EME152 Equation Sheet

Complex Equations Standard Form

$$r_1 e^{i\phi_1} + r_2 e^{i\phi_2} = Z \tag{1}$$

$$(a + ir)\, e^{i\theta} = Z \tag{2}$$

Gruebler Equation

$$DOF = 3(n-1) - 2f_1 - f_2 \tag{3}$$

Range of Motion

Non-Grashof Linkage: $r_s + r_l > r_p + r_q$

$$\Delta\theta_2 = 2|\theta_2''| \tag{4}$$

Outward-Limited: $r_1 + r_2 \geq r_3 + r_4$

$$\cos(\theta_2'') = \frac{r_1^2 + r_2^2 - (r_3 + r_4)^2}{2r_1 r_2} \tag{5}$$

Inward-Limited: $r_1 + r_2 < r_3 + r_4$

$$\cos(\theta_2'') = \frac{r_1^2 + r_2^2 - (r_3 - r_4)^2}{2r_1 r_2} \tag{6}$$

Grashof Linkage: $r_s + r_l \leq r_p + r_q$

$$\cos(\theta_2') = \frac{r_1^2 + r_2^2 - (r_3 + r_4)^2}{2r_1 r_2} \tag{7}$$

$$\cos(\theta_2'') = \frac{r_1^2 + r_2^2 - (r_3 - r_4)^2}{2r_1 r_2} \tag{8}$$

$$\Delta\theta_2 = |\theta_2' - \theta_2''| \tag{9}$$