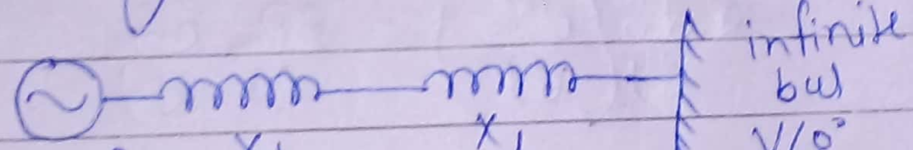
① **Equal area criterion-**

Consider a loss free synchronous generator supplying an infinite bus through a purely reactive transmission line of reactance X_l

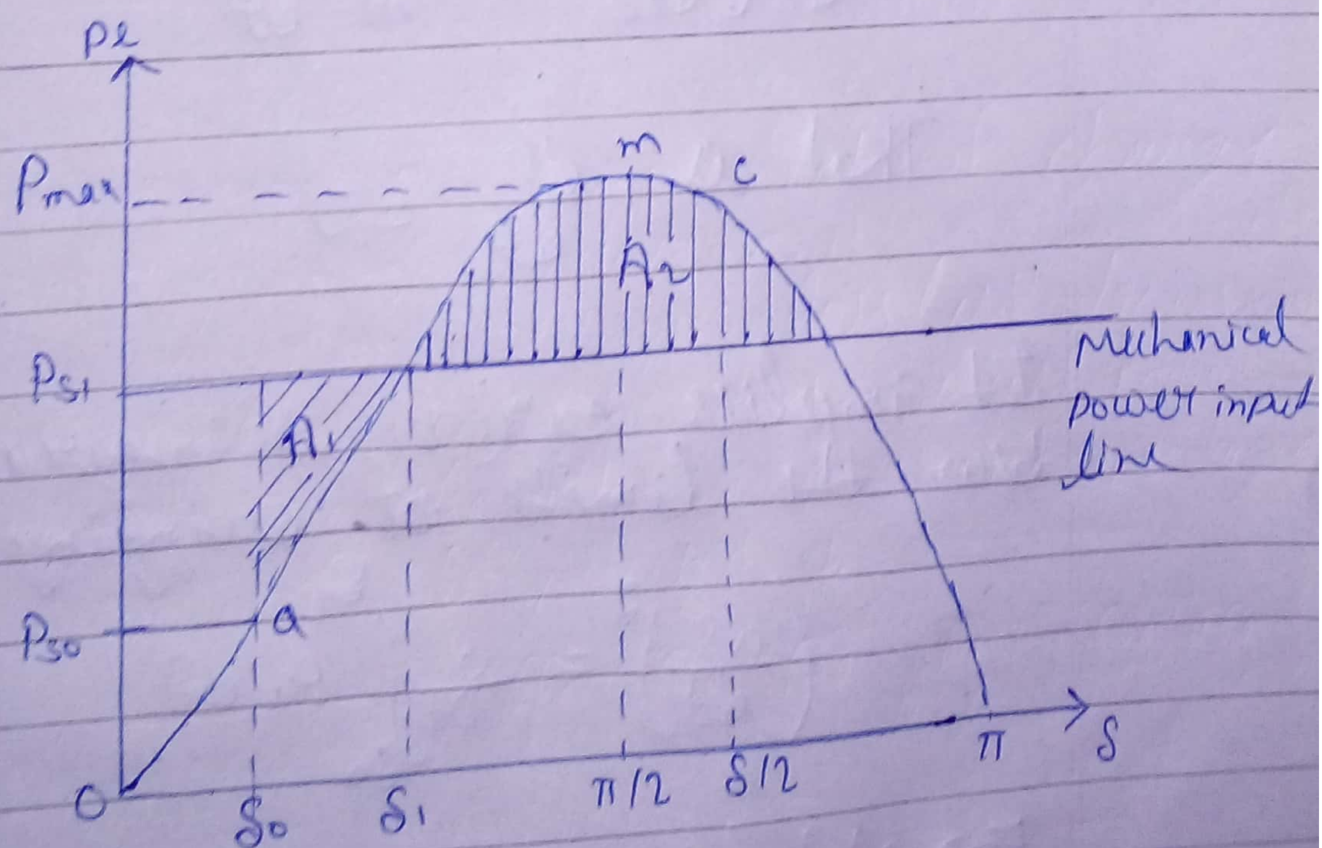
The electrical power transferred is given by equation

$$P_e = P_{emax} \sin\delta$$

Let the mechanical input power suddenly increase to P_{s1}.



(a)



The load angle goes on decreasing untill it is equal to δ_0 where again the rotor is running at synchronous speed.

Consider the swing eq^n

$$\frac{d^2\delta}{dt^2} = \frac{P_a}{M} \quad \text{--- (1)}$$

~~Mult~~

Multiplying both side by $2\frac{d\delta}{dt}$

$$2\frac{d\delta}{dt}\left(\frac{d^2\delta}{dt^2}\right) = \frac{2P_a}{M}\frac{d\delta}{dt}$$

$$\frac{d}{dt}\left(\frac{d\delta}{dt}\right)^2 = \frac{2P_a}{M}\frac{d\delta}{dt} \quad \text{--- (2)}$$

That is, $\frac{d\delta}{dt} = 0$

It implies eq^n(2) is integrated b/w the limits of swinging of δ.

$$\left(\frac{d\delta}{dt}\right)^2 = \frac{2}{M}\int_{\delta_0}^{\delta_2} P_a \, d\delta$$

For stability $\frac{d\delta}{dt} = 0$

$$\int_{\delta_0}^{\delta_2} P_a \, d\delta = 0 \quad \text{--- (3)}$$

$$\int_{\delta_0}^{\delta_1} P_a \, d\delta + \int_{\delta_1}^{\delta_2} P_a \, d\delta = 0$$

$$\int_{\delta_0}^{\delta_1} P_a \, d\delta = -\int_{\delta_1}^{\delta_2} P_a \, d\delta \quad \text{--- (4)}$$

$$A_1 = -A_2 \quad \text{--- (5)}$$

where $A_1 = \int_{\delta_0}^{\delta_1} P_a \, d\delta$ = Positive or accelerating area

$A_2 = \int_{\delta_1}^{\delta_2} P_a \, d\delta$ = Negative or decelerating area.