DEPARTMENT OF ELECTRICAL ENGINEERING

MAJOR TEST, SECOND SEMESTER 2006-07

COURSE : FLEXIBLE AC TRANSMISSION SYSTEMS/EEL894

Time : 2 Hours Max. Marks : 40

1 (a) The UPFC linearised power equations are written as

$$[f(x)] = [J][\Delta X]$$

where $[f(x)]$ is mismatch vector, $[J]$ is Jacobian and $[\Delta X]$ is the correction vector. The UPFC is used for the following modes of operation:

(i) Real and Reactive power flow control on the line and voltage control at the UPFC bus;

(ii) Only for real and reactive power flow control with magnitude of the shunt converter voltage fixed.

What are mismatch and correction vectors in each of the above two cases? (5)

(b) The control region of the attainable real power P and receiving-end reactive power demand Q with a UPFC controlled transmission line is expressed as:

$$\left\{P(\delta, P) - P_0(\delta)\right\}^2 + \left\{Q(\delta, P) - Q_0(\delta)\right\}^2 = \left\{\frac{V V_{pqmax}}{X}\right\}^2$$

Derive the above equation for a transmission line assuming $V_s = V_r = V$ and line reactance $= X$. (5)

2 (a) Explain the principle of operation of a typical two converter Interline Power Flow Controller (IPFC). Considering system 1 as prime system, explain the constraints on the operation of the converter 2. (5)

(b) "TCBR is used for enhancing transient stability of a power system". Explain with the help of equal-area criterion of stability, the transient

stability enhancement in terms of "stability margin". Explain control scheme of the TCBR.

(5)

3 (a) Explain the principle of operation of "NGH-SSR Damping Scheme". The TCSC is used for regulating power flow on a line. What is the difference in the operation of TCSC as compared to NGH-SSR Damping scheme? Is TCSC SSR neutral? Explain

(5)

(b) Draw a neat circuit diagram of 3-phase TCPAR. What are the merits of using 'ternary proportioned winding sections' as compared 'equal winding' sections.

(5)

4 (a) The current rating of the FC is 1 pu and that of TCR is 0.5 pu of an SVC. Sketch the V-I characteristic of the SVC.

(2)

(b) What are the parameters of the power semiconductor devices which determine power dissipation when used in converters?

(2)

(c) A TCSC consists of a fixed capacitor (Capacitive reactance = 1.33 Ω) and TCR (inductive reactance = 2 Ω). Sketch the variation of TCSC reactance over the compete operating range.

(2)

(d) What is the difference between "internal" and "external" controls of the FACTS devices?

(2)

(e) A STATCOM is installed at the mid-point of a transmission line. Compute the power transmitted if $V_s = 1$ pu, $V_r = 1$ pu, $V_m = 0.95$ pu and line reactance $X = 1$ pu. Assume $\delta = 60°$.

(2)