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**Answer The Following Questions**

**Question # 1 (13 Marks)**

**Write only the missing word in the following sentences:**

- 1- Interconnections to neighboring power systems are usually formed at the ..... system level.
- 2- The system is in normal operating condition state, if all variables are ..... the normal range.
- 3- The power system enters the ..... state if the security level falls below a certain limit of adequacy.
- 4- .... systems provide information to indicate the power system operation status.
- 5- If the power system is ..... the result is cascading outages.
- 6- Control action in case of in-extremis state is ..... to save the system from blackout.
- 7- The ..... state represents a condition in which control action is being taken to reconnect the loads.
- 8- Small signal stability control modes are caused due to ..... tuned exciters.
- 9- The study period of transient stability studies is limited to ..... seconds following the disturbance.
- 10- The power system enters the ..... state if a severe disturbance occurs when it is in alert state.
- 11- A system is voltage unstable if a bus voltage ..... as the reactive power injection is increased.
- 12- The reactive power increases as the .... of the power transmitted for transmitted greater than natural power.
- 13- The power transmitted from a constant voltage source is maximum when the voltage drop of the line is equal to ..... voltage.
- 14- At loads below the natural load, the overhead lines ..... net reactive power.
- 15- Shunt ..... is usually required for EHV overhead lines longer than 200 km.
- 16- The reactive power produced by a series capacitor ..... with increasing power transfer.
- 17- Synchronous condensers and SVCs provide ... .. compensation.
- 18- A practical upper limit to the degree of series compensation of the EHV lines is about ..... %.
- 19- The best location point of series capacitors is at ... .. of the EHV lines.
- 20- Shunt capacitive compensation in effect increases .....
- 21- The effect of increasing the TCR firing angle is to reduce the fundamental component of .....
- 22- The total response time of TCR is typically around ..... cycles of supply frequency.
- 23- The control of the thyristor gating of SVC can be lost if the voltage drops below ..... pu.
- 24- The degree of shunt compensation  $k_{sh}$  is positive for ..... shunt compensation.
- 25- The degree of series compensation  $k_{se}$  is negative for ..... shunt compensation.
- 26- Heavy use of shunt capacitor compensation leads to ... .. of small-signal stability margin.
- 27- Voltage stability is concerned with the ability of a power system to maintain voltages at .... under normal conditions after disturbance.
- 28- For a load higher than the maximum power, an increase in ..... admittance reduces the power.
- 29- At voltages below 0.85 pu, some induction motors may ... .. and draw high reactive current.
- 30- Sub-synchronous resonance with the alternators is a possibility problem of ..... compensation.
- 31- Shunt reactors is connected to the line to limit temporary overvoltage to about ..... pu.
- 32- The short-term stability period is less than ..... seconds.

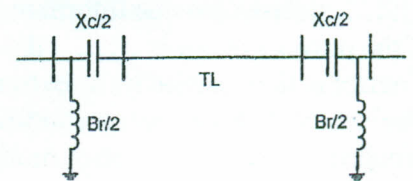


- 33- The reactive power supplied by shunt capacitors is proportional to .....
- 34- The maximum power transferred can be increased by ..... both  $Z_c'$  and  $\theta'$ .
- 35- Regulated compensation ..... the maximum power transfer capability of a long transmission line.
- 36- The effect of ..... the TCR firing angle is to increase the effective inductance.
- 37- Ideally, an SVS should hold constant .....
- 38- Shunt capacitors and reactors, and series capacitors provide ... .. compensation.
- 39- Following a fault switching out the reactor ..... stability.

**Question # 2 (16 Marks)**

A- Voltage collapse is strongly influenced by system conditions and characteristics. State the significant factors contributing to voltage collapse. Then, state the voltage collapse prevention methods. (4 Marks)

B- A 500 kV, 50 Hz, 300 km, three-phase transmission line has the following parameters:  $r=0.01$  ohms/km,  $x=0.3$  ohms/km,  $g=2 \times 10^{-8}$  siemens/km,  $b=4 \times 10^{-6}$  siemens/km. Series and shunt compensation of the line are employed as shown. Calculate the maximum sending-end power of the system with the degree of series compensation is 0.4 and the degree of shunt compensation is 0.6. (6 Marks)



C- The TCR is considered as a source harmonics in the power system; compare between the possible arrangements used to eliminate the third harmonics from the output of the TCR. (3 Marks)

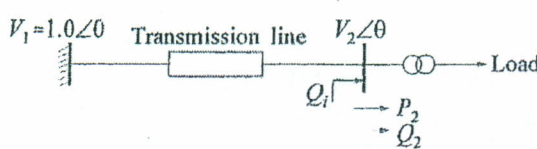
D- Compare between the steam turbine sustained and momentary fast-valving. (3 Marks)

**Question # 3 (16 Marks)**

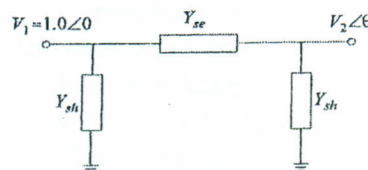
A- Generator tripping imposes a high thermal stress. Explain this sentence. (2 Marks)

B- Compare between the five operating condition states of the electrical power system. Sketch schematically the relation between them. (3 Marks)

C- For the 500 kV, 600 km transmission line system shown. The system supplies a radial load. The line parameters are expressed in pu on 300 MVA and 500 kV base. When  $P_2 = 1500$  MW, calculate the eigenvalues of the reduced Q-V Jacobian matrix and V-Q sensitivities with  $Q_i = 500$  MVar injection for each of the corresponding two voltages on the Q-V curve (7 Marks)



(a) Schematic diagram



(b) Equivalent  $\pi$  circuit

$$Y_{se} = 2.142 - j24.973 \text{ pu}$$

$$Y_{sh} = 0 + j2.076 \text{ pu}$$

D- In today's practical power systems, small signal stability is largely a problem of insufficient damping of oscillations. State the most concerning stability modes of oscillations. (2 Marks)

E- State the main practical applications of SVC in both transmission and distribution levels. (2 Marks)

With My Best Wishes  
Dr. Ebrahim A. Badran