SNS COLLEGE OF ENGINEERING

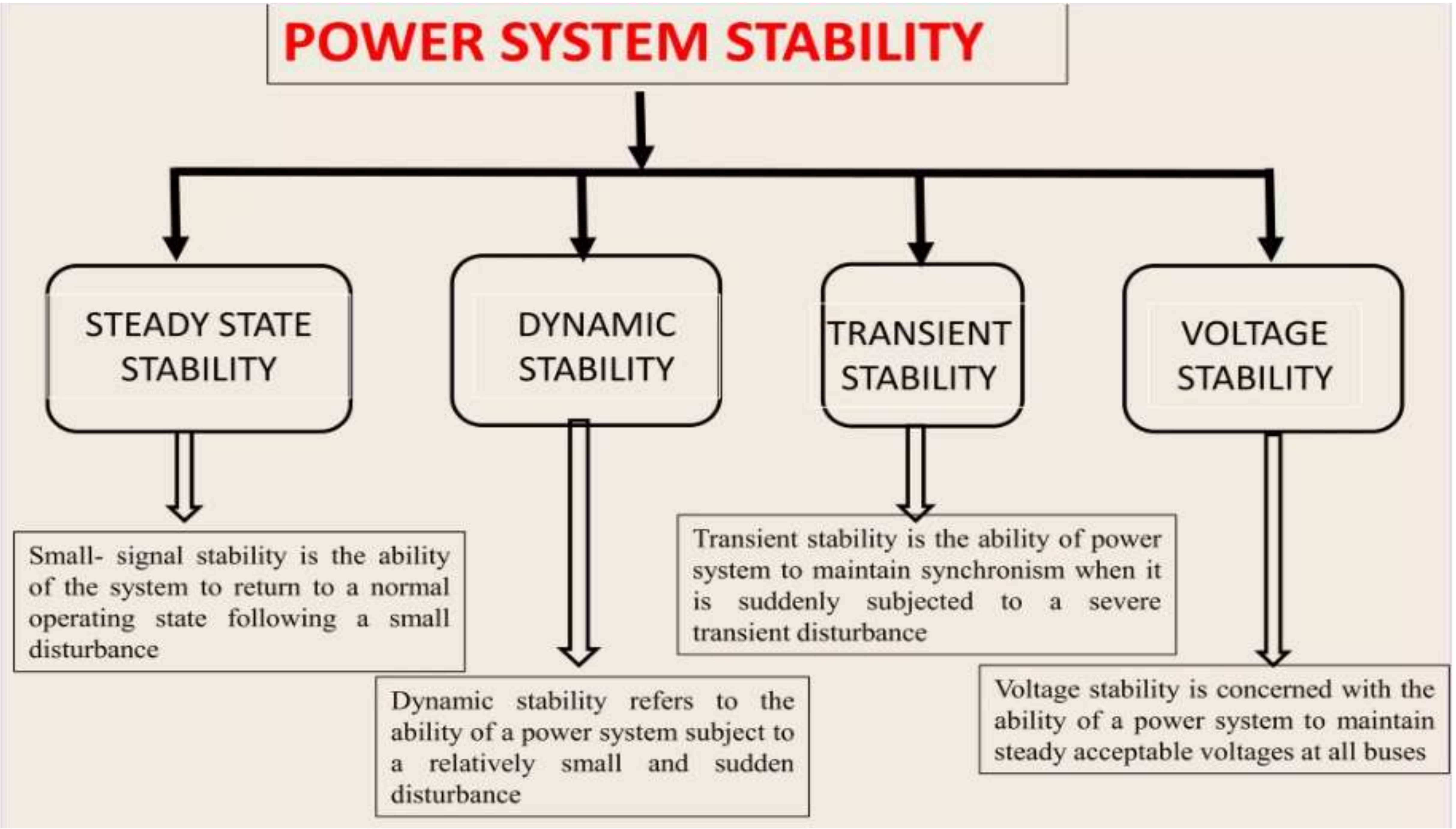
Kurumbapalayam (Po), Coimbatore – 641 107

An Autonomous Institution

Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A' Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

UNIT – V
Stability Studies and Reactive Power Compensation
Power System Stability


POWER SYSTEM STABILITY
STEADY STATE STABILITY
DYNAMIC STABILITY
TRANSIENT STABILITY
VOLTAGE STABILITY
Small- signal stability is the ability of the system to return to a normal operating state following a small disturbance
Dynamic stability refers to the ability of a power system subject to a relatively small and sudden disturbance
Transient stability is the ability of power system to maintain synchronism when it is suddenly subjected to a severe transient disturbance
Voltage stability is concerned with the ability of a power system to maintain steady acceptable voltages at all buses

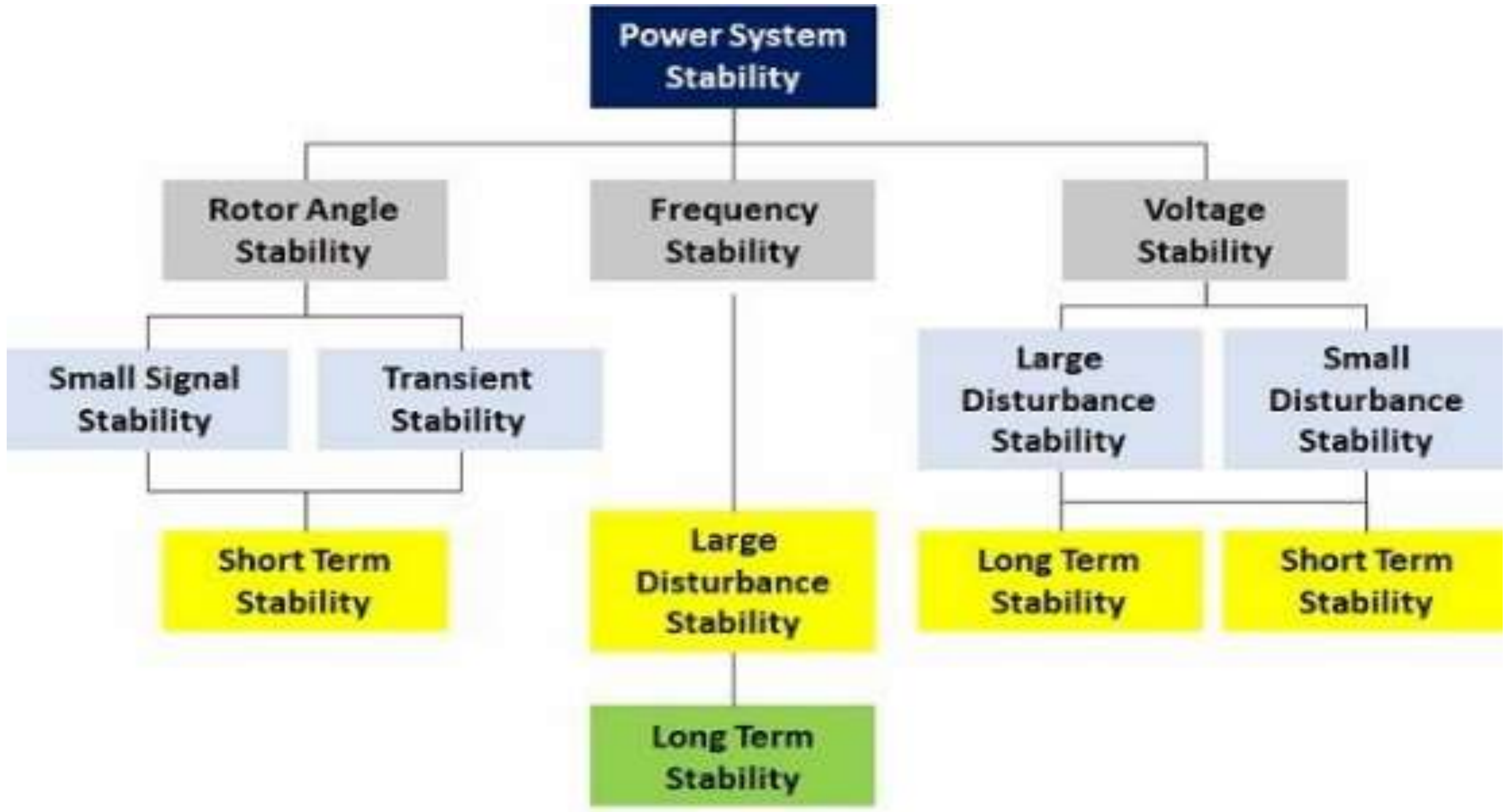
TRANSIENT STABILITY

- It is the ability of the power grid system to maintain synchronism when subjected to severe disturbances.
- Transient stability analysis is considered with large disturbances like :
  - Suddenly change in load
  - Generation or transmission system configuration due to fault
  - Switching

ROTOR ANGLE STABILITY

- It is the ability of the system to remain in synchronism when subjected to a disturbance.
- The rotor angle of a generator depends on the balance between the electromagnetic torque due to the input mechanical power through prime mover.
- Remaining in synchronism means that all the generators electromagnetic torque is exactly balanced by the mechanical torque .
- In some generators the balance between electromagnetic and mechanical torque is disturbed which leads to disturbance in oscillations and rotor angle.

Classification of power system stability



VOLTAGE STABILITY

- Voltage stability refer to the ability of power system to maintain steady voltages at all buses in a system after being subjected to a disturbance from a given initial operating point.

- The system state enters the voltage instability region when a disturbance or an increase in load demand or alteration in system state results in an uncontrollable and continuous drop in system voltage.

DYNAMICS OF SYNCHRONOUS MACHINE

The kinetic energy of the rotor at synchronous machine is,

$$K.E = \frac{1}{2} J \omega_{sm}{}^{2} \times 10^{-6}\ MJ$$

Where,

J=rotor moment of inertia in $Kg.m^2$

ω_{sm}=rotor speed in radian (mechanical)/second

But $\omega_s = (\frac{P}{2})\ \omega_{sm}$ rotor speed in radian (electrical)/second

Where P is no of machine poles.

$$K.E = \frac{1}{2}\left[J\left(\frac{2}{P}\right)^{2} \omega_s \times 10^{-6}\right] \times\ \omega_s$$

$$K.E = \frac{1}{2} M\ \omega_s$$

Where, M = $J\left(\frac{2}{P}\right)^{2} \omega_s \times 10^{-6}$ *moment of inertia in MJ.S/(elect rad)*

GH= $K.E = \frac{1}{2} M\ \omega_s$, Where G is machine rating in MVA and H is inertia constant in MJ/MVA

DYNAMICS OF SYNCHRONOUS MACHINE

$$M = \frac{2GH}{\omega_s} = \frac{GH}{\pi f} \quad MJ.S/(elect\ rad)$$

$$M = \frac{GH}{180f} \quad MJ.S/(elect\ degree)$$

ASSESSMENT

1. What is the value of transient stability limit?

- Higher than steady state limit
- **Lower than steady state limit**
- Depending upon the severity to load
- All of these

ASSESSMENT

2. By using which component can the transient stability limit of a power system be improved?

- Series resistance
- **Series capacitor**
- Series inductor
- Shunt resistance


thank you