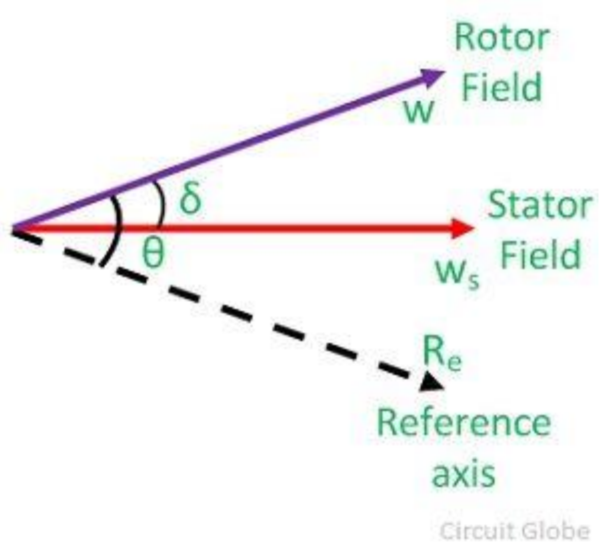
SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)
COIMBATORE-35
Accredited by NBA-AICTE and Accredited by NAAC – UGC with A+ Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

19EEB302/ POWER SYSTEMS – II
III YEAR / VI SEMESTER
UNIT-II : STABILITY ANALYSIS

SWING EQUATION

The [transcient stability] of the system can be determined by the help of the swing equation. Let θ be the angular position of the rotor at any instant t. θ is continuously changing with time, and it is convenient to measure it with respect to the reference axis shown in the figure below. The angular position of the rotor is given by the equation



$$\theta = w_s t + \delta \dots\dots\dots\dots\dots equ(1)$$

Where,

θ – angle between rotor field and a reference axis

w_s – synchronous speed

δ – angular displacement

Differentiation of equation (1) gives

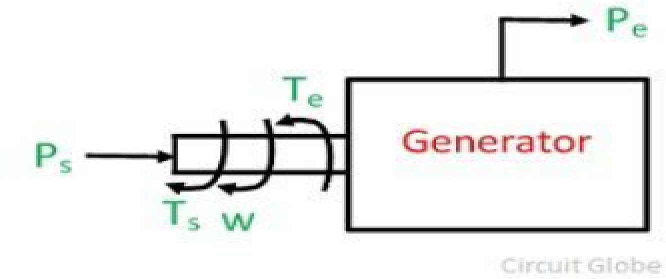
$$\frac{d\theta}{dt} = w_s + \frac{d\delta}{dt} \dots\dots\dots\dots\dots equ(2)$$

Differentiation of equation (2) gives

$$\frac{d^2\theta}{dt^2} = \frac{d^2\delta}{dt^2} \dots\dots\dots\dots\dots equ(3)$$

Angular acceleration of rotor

$$\alpha = \frac{d^2\theta}{dt^2} = \frac{d^2\delta}{dt^2}\ elect.rad/s^2$$



$$T_a = T_s - T_e \ldots\ldots\ldots\ldots\ldots\ldots equ(5)$$

Where,

- T_a – accelerating torque
- T_s – shaft torque
- T_e – electromagnetic torque

Angular momentum of the rotor is expressed by the equation

$$M = Jw \ldots\ldots\ldots\ldots\ldots\ldots equ(6)$$

Where,

- w- the synchronous speed of the rotor
- J – moment of inertia of the rotor
- M – angular momentum of the rotor

Multiplying both the sides of equation (5) by **w** we get

$$wT_a = wT_s - wT_e$$

$$P_a = P_s - P_e$$

Where,

P_s – mechanical power input
P_e – electrical power output
P_a – accelerating power

But,

$$J\frac{d^2\delta}{dt^2} = T_a$$

$$J\frac{d^2\theta}{dt^2} = T_a$$

$$wJ\frac{d^2\delta}{dt^2} = wT_a$$

$$M\frac{d^2\delta}{dt^2} = P_a = P_s - P_e \dots\dots\dots\dots\dots\dots\dots equ(7)$$

RECAP….

…THANK YOU