(1) Write a Matlab program to measure the structural similarity (SSIM) of two images A and B. The sizes of A and B are equivalent.

$$SSIM(A, B, c1, c2)$$

where c1 and c2 are some adjust constants.
The Matlab file should be mailed to displab531@gmail.com.   (20 scores)

(2) How do we implement the following matrix operations with <u>the lest number of multiplications</u>?

(a)
$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \end{bmatrix} = \begin{bmatrix} a & c & b \\ -b & c & a \\ -a & c & -b \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix}$$

(b)
$$\begin{bmatrix} y_1 \\ y_2 \\ y_3 \\ y_4 \end{bmatrix} = \begin{bmatrix} a & c & b & d \\ d & a & c & b \\ b & d & a & c \\ c & b & d & a \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \\ x_4 \end{bmatrix}$$
(20 scores)

(3) Suppose that x is a complex number. What are the constraints of θ such that the multiplication of x and $\exp(j\,\theta)$ required only 2 real multiplications?
                                                                                 (10 scores)

(4) Determining the numbers of real multiplications for the (a) 140-point DFT, (b) 165-point DFT, and the (c) 242-point DFT.   (15 scores)

(5) Suppose that length($x[n]$) = 1500. What is the best way to implement the convolution of $x[n]$ and $y[n]$ if
(a) length($y[n]$) = 300,   (b) length($y[n]$) = 40,
(c) length($y[n]$) = 8,   and (d) length($y[n]$) = 2?
   Also show the number of real multiplications required for each case.
                                                                       (25 scores)

(6) Suppose that $x_1[n]$ and $x_2[n]$ are two N-point <u>real and even</u> sequences and $x_3[n]$ and $x_4[n]$ are two N-point <u>real and odd</u> sequences. How do we implement the FFT of $x_1[n]$, $x_2[n]$, $x_3[n]$, and $x_4[n]$ using only one N-point FFT?   (10 scores)