

Electrical Engineering Department
EEL404/EEL894 Flexible AC Transmission System
Major Test

Time allowed- 2 hour

Maximum Marks- 50

Answer all questions

Q.1 Fill up the blanks

- i. For what value of X/R ratio the power flow in a line is maximum?
- ii. The steady state V-I characteristics of a SVC in the regulating zone is
 $V = V_{ref} + 0.05 I_{svc}$ where $V_{ref} = 1.0$
 The system load characteristics is
 $V = 0.95 - 0.02 I_{svc}$
 Determine the system bus voltage.
- iii. For a "P" pulse TCR subjected to an A.C. wave of time period "T" the transport and firing delay time are _____ and _____ respectively.
- iv. The transfer function of the voltage regulator of a SVC is $(\frac{20}{1 + 0.01s})$. What is the slope of the V-I characteristics in the control zone.
- v. In question (iv) what is the transient gain.
- vi. When SVC is operating in the control range the bus in the high voltage side is represented as a _____ type bus and the fictitious bus having voltage magnitude " V_{ref} " is represented as _____ type bus in the load flow.
- vii. The condition for stability of a TYPE-2 based STATCOM is _____.
- viii. Is power reversal theoretically possible in a series compensated line? If "yes" what is its practical limitations.
- ix. In case of UPFC the regulation of D.C. voltage is achieved through _____ side converter.
- x. Will a SSSC in a line introduce SSR? (yes/no)

Marks = 10

Q.2. A basic two machine power system presented in Fig.1. with SSSC at the middle is used for regulating the real power flow in the line. If the real power flowing in the line is 1.2 p.u

- a. Find the required injected voltage.
- b. The reactive power supplied by the SSSC.

Derive the formulae that you are using starting from the two port network model.

Marks = 3+3+4

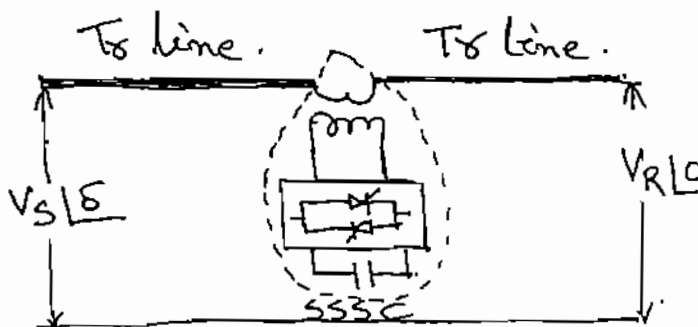


Fig. 1

$$|V_s| = |V_R| = 1.0 \text{ p.u.}$$

$$\delta = 60^\circ$$

$$\text{Surge impedance} = 1 \text{ p.u.}$$

$$\text{Electrical length of the line}$$

$$\theta = \frac{2\pi}{\lambda} d = 30^\circ$$

Q.3. Derive the real power flow in a loss less transmission line having an UPFC at the middle. Assume the shunt current as $(I_c \angle \beta)$ and series injection voltage as $(V_c \angle \psi)$. Derive the condition for maximum power flow and at that condition find out the real power injected by the shunt and series converter. Take the sending end voltage as $V \angle \delta$, receiving end as $V \angle 0$ and reactance of the line as $X \angle 90^\circ$.

Marks = 10

Q.4. Draw the control block diagram for the shunt and series VSC of an UPFC. Explain the logic behind the consideration of particular error for generating the control signal.

Marks=5

Q.5. Draw and explain from equal area criteria that modulating SVC bus voltage through speed deviation of the generator will improve transient stability.

Marks=7

Q.6. Write Notes on:-

Marks=8

- i. TCBR
- ii. NGH-SSR damping scheme.
- iii. IPFC
- iv. Damping Analysis through Eigenvalues