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B.E (Full - Time) END SEMESTER EXAMINATIONS, MAY 2019
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGNEERING
EE 8009 - FLEXIBLE AC TRANSMISSION SYSTEMS
R 2012

Time : 3 Hrs | Answer All Questions | Max. Marks: 100

PART A (10 x 2 =20)

1. Differentiate between surge impedance and characteristic impedance.
2. What are the objectives of line compensation?
3. Draw the V-Q characteristics of SVC.
4. What are the advantages of having the slope in the V-I characteristics of SVC?
5. Draw the V-I characteristics of two module TCSC.
6. Compare SVC and STATCOM.
7. What are the advantages of second generation of FACTS controllers?
8. What is the need for coordination of FACTS controllers?
9. Name the FACTS controllers that are installed in India.
10. What is the need for FACTS controllers?

PART B - (5x16 = 80)

11 i) Prove that the MVAR rating of series compensator required is only 7.2% of that of a shunt compensator for same change in power transfer of a transmission line with a load angle of 30°.(6)

ii) Consider a 735kV symmetrical lossless transmission line with l=0.95mH/km, c=12nF/km, and a line length of 900 km. Consider the system frequency as 50Hz. Design a compensator to maintain the mid-point voltage at 1.045 p.u. when the power transfer varies from 30% SIL to 120% SIL. (10)

12 (a) (i) Draw the V-I characteristics of SVC (FC+TCR) and power system and explain how the SVC is able to regulate the HVAC bus voltage.(8)

(ii) From the fundamentals show that TCR acts as a variable inductor by deriving the necessary formulae. (8)

[OR]

12.(b) (i) Consider a symmetrical lossless short transmission line with both end voltages regulated at V p.u. and of reactance X p.u with SVC connected at the mid-point. The slope of V-I characteristics of SVC is X_{sl}. Derive the expression for the power transfer.(6)

(ii)An SVC is connected to 765 kV system has a reactive power range of 550 MVAR production to 300 MVAR absorption. If the per unit proportional gain of voltage regular is to be 0.65, determine the short-circuit level of the system. The SVC has a slope of 4%.(10)

13.(a). (i). Explain about the various operating modes of TCSC. (6)

(ii). From the fundamentals derive the expression for steady-state thyristor current when the TCSC is operating in the vernier mode.(10)

[OR]

13.(b) (i) Explain about the modelling of TCSC for power flow analysis. (6)
(ii) Explain about constant current and constant angle strategies of TCSC.(10)

14.(a). (i) Explain the principle of operation of STATCOM.(8)
(ii) What are the various ways of controlling the output voltage of STATCOM. Explain them with necessary block-diagrams.(8)

[OR]

14.(b).(i) Derive the expression for the power flow through the line when it is compensated with SSSC. (8)
(ii) Compare the performance of SSSC with that of TCSC compensation. .(8)

15.(a). (i)Explain about the effect of electrical coupling and short-circuit level on the controller interaction between multiple SVCs that are located in a power system. (6)
(ii)Write about the basic procedure that has to be followed for the coordination of multiple controllers using linear-control techniques.(10)

[OR]

15.(b) Explain the principle of operation of UPFC. Illustrate the control capabilities of UPFC using phasor diagrams. (16)