**PART A**

a) Given that:

Therefore, in polar form, can be expressed as:

b) Since we know that:

So

a)

b)

# 

a) Let , It holds that:

Thus, the real and imaginary parts of the given function are:

b) The given function is harmonic if and only if it satisfies the Laplace equation:

Thus, with all real value of and , the given function is harmonic.

Given that:

Let , it holds that:

Taking Laplace transform both sides of , we obtain:

Thus, the solution of the given differential equation is:

**PART B**

a)

b)

From and , which does not satisfies first equation of the Cauchy-Riemann equation. So, is nowhere differentiable.

Given that:

And

Let and , it holds that:

Taking Laplace transforms both side of the whole given system equations, we obtain:

Substitute into , we get:

Substitute back into , we get:

From and , taking inverse Laplace transforms to get the final result:

a)

Since, we know that:

Therefore, there is exists 3 cubic roots of as follows:

b)

Let:

Apply power series for analyzing this problem:

For :

For:

Thus, the Laurent expansion series for the given function around the point are: