MARIA COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FLEXIBLE AC TRANSMISSION SYSTEMS

TWO MARK QUESTION AND ANSWERS

UNIT – I INTRODUCTION

1. **What is meant by reactive power control in electrical power transmission lines?**
   To make transmission networks operate within desired voltage limits, methods of making up or taking away reactive-power is called reactive-power control.
2. **States uses of series compensation.**
   Series compensation used in the improvement of the maximum power-transmission capacity of the line. The net effect is a lower load angle for a given power-transmission level and, therefore, a higher-stability margin. The series compensation effectively reduces the overall line reactance, it is expected that the net line-voltage drop would become less susceptible to the loading conditions.
3. **What is the necessity of compensation?**
   The objectives of line compensation are invariably
   1. to increase the power-transmission capacity of the line, and/or
   2. to keep the voltage profile of the line along its length within acceptable bounds to ensure the quality of supply to the connected customers as well as to minimize the line-insulation costs.
4. **How is reactive power controlled in the electrical networks?**
   To keep the voltages in the network at nearly the rated value, two control actions seem possible:
   1. load compensation, and
   2. system compensation.
5. **What is meant by Power System Stabilizer (PSS)?**
   A power-system stabilizer (PSS) is implemented by adding auxiliary damping signals derived from the shaft speed, or the terminal frequency, or the power—an effective and frequently used technique for enhancing small-signal stability of the connected system.
6. **What is meant by STATCOM?**
   A control on the output voltage of this converter—lower or higher than the connecting bus voltage—controls the reactive power drawn from or supplied to the connected bus. This FACTS controller is known as a static compensator (STATCOM).
7. **What is meant by load compensation?**
   It is possible to compensate for the reactive current Ix of the load by adding a parallel capacitive load so that Ic c `Ix. Doing so causes the effective power factor of the combination to become unity. The absence of Ix eliminates the voltage drop DV1, bringing Vr closer in magnitude to Vs; this condition is called load compensation.
8. **What is meant by system compensation?**

To regulate the receiving-end voltage at the rated value, a power utility may install a reactive-power compensator as shown in Fig. 2.3. This compensator draws a reactive current to overcome both components of the voltage drop DV1 and DV2 as a consequence of the load

current Il through the line reactance Xl . To compensate for DV2, an additional capacitive current, DIc, over and above Ic that compensates for Ix, is drawn by the compensator.

9. Define passive and active VAR control.

When fixed inductors and / or capacitors are employed to absorb or generate reactive power they constitutes passive control. An active var control, is produced when its reactive power is changed irrespective of terminal voltage to which the var controller is connected.

10. What is meant by shunt compensation?

Shunt devices may be connected permanently or through a switch. Shunt reactors compensate for the line capacitance, and because they control overvoltages at no loads and light loads, they are often connected permanently to the line, not to the bus.

11. Define series compensation.

Series capacitors are used to partially offset the effects of the series inductances of lines. Series compensation results in the improvement of the maximum power-transmission capacity of the line. The net effect is a lower load angle for a given power-transmission level and, therefore, a higher-stability margin. The reactive-power absorption of a line depends on the transmission current, so when series capacitors are employed, automatically the resulting reactive-power compensation is adjusted proportionately.

12. What are the factors are affecting the application of series compensation?

the following factors need careful evaluation:

1. The voltage magnitude across the capacitor banks (insulation);
2. The fault currents at the terminals of a capacitor bank;
3. The placement of shunt reactors in relation to the series capacitors (res-

onant overvoltages); and

4. The number of capacitor banks and their location on a long line (voltage

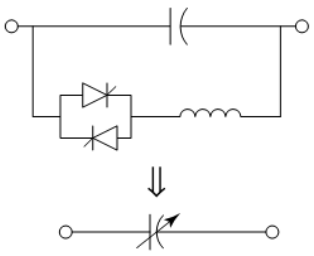
profile).

13. What is SVC?

Static var compensators (SVCs) are used primarily in power systems for voltage control as either an end in itself or a means of achieving other objectives, such as system stabilization.

14. What is TCSC?

Thyristor switches may be used for shorting capacitors; hence they find application in step changes of series compensation of transmission lines. A blocked thyristor switch connected across a series capacitor introduces the capacitor in line, whereas a fully conducting thyristor switch removes it. In reality, this step control can be smoothed by connecting an appropriately dimensioned reactor in series with the thyristor switch as shown in to yield vernier control. This application of thyristor switches creates the thyristor-controlled series capacitor (TCSC) FACTS controller.



15. What is UPFC?

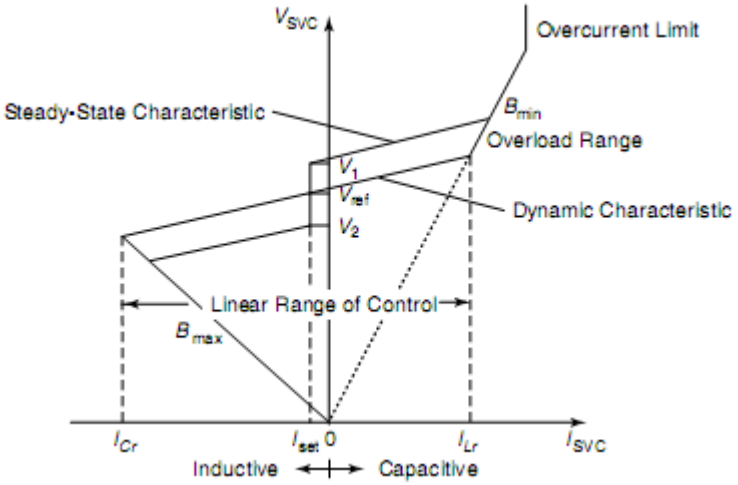
Unified Power Flow Controller (UPFC) offers a fast, controllable FACTS device for the flow of combined active –reactive power in a line.

16. What is IPFC?

The Interline Power Flow Controller (IPFC), proposed by Gyugyi with Sen and Schauder in 1998, addresses the problem of compensating a number of transmission lines at a given substation. Conventionally, series capacitive compensation (fixed, thyristor-controlled or SSSC-based) is employed to increase the transmittable real power over a given line and also to balance the loading of a normally encountered multiline transmission system.

UNIT II STATIC VAR COMPENSATOR (SVC) AND APPLICATIONS

1. Draw the steady state VI characteristics of SVC.



2. What is the cause for Voltage instability?

Voltage instability, the subject of intense research is caused by the inadequacy of the power system to supply the reactive-power demand of certain loads, such as induction motors. A drop in the load voltage leads to an increased demand for reactive power that, if not met by the power system, leads to a further decline in the bus voltage. This decline eventually leads to a progressive yet rapid decline of voltage at that location, which may have a cascading effect on neighbouring regions that causes a system voltage collapse.

3. Write the application of SVC.

1. Stability Enhancement
2. Damping sub synchoronous oscillations
3. Improvement of HVDC link Performance

4. How is the voltage instability identified in the power system?

The instability is caused by tripping one of the transmission lines and is detected from eigenvalue analysis.

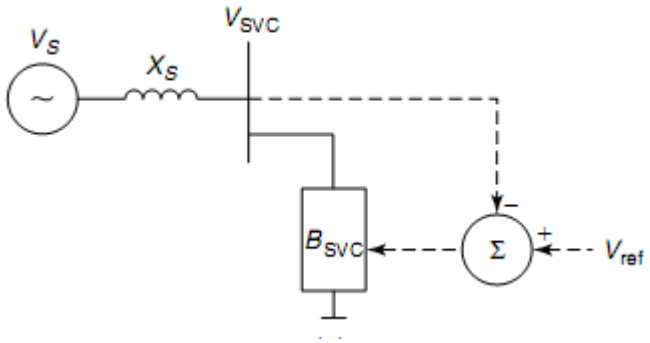
5. What are the advantages of the slope in the SVC dynamic characteristic?

Although the SVC is a controller for voltage regulation, that is, for maintaining constant voltage at a bus, a finite slope is incorporated in the SVC's dynamic characteristic and provides the following advantages despite a slight deregulation of the bus voltage. The SVC slope

1. Substantially reduces the reactive-power rating of the SVC for achieving nearly the same control objectives;

2. Prevents the SVC from reaching its reactive-power limits too frequently and
3. Facilitates the sharing of reactive power among multiple compensators operating in parallel.

6. **What will happen if the SVC absence in a power system network?**
   If the SVC absence in a power system network the voltage of either end of the transmission network will not maintain as constant and the system stability will be poor.
7. **Define the reactive power rating of the SVC?**
   The reactive power rating of the SVC is defined as the sum of its inductive and capacitive rating.
8. **Draw the block diagram of power system with SVC control system.**



9. **What is meant by SVC?**
   Static var compensators (SVCs) are used primarily in power systems for voltage control as either an end in itself or a means of achieving other objectives, such as system stabilization.
10. **What are the factors affecting the performance of SVC?**
    The performance of SVC voltage control is critically dependent on several factors, including the influence of network resonances, transformer saturation, geomagnetic effects, and voltage distortion.

UNIT – III TCSC AND APPLICATIONS

1.Define Bypassed – Thyristor Mode.

- In this bypassed mode the thyristors are made to fully conduct with a conduction angle of 180 degree.
- Gate pulses are applied as soon as the voltage acroos the thyristors reaches zero and becomes positive resulting in a continuous sinusoidal of flow current through the thyristor valves.

2. Define Blocked – Thyristor Mode.

It also known as the waiting mode the firing pulses to the thyristor valves are blocked.
If the thyristors are conducting and a blocking command is given the thyristors turn off as soon as the current through them reaches a zero crossing.
The TCSC module is thus reduced to a fixed=series capacitor, and the net TCSC reactance is capacitive.

3. List out the different causes for capacitive region in the different TCSC reactance constraints.

1. The limit on the TCSC firing angle represented by constant reactance limit Xmax.
2. The limit on the TCSC voltage VCtran. The corresponding reactance constraint is give by
   Xmax VC = (VCtran) ILrated / I line

4.Define SSR Mitigation.

Important aspect of the SSSC is that because it does not introduce a physical capacitor in the line it Does not cause SSR.However it assists in the damping of sub Synchronous oscillations caused by other series capacitors Inserted in the transmission network.

5.What is Selection of Input Signals.

It is a desirable feature that the TCSC controller input signals can extend as far as possible without sensitivity to the TCSC output and this feature ensures that the control signals represent mainly the system conditions for which the TCSC is expected to improve.

6. Define Bang-Bang control.

Bang – bang control is a discrete control form in which the thyristors are either fully switched on Or fully switched off. Bang – bang control is employed in face of large disturbance to improve the transient stability.

7. List out the different techniques to Improvement the System-stability Limit.

During the outage of a critical line in a meshed system a large volume of power tends to flow In parallel transmission paths which may become severely over loaded.

By providing fixed-series compensation on the parallel path to augment the power-transfer capability appears to be a feasible solution but it may increase the total system losses.

8. List out the different causes for inductive region in the different TCSC reactance constraints.

The limit on the firing angle represented by a constant-reactance limit Xmin 0.

The harmonics-imposed limit represented by a constant – TCSC-voltage limit VLtran.

UNIT – IV EMERGING FACTS CONTROLLERS

1.Define STATCOM.

The STATCOM (SSC) is a shunt-connected reactive-power compensation devices that is capable of generating absorbing reactive power and in which the output can be varied to control the specific parameters of an electric power system.

2. List out the advantages of STATCOM.

1.It occupies a small footprint for it replaces passive banks of circuit elements by compact electronic converters.

2.It offers modular factory-built equipment thereby reducing site work and commissioning time.

3.It uses encapsulated electronic converters thereby minimizing its environmental impact.

3. List out the applications of STATCOM.

1. A static synchronous compensator(STATCOM) also known as a " static synchronous condenser"(STATCOM) is a regulating device used on alternating current electricity transmission networks

2. It is based on a power electronics voltage-source converter and can act as either a source or sink of reactive AC power to an electricity network.

4. Define UPFC.

1. The UPFC is the most versatile FACTS controller developed so far with all encompassing capabilities of voltage regulation series compensation and phase shifting.

2. It can independently and very rapidly control both real and reactive power flows in a transmission line.

5. List out the application of UPFC.

1. The UPFC also provides very significant damping to power oscillations when it operates at power flows within the operating limits.

2. Although this power can be raised further by enhancing the UPFC rating the power increase is correspondingly and significantly lower than the increase in the UPFC rating thereby indicating that the practical limit on the UPFC size has been attained.

6. Define function of control system on SSSC.

1. The introduction of desired series-reactive compensation (capacitive or inductive)
2. The damping of power-swing oscillations and enhancement of transient stablility.
3. The control of current in the SSSC –compensated line.

7. List out the different constraints available on UPFC.

1. The series –injected voltage magnitude.
2. The line current through series converter.
3. The shunt-converter current
4. The maximum line-side voltage of the UPFC.

8. What is the use of PWM mode and DC Capacitor bank on STATCOM?

1. Pulse width modulated (PWM) mode is used to prevent the fault current from entering the VSCs and in this way the STATCOM is able to withstand transients on the ac side without blocking.
2. The DC capacitor bank is used to support (stabilize) the controlled dc voltage needed for the operation of the VSC.

UNIT-V Co-Ordination OF Facts Controllers

1. Define shunt-reactor resonance.

If shunt reactors are present in the system (which the usually are) the series compensation of the transmission line introduces additional resonant modes from the interaction of series capacitance with the inductance of shunt inductors is called shunt-reactor resonance.

2. What are all the different combinations available in controller interactions?

1. Multiple FACTS controllers of a similar kind.
2. Multiple FACTS controllers of a dissimilar kind.
3. Multiple FACTS controllers and HVDC converter controllers.

3. what are all the different frequency ranges available in control interactions?

1. 0 Hz for steady-state interactions.
2. 0-3/5 Hz for electromechanical oscillations.
3. 2-15 Hz for small-signal or control oscillations

4. Define LQR Techinique.

The LQR technique is one of the optimal control that can be used to coordinate the controllers with the overall objective of damping low-frequency inter-area modes during highly stressed power-system operations

5. Define modal-performance index.

In the nonlinear-constrained optimization techniques the objective function is called a modal-performance index which relates exclusively to system damping enhancement.

6. Define Genetic algorithms.

The genetic algorithms are optimization techniques based on the laws of natural selection and natural genetics that recently have been applied to the control design of power systems

7.Define adaptive control.

The nonlinear control technique in which the system nonlinearities are expressed as system changes constituting a function of time is the adaptive control.

8.Define constrained-optimization.

The constrained –optimization techniques for control coordination use control structures generally used in industry but may or may not use robustness criteria explicitly in the design process.