



# **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**

**Overview of Reactive Power Control**



# CONTENTS

- Need for reactive power compensation
- Methods of reactive power compensation
- Shunt Compensation
- Advantages & Disadvantages of Compensators



## NEED FOR REACTIVE POWER COMPENSATION

- Voltage variation at a node is indication of the unbalance between reactive power generated and consumed by load.

$$P = (V_1 V_2) \sin \delta / X, Q = V_1 (V_1 - V_2 \cos \delta) / X$$

- If reactive power generated is greater than consumed by node, the voltage goes up & vice versa.
- Lack of reactive power can cause voltage collapse in a system.
- Its important to supply / absorb excess reactive power to / from the network.



## NEED FOR REACTIVE POWER COMPENSATION

- Ferranti Effect is minimized so that flat voltage profile will exist on line for all loading condition.
- Power transfer capability of system will be enhanced , hence stability margins increases.



# METHODS OF REACTIVE POWER COMPENSATION



- Shunt Compensation
- Series Compensation
- Synchronous Condensers
- Static VAR Compensators
- Static Compensator



# SHUNT COMPENSATION



- A device that is connected in parallel with a transmission line is called a shunt compensator.
- A shunt compensator is always connected at the end point and will be in the middle of the transmission line.
- It can be provided by shunt reactor or a shunt capacitor



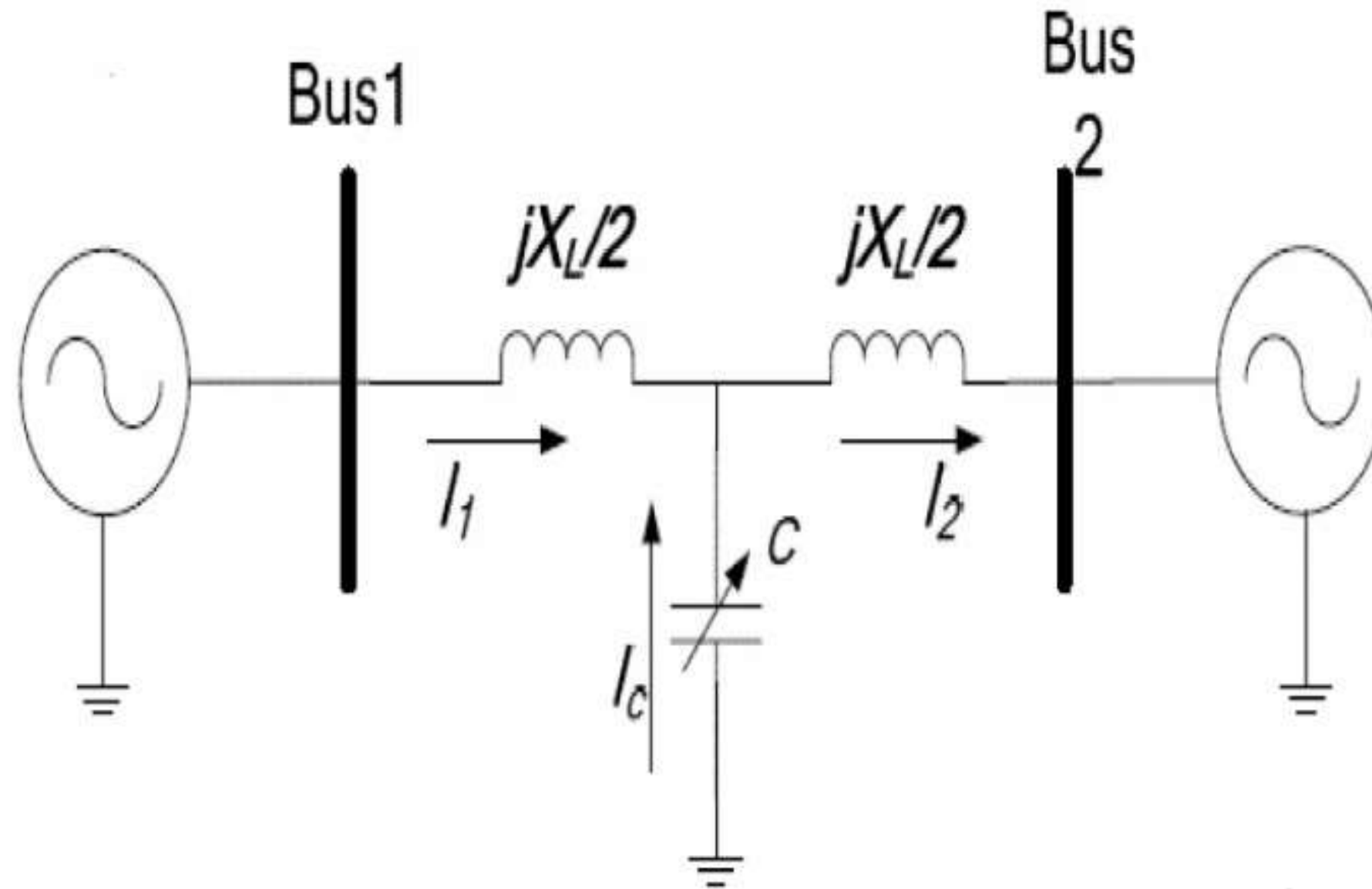
# SHUNT COMPENSATION



- Shunt connected reactors are used to reduce the line over voltages consuming  $\epsilon$  reactive power, while shunt connected capacitors are used to maintain the voltage levels by compensating the reactive power of transmission line .
- It improves
  - Voltage profile
  - Power angle characteristics
  - Improved power factor
  - Load stabilization



# TRANSMISSION LINE WITH SHUNT COMPENSATION







# SERIES COMPENSATION



- When a device is connected in series with the transmission line, it is called series compensator.
- A series compensator can be connected anywhere in the line.
- There are two modes of operation
  - Capacitive mode
  - Inductive mode



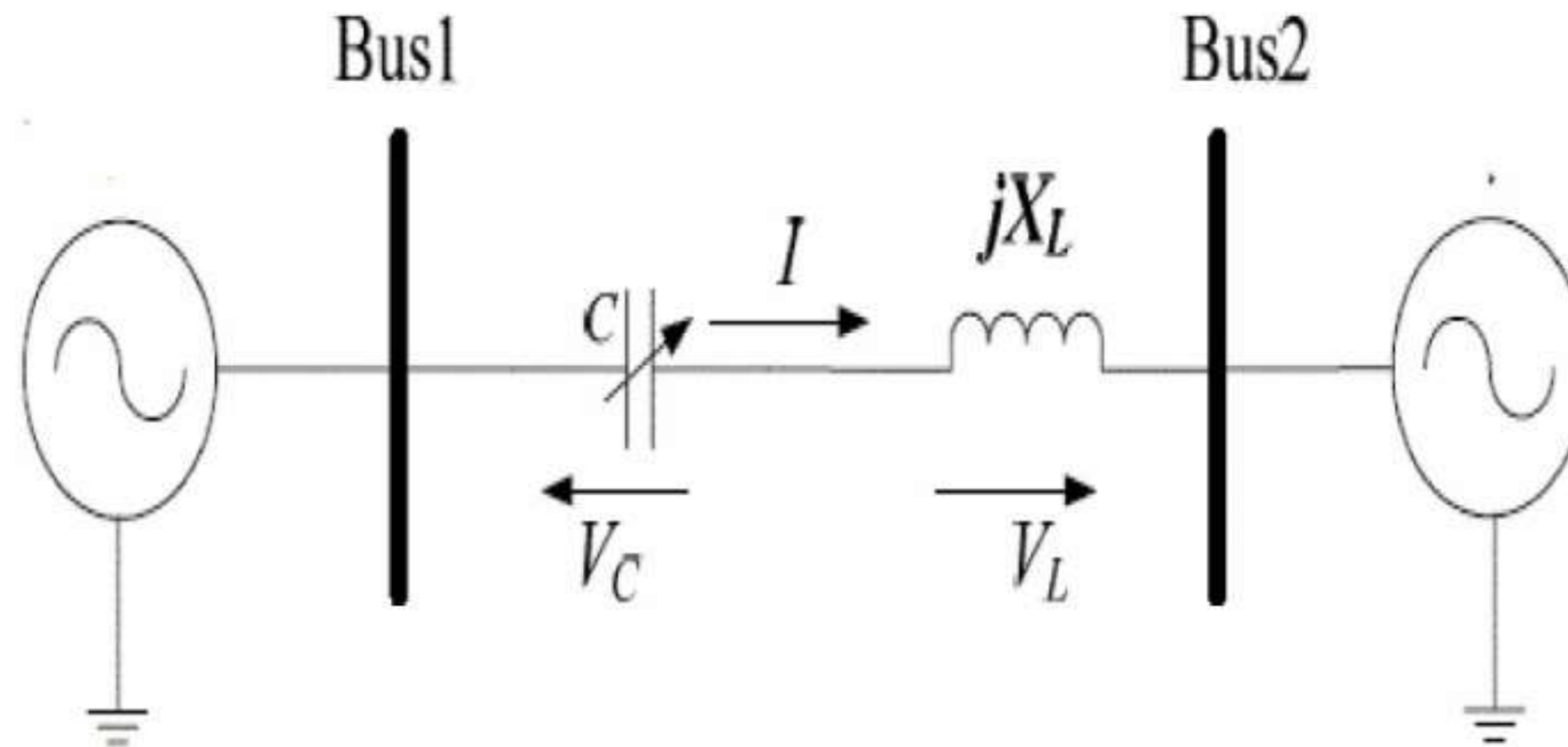
# SERIES COMPENSATION



- Main idea of series compensation is to cancel part of series inductive reactance of the line by use of series capacitors :
  - Increase in maximum transferable power
  - Increase in virtual impedance loading
  - Reduction of transmission angle or certain amount of power transfer



# TRANSMISSION LINE WITH SERIES COMPENSATION





# ASSESSMENT

1. Which is not a static compensation that used in transmission line?
  - Shunt capacitor bank
  - **Synchronous condensers**
  - VAR Compensators
  - Series Compensation



# ASSESSMENT

2. How is the reactive power of the line capacitance during low loads in long EHV transmission lines compensated.

- **By shunt reactor**
- By series reactor
- By static var sources

