



# **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**

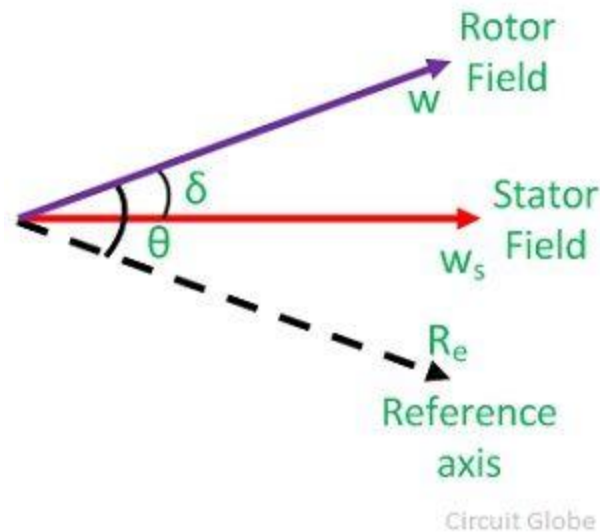
### **III YEAR / VI SEMESTER**

### **UNIT-II : STABILITY ANALYSIS**

# **SWING EQUATION**



The transient stability of the system can be determined by the help of the swing equation. Let  $\theta$  be the angular position of the rotor at any instant  $t$ .  $\theta$  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





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

Where,

$\theta$  – angle between rotor field and a reference axis

$w_s$  – synchronous speed

$\delta$  – angular displacement

Differentiation of equation (1) gives

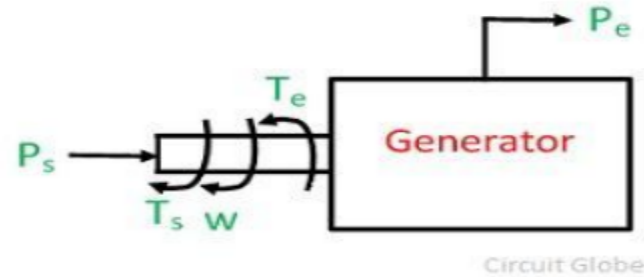
$$\frac{d\theta}{dt} = w_s + \frac{d\delta}{dt} \dots\dots\dots equ(2)$$

Differentiation of equation (2) gives

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

Angular acceleration of rotor

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



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

Where,

$T_a$  – accelerating torque

$T_s$  – shaft torque

$T_e$  – electromagnetic torque

Angular momentum of the rotor is expressed by the equation

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

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  $\omega$  we get

$$\omega T_a = \omega T_s - \omega T_e$$

$$P_a = P_s - P_e$$

Where,

$P_s$  – mechanical power input

$P_e$  – electrical power output

$P_a$  – accelerating power

But,

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

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

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

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



# RECAP....



# ...THANK YOU