ESC101 : Fundamental of Computing
Lab 7 for 25th September 2008

1. (Marks = 5)
As all of us know, every complex number can be represented as $a + ib$, where both a and b are real numbers and $i = \sqrt{(}-1)$. Also, a and b are called the *real* and *imaginary* part of the complex number respectively. Few of the operations defined on complex numbers are as follows:

   (a) Addition:
   $$(a + ib) + (c + id) = (a + c) + i(b + d)$$

   (b) Substraction:
   $$(a + ib) - (c + id) = (a - c) + i(b - d)$$

   (c) Multiplication:
   $$(a + ib) \times (c + id) = (ac - bd) + i(bc + ad)$$

   (d) Division:
   $$\frac{a + ib}{c + id} = \frac{ac + bd}{c^2 + d^2} + i\frac{bc - ad}{c^2 + d^2}$$

   (e) Conjugate:
   $$\overline{(a + ib)} = (a - ib)$$

   (f) Inverse:
   $$(a + ib)^{-1} = \frac{a}{a^2 + b^2} - i\frac{b}{a^2 + b^2}$$

   (g) Modulus:
   $$|a + ib| = \sqrt{(a^2 + b^2)}$$

   Design and implement a public class complex using the following attributes and methods.
   Attributes :
   ```
   private double real;
   private double imag;
   ```
   Constructors :

   - `public complex(double r, double i)`
     constructor to initialize the *real* and *imaginary* part of the complex number created by **new** to r and i respectively.
   - `public complex()`
     constructor to initialize both the *real* and *imaginary* part of the complex number created by **new** to 0.

   Methods :

   (a) `public complex add(complex c)`
   return (reference to) the complex number which is formed by adding the complex number c with the current complex number (the object on which method is called).

   (b) `public complex substract(complex c)`
   return (reference to) the complex number which is formed by substracting the complex number **c** from the current complex number.

(c) `public complex multiply(complex c)`
return (reference to) the complex number which is formed by multiplying the complex number c with the current complex number.

(d) `public complex divide(complex c)`
return (reference to) the complex number which is formed by dividing the current complex number by the complex number c.

(e) `public complex inverse()`
Returns (reference to) the complex number which is equal to the inverse of the current complex number.

(f) `public complex conjugate()`
Returns (reference to) the complex number which is complex conjugate of the current complex number.

(g) `public double modulus()`
Returns the modulus of the current complex number.

(h) `public double getReal()`
Returns the real part of the current complex number.

(i) `public double setReal(double real)`
Update the real part of the current complex number with real.

(j) `public double getImaginary()`
Returns the imaginary part of the current complex number.

(k) `public void setImaginary(double imag)`
Set the imaginary part of the current complex number to imag.

(l) `public void display()`
This method is used to display the real and imaginary part of the current complex number.

2. (marks = 5)
Write a JAVA program to find the value of the expression using the class defined above.

$$\left| \frac{z_1^2(z_3 + z_4)(z_5 - z_6)}{z_4(z_1 - z_6)(z_2 + z_5)} \right|$$

where,

$$z_1 = 2 + 3i \quad (1)$$
$$z_2 = 5 - 7i \quad (2)$$
$$z_3 = -11 + 13i \quad (3)$$
$$z_4 = -17 - 19i \quad (4)$$
$$z_5 = 23.29 + 31.37i \quad (5)$$
$$z_6 = -41 - 43.47i \quad (6)$$

Note: You have to use only the methods defined in **complex** class. If necessary you may add a few more methods in the class complex. For example, you may add addReal, substractReal, addImag, substractImag etc to the **complex** class if required. Also, do not simplify the given expression before evaluation.