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Paper Code : PE- EE 801B/PE- EEE-801C Power system dynamics & control

UPID : 008279

Time Allotted : 3 Hours *Full Marks :70*

The Figures in the margin indicate full marks.
Candidate are required to give their answers in their own words as far as practicable

Group-A (Very Short Answer Type Question)

1. Answer any ten of the following : [1 x 10 = 10]

(I) Why the analysis of synchronous machine equations in terms of *dq0* variables is considerably simpler than in terms of phase quantities?

(II) The transmission line parameter that represents the decrease in signal strength is_____constant.

(III) What is instability in a power system?

(IV) Shunt reactors are connected to long EHV lines to prevent over voltage. (True / False)

(V) Transient (or large) disturbances are caused by_____. (give at least two examples)

(VI) If e is the number of elements and n is the number of nodes in graph, then the element-node incidence matrix will have the dimensions _____

(VII) A matrix will be sparse when its sparsity is greater than_____

(VIII) Under no load or open circuit condition what is the value of i_d and i_q?

(IX) How the voltage dependency of load characteristics is represented by the exponential model?

(X) State whether the transient stability limit of a power system increases with the fault clearing time or not.

(XI) The Power Systems are operated with power angle around _____

(XII) Z_{BUS} matrix is sparse matrix or full matrix?

Group-B (Short Answer Type Question)

Answer any three of the following : [5 x 3 = 15]

2. What is the role of independent pole operation of circuit breaker in transient stability enhancement? [5]
3. Write the assumptions made in modeling the synchronous machine in stability analysis of power system network. [5]
4. With the help of a neat block diagram, explain different operating states of a typical power system network. [5]
5. Distinguish between Eigen values and Eigenvectors. [5]
6. Discuss the advantages of delta -P - omega stabilizer over delta – omega stabilizer. [5]

Group-C (Long Answer Type Question)

Answer any three of the following : [15 x 3 = 45]

7. [15]

A 555 MV A, 24 kV, 0.9 p.f., 60 Hz, 3 phase, 2 pole synchronous generator has the following inductances and resistances associated with the stator and field windings:

$$l_{aa} = 3.2758 + 0.0458\,cos(2\theta)\ \text{mH}$$
$$l_{ab} = -1.6379 - 0.0458\,cos(2\theta + \pi/3)\ \text{mH}$$
$$l_{afd} = 40.0\,cos\,\theta\ \text{mH}$$
$$L_{ffd} = 576.92\text{mH}$$
$$R_a = 0.0031\Omega$$
$$R_{fd} = 0.0715\Omega$$

a) Determine L_d and L_q in henrys.
b) If the stator leakage inductance L_l is 0.4129 mH, determine L_{ad} and L_{aq} in henrys.
c) Using the machine rated values as the base values for the stator quantities, determine the per unit values of the following in the L_{ad} base reciprocal per unit system:

$$L_l, L_{ad}, L_{aq}, L_d, L_q, L_{afd}, L_{ffd}, L_{fd}, R_a, R_{fd}$$

8. (a) From fundamentals derive the swing equation of a single generator connected to an infinite bus [8]

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(b) A 500MW, 21kV, 50Hz, 3-phase, 2-pole generator having a rated pf of 0.9 (lagging), has a moment of inertia of 27500 kg-m2. Find inertia constant H in MJ/MVA. [7]

9. (a) Explain the following terms: Local modes, inter-area modes, control modes, torsional modes. [10]

(b) Find the frequency of oscillation for a synchronizing coefficient of 0.6, inertial constant H = 4 and frequency of 50Hz. [5]

10. Explain the performance of synchronous machines under steady state conditions by applying the per unit equations [15]

11. (a) List the fundamental requirements that a properly designed and operated power system should meet. [5]

(b) Draw and explain the block diagram of a power system and associated control. [10]

*** END OF PAPER ***