110000110111101010  
10011110110101101111011001111000101101
```

Figure 8. The Recovered Watermark After HIGH Frequency DCT

**Table 4. NC for the Watermarked Image After LOW Frequency DCT.**

DCT NC	Speckle noise
Lena	0.14138999547492456
Baboon	0.09599192591696515
PeppersRGB	0.16237886533617477

**Table 5. NC for the Watermarked Image After HIGH Frequency DCT.**

DCT NC	Speckle noise
Lena	0.021729490022172948
Baboon	0.18482835032909103
PeppersRGB	0.04519776737830869

**Table 6. NC for the Watermarked Image After DWT.**

DWT NC	Speckle noise
Lena	0.4235587248015105
Baboon	0.5124977061107785
PeppersRGB	0.4441026811597043

The following figure shows the objective quality (watermarked image) after poisson noise with DCT, and DWT.

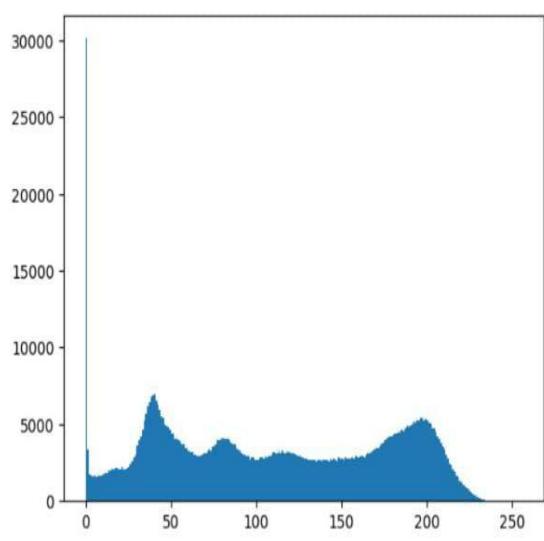
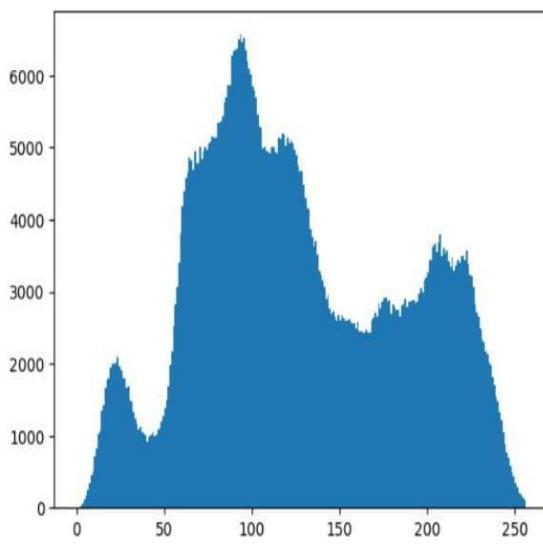
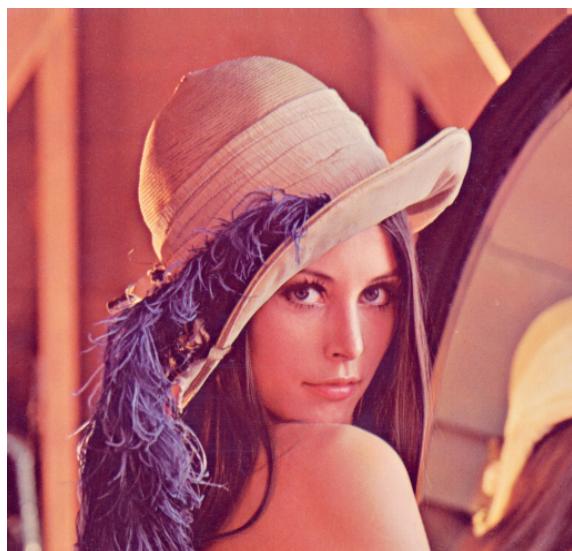
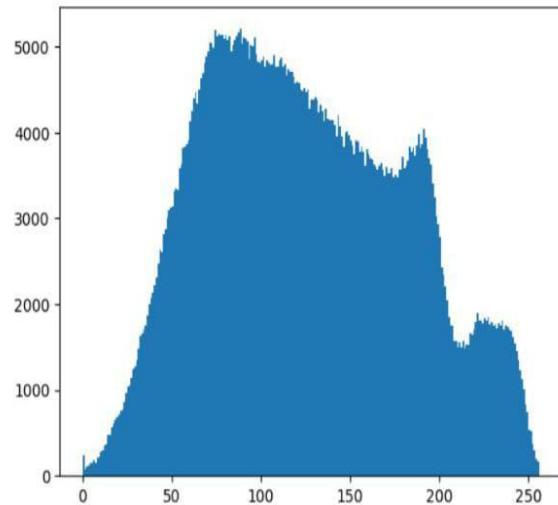
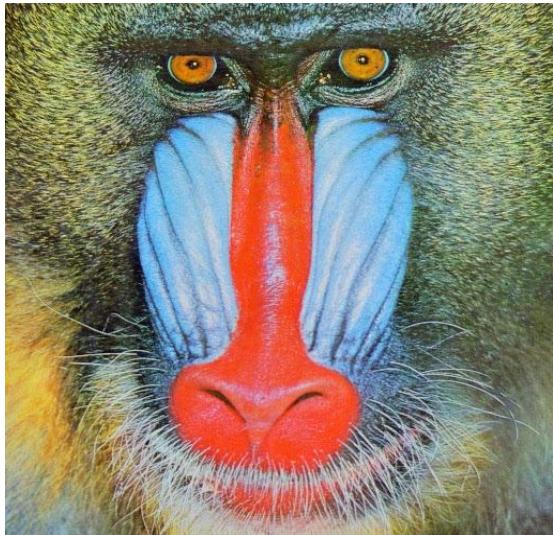
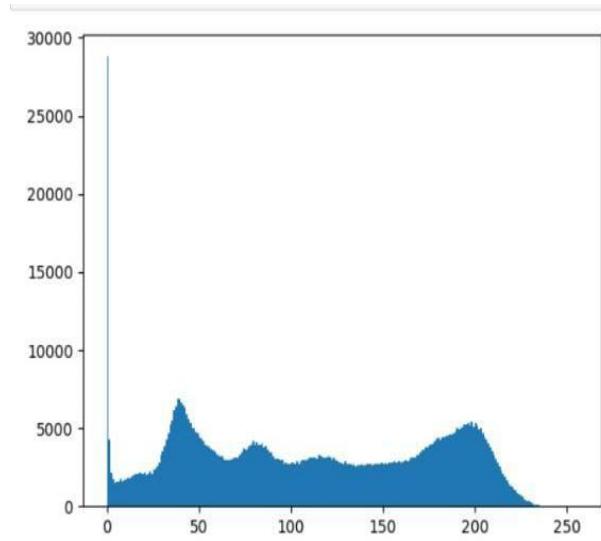
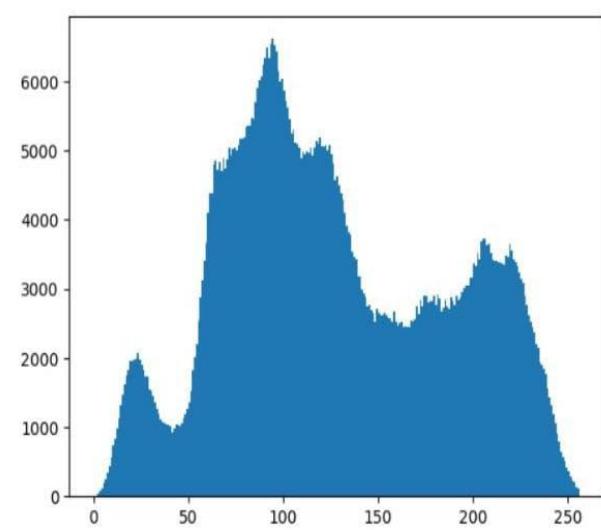
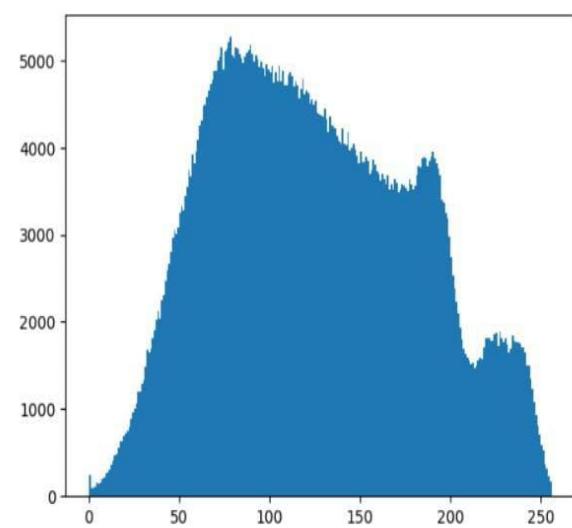
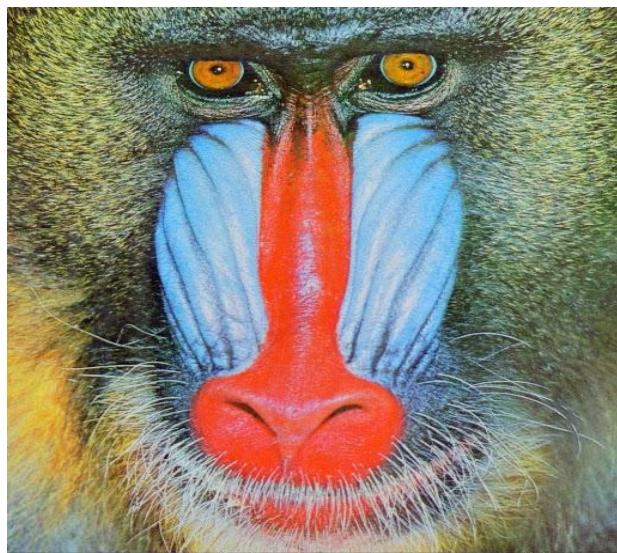


Figure 9. The Watermarked Image after Poisson Noise after LOW Frequency DCT



**Figure 10. The Watermarked Image after Poisson Noise after HIGH Frequency DCT**

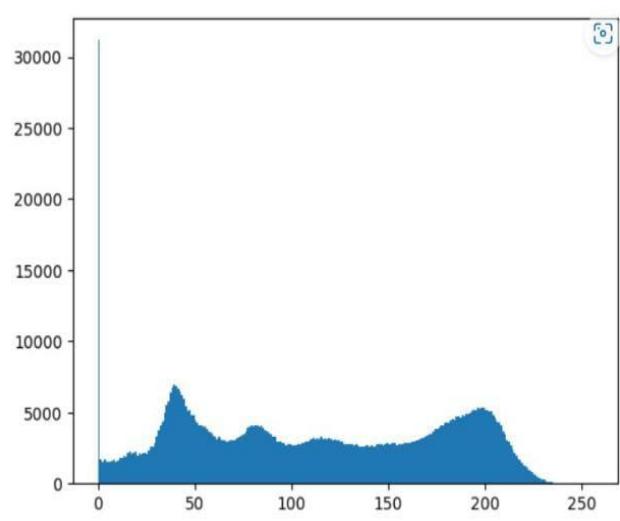
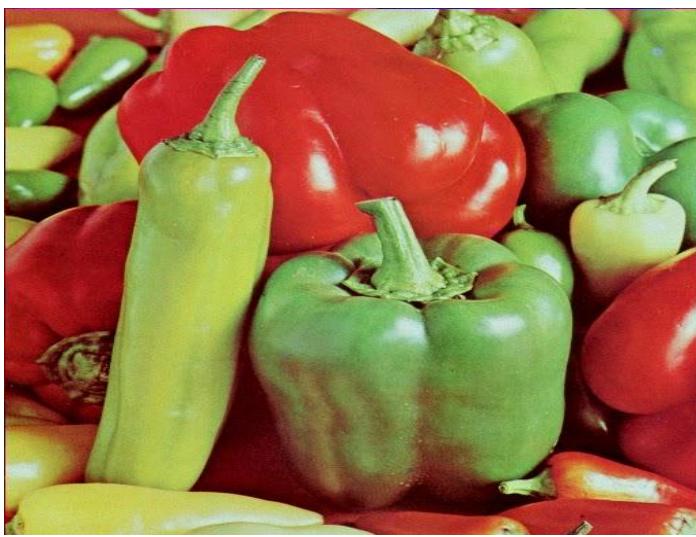
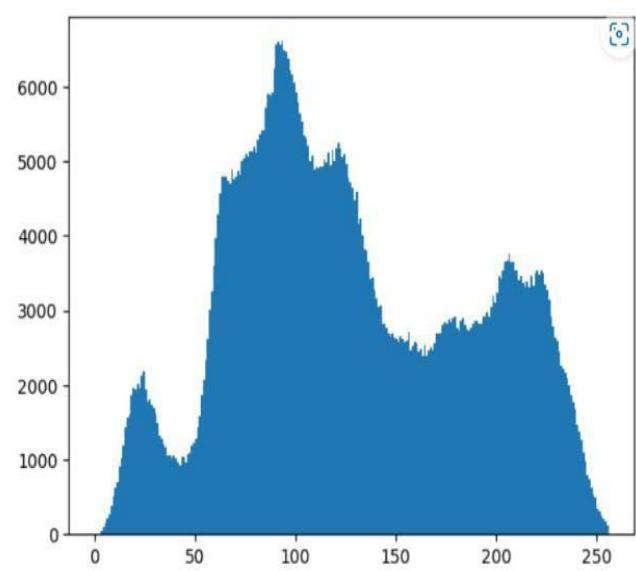
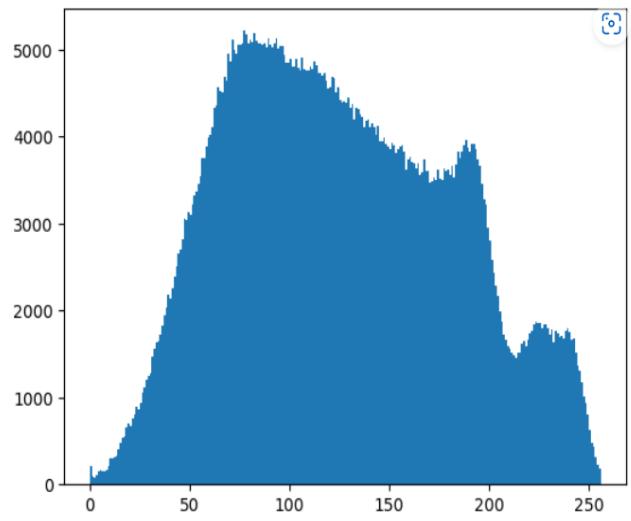
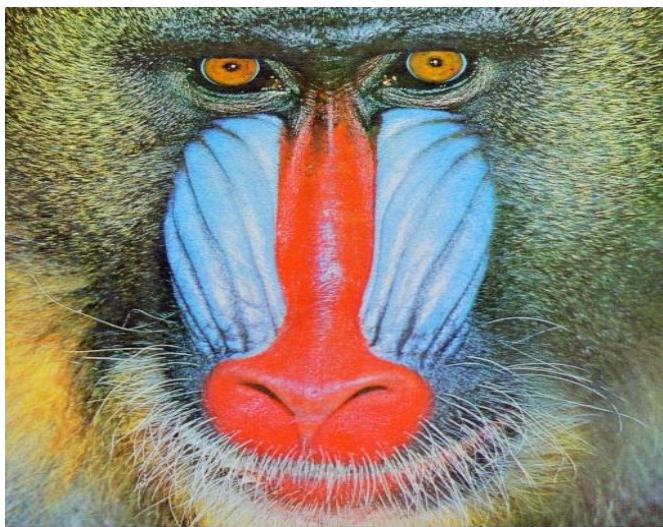


Figure 11. The Watermarked Image after Poisson Noise after DWT

**Table 7. SIM for the Watermarked Image After LOW Frequency DCT.**

DCT	SIM
Lena	0.9756517639510721
Baboon	0.9877899262295081
PeppersRGB	0.9806344688298948

**Table 8. SIM for the Watermarked Image After HIGH Frequency DCT.**

DCT	SIM
Lena	0.9747255040856081
Baboon	0.9869279074279441
PeppersRGB	0.9793896376435772

**Table 9. SIM for the Watermarked Image After DWT.**

DWT	SIM
Lena	0.9775021250796044
Baboon	0.9227768294024111
PeppersRGB	0.9822926615867985

**Table 10. PSNR, MSE for the Noisy Image After DWT.**

DWT (db units)	Lena	Baboon	PeppersRGB
PSNR	39.09079040174216	39.25582539770636	39.85073695933372
MSE	0.5357142857142857	0.4107142857142857	0.5982142857142857

**Table 11. PSNR, MSE for the Noisy Image After LOW Frequency DCT.**

DCT (db units)	Lena	Baboon	PeppersRGB
PSNR	38.621912898564204	38.84096033292449	39.332270599224735
MSE	0.4895833333333333	0.46875	0.40625

**Table 12. PSNR, MSE for the Noisy Image After HIGH Frequency DCT.**

DCT (db units)	Lena	Baboon	PeppersRGB
PSNR	38.42098872342396	38.46920539111089	39.03931137696258
MSE	0.5	0.5833333333333334	0.5208333333333334