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**Question Paper Code : X 20467**

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2020

Seventh Semester

Electrical and Electronics Engineering

EE 6004 – FLEXIBLE AC TRANSMISSION SYSTEMS

(Regulations 2013)

Common to : PTEE 6004 – Flexible AC Transmission Systems for B.E.  
(Part-Time) – Seventh Semester Electrical and Electronics Engineering

(Regulations 2014)

Time : Three Hours

Maximum : 100 Marks

Answer ALL questions

PART – A

**(10×2=20 Marks)**

1. Mention any four possible benefits that are associated with FACTS technology.
2. What are the basic types of FACTS controllers ?
3. Draw the plot between the amplitude variations of the fundamental Thyristor Controlled Reactor (TCR) current and the delay angle  $\alpha$ , with a suitable current equation.
4. Draw the VI and VQ characteristics of SVC.
5. What is the role of a TCSC in a power system ?
6. Draw the impedance vs delay angle ( $\alpha$ ) characteristics of TCSC.
7. Draw the block diagram for the basic control scheme of a voltage source converter based VAR generator for reactive power control.
8. Explain the principle of operation of a STATCOM.
9. Mention the possible combinations of FACTS controllers during interactions. List any two control techniques for coordination of multiple controllers.
10. Explain the phenomenon of subsynchronous Resonance (SSR).



11. a) List the different factors that limit the loading capability of a transmission line. With a suitable schematic diagram, explain the various basic types of FACTS controllers in detail.

(OR)

- b) With a suitable system equivalent circuit, derive the expression for real and reactive power of an UPFC connected at the midpoint of a line.
12. a) What are the objectives of shunt compensation ? Derive an expression for real and reactive power for midpoint voltage regulation of a simple two machine model by SVC.

(OR)

- b) Explain the principle of operation of a basic Thyristor Switched Capacitor – Thyristor Controlled Reactor (TSC-TCR) based Static VAR generator in detail with suitable illustrations.
13. a) What is the need for variable series compensation ? Explain the modes of operation of TCSC with advantages.

(OR)

- b) Explain the analysis of TCSC with a suitable diagram. Mark the angle of advance, delay angle and conduction angle in the waveforms of  $I_s$  and  $V_c$  clearly.
14. a) Derive the power flow with constant active and reactive voltage injection in the line with SSSC.

(OR)

- b) Draw the VI and VQ characteristics of a STATCOM. Explain about the improvement of transient stability using a STATCOM connected to a midpoint of a line. Draw a suitable power angle curve (P vs  $\delta$ ).
15. a) Classify the different control interactions based on the frequency ranges and explain about them in detail.

(OR)

- b) Explain the basic procedure for the controller design and coordination of multiple FACTS controllers in detail using Linear-control techniques.



**PART – C**

**(1×15=15 Marks)**

16. a) The first prototype STATCOM installation in USA is at 161 kV, Sullivan substation of the Tennessee Valley Authority (TVA). It has the following data. Nominal DC voltage : 6.6 kV, energy stored in the DC capacitor : 65 kJ, frequency of the AC system = 60 Hz, rating of the STATCOM is +/- 100 MVA.
- i) Find the equivalent value of the capacitor at 161 kV.
  - ii) The capacitor susceptance in per unit.

(OR)

- b) Distinguish between the internal and external converter control applied to a SSSC with its operation and V-I characteristics. Justify the necessity of an operating mode selector in the external control scheme and explain all the possible operating control modes.
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