Railway Engineering Mathematics
Tutorial Sheet 20

1. Given the following complex numbers in Cartesian form:

$$z_1 = 7 - j3, \qquad z_2 = -1 - j4, \qquad z_3 = -5 + j, \qquad z_4 = 9 + j6$$

(i) Express in polar form:

(a) z_1

(b) z_2

(c) z_3

(d) z_4

(ii) Calculate the following in polar form:

(a) $z_3 z_1$

(b) $z_2 z_4$

(c) $\dfrac{z_3}{z_1}$

(d) $\dfrac{z_4}{z_2}$

(e) $\dfrac{z_1}{z_3}$

(f) $z_3 z_2$

(g) $\dfrac{1}{z_2}$

(h) $\dfrac{1}{z_4}$

2. Given the following complex numbers in Polar form:

$$z_5 = 2.5\angle -2.9, \qquad z_6 = 4.1\angle -5.1, \qquad z_7 = 0.3\angle 1.7, \qquad z_8 = 7.9\angle 6.1$$

(i) Express in rectangular/Cartesian form:

(a) z_5

(b) z_6

(c) z_7

(d) z_8

(ii) Calculate the following in polar form, and then convert the result to Cartesian form:

(a) $z_5 z_6$

(b) $z_7 z_8$

(c) $\dfrac{z_6}{z_8}$

(d) $\dfrac{z_8}{z_5}$

(e) $\dfrac{1}{z_7}$

(f) $\dfrac{1}{z_5}$

3. When multiple impedances in a electrical circuit are connected in series, the total impedance Z (ohms) is given by the sum of the individual impedances. This is related to the voltage V (volts) and current I (amps) using Ohm's Law, which states that $V = IZ$.

   Two impedances $Z_1 = (3 + j6)\ \Omega$ and $Z_2 = (4 - j3)\ \Omega$ are connected in series to a supply voltage of 120 V. What is the magnitude of the current flowing through the circuit?