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B.E. (Full Time) END SEMESTER EXAMINATIONS, APRIL/MAY 20121

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGG.

EE9038 – FLEXIBLE AC TRANSMISSION SYSTEMS

(Regulations 2009)

Time : 3 Hrs | Max. Marks: 100

Answer all questions

PART A (10 x 2 =20)

1. Compare load compensation and system compensation
2. Draw the V-Q characteristics of SVC
3. What is the impact of short Circuit MVA of SVC connected bus to response rate of SVC?
4. Draw V-I and X-I characteristics curves two module TCSC.
5. Consider a SMIB system generating 0.8 p.u MW and 0.28 p.u MVAR. The infinite bus voltage is 1 at an angle 0° and the machine terminal voltage is1.01 at an angle of 25°, transmission line reactance is 0.57 p.u .Compute the value of degree of compensation that has to be provided to enhance the power transfer to 0.95 p.u
6. What are the advantages of second generation of FACTS controllers?
7. In what way STATCOM is superior to SVC?
8. Draw the P-δ characteristics of SSSC and compare it with uncompensated case
9. What is the need for coordination of FACTS devices?
10. What are the different methods of tuning of FACTS controllers?

PART B - (5x 16 = 80)

11(i). Consider a 765kV symmetrical lossless transmission line with l=0.965mH/km, c=12.6nF/km, and a line length of 1000km. calculate the voltage at a distance of 550km from the sending end when the power flow through the line is 860MW. (10)

ii) Deduce the VI Characteristics of SVC from VI Characteristics of TCR & TSC and explain the need of slope in SVC Characteristics. (6)

12a(i) An SVC is connected to 765 kV system has a reactive power range of 500 MVAR production to 150 MVAR absorption. If the per unit proportional gain of voltage regular is to be 0.55 determine the short-circuit level of the system. The SVC has a slope of 2.5%. (8)

ii) Draw the IEEE block diagram of SVC control using current droop feedback and deduce the transfer function of the power system (8)

(OR)

12b Consider a SMIB system in which the synchronous machine is generating 0.9 p.u. MW and 0.38 p.u. MVAR. The voltage of Infinite bus is 0.995+j0.0 p.u. The machine transient reactance is 0.3p.u. and the transmission line reactance is 0.69 p.u.

i) Calculate what should be the net susceptance of SVC to maintain the midpoint voltage at 1.01 p.u. (8)

ii) Calculate synchronizing torque co-efficient with and without SVC. (8)

13a(i) Explain the constant current control strategies in TCSC applications? (6)

(ii) Explain how STATCOM is modeled in power flow analysis. (10)

(OR)

13b Consider the SMIB system in which the synchronous machine is generating 0.85 pu MW and 0.25 MVAR. The infinite bus voltage is 1 at angle of 0. The machine transient reactance is 0.32 p.u and the transmission line reactance is 0.65p.u. Calculate the value of net reactance offered by the TCSC and the voltage that has to be injected by the TCSC to enhance the power flow to 1.0 p.u. (16)

14a. Consider a SMIB system in which the synchronous machine is generating 0.95 MW and 0.35 MVAR at a terminal voltage of 1 p.u at angle of 36. The machine transient reactance is 0.25 p.u and the transmission line reactance is 0.6 p.u. If the damping ratio has to be 0.12, calculate how the voltage injected by SSSC has to be modulated. (16)

(OR)

14b (i) Derive the expression for the power flow through the line when it is compensated by SSSC. (6)

ii)Consider a SMIB system generating 0.8 p.u MW and 0.28 p.u MVAR. The infinite voltage is 1 at 0 and the machine transient reactance is 0.3 p.u, transmission line reactance is 0.57 p.u. Calculate the voltage that has to be injected by SSSC to enhance the power transfer to .92 p.u MW. (10)

15a. Explain the principle of operation of UPFC. Derive the P and Q equations. Illustrate the control capabilities of UPFC using phasor diagrams. (16)

(OR)

15b. 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. (16)