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B.E. DEGREE EXAMINATION, NOV./DEC. 2011 R 2008

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

VII Sem. (Full-Time)

EE 9039 - Advanced Power System Analysis

Time: Three hours **Maximum Marks:100**

Answer ALL questions

PART A – (10 x 2 = 20 marks)

1. What is effect of shunt compensation on PV curves?
2. Give expressions for P and Q of exponential and polynomial loads.
3. What is the degree of compensation on a 60 Hz power system that excites the first torsional mode of a shaft system of a thermal unit characterized by the following eigenvalues (sec^{-1} + j rad/sec) for torsional oscillations: 0 ± j 6.4, 0 ± j 127.1556, 0 ± j 99.7088, 0 ± j 160.3898, 0 ± j 202. 863, 0 ± j 298.1767?
4. What is the nature of an induction motor load for steady state and immediately after a disturbance?
5. What is the need for FACTS controllers?
6. What is meant by loadability limit.?
7. What are the different types of HVDC links?
8. What is meant by load restoration?
9. Classify power system stability in terms of short-term / long-term time regimes and driving mechanisms.
10. Name any two HVDC links that are available in India with their rating.

PART B – (5 x 16 = 80 marks)

11. Derive the expressions for maximum deliverable power for a two-bus system for the following cases:(i) unconstrained case, (ii) under a given load power factor and (iii) from power flow equations.

12.a Explain the assumptions that are made in the Fast-Decoupled method. Explain the algorithmic steps for solving the power flow problem using Fast-decoupled power flow method.

OR

12.b For the system shown in Fig.12.b find out the voltage at bus 2 after two iterations using Fast-Decoupled method and the line flow. All values are in pu.

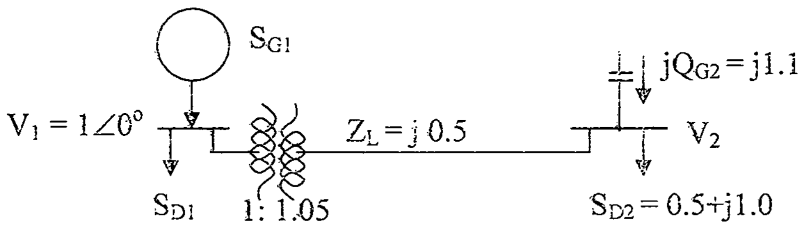

Fig. 12.b

13.a Draw the block diagram of an OXL with integral control. Explain its functions with relevant sketches showing outputs of various blocks when there is a step increase in field current over the set point.

OR

13.b i) Consider a two-bus system. In this system fixed shunt compensation (susceptance B_c) is provided at the receiving-end of the line. The transmission line is represented by a π-model. Derive the expression for max. steady –state power transfer.(12)

(ii) Compare the performance of SSSC with fixed series capacitive compensation. (4)

14.a The data for a SMIB system consisting of a generator, step up transformer, a transmission line and infinite bus is given below:

Generator: 588 MVA, 500 MW, 21 kV, 50 Hz, 2-pole; R_a=0.0023, X_d = 2.35, X_q = 2.15, X_d' = 0.253, T_{d0}' = 6.0 sec; H = 3.07 MW-sec/MVA; step-up transformer: leakage reactance = j0.15; Transmission line: X_{pos}= j 0.5. All reactances are on 588 MVA. Initial operating condition: active power output of the generator P = 0.85 p.u; reactive power output Q = 0.52 p.u (lagging); terminal voltage of the generator V_t = 1.0 +j0 p.u.

All resistances, shunts including half line-charging and the series impedance between the double circuit transmission line and infinite bus ignored. This assumption yields external impedance value as *0+j0.65 p.u.* Assume that the machine is represented by classical model.

Calculate (i) the synchronising torque coefficient (K_s), (ii) natural frequency of rotor oscillation and (ii) with the damping coefficient (K_D) of 10.0, determine the damping ratio (ξ).

OR

14.b Describe stepwise computations involved in interfacing a classical model of a synchronous machine with the transient stability algorithm based on iterations to advance simulation from time "t-Δt" to time "t." using trapezoidal rule.

15.a The data applicable to a five-mass torsional model of a 600 MVA, 21 kV, 0.9 pf, 2-pole, 50 Hz thermal unit is as follows:

Mass No	Rotor	Moment of Inertia ($kg\text{-}m^2$)	Shaft section	Stiffness (Nw-m/mech rad)
1	HP	616.7	HP-IP	2.5×10^8
2	IP	2166.8	IP- LP	3.5×10^8
3	LP	22881.0	LP-GEN	1.25×10^8
4	GEN	10154.4	GEN-EXC	7.55×10^7

(i) Determine the inertia constant H in MW-sec / MVA for each of the four rotor masses and stiffness K in pu torque / elec. rad for each of the four shaft sections. (8)

(ii). Compute the steady-state torque transmitted by each shaft section and angular displacement between the generator and HP turbine section when the generator is operating at the rated output. (8).

OR

15.b. (i) Explain how self-excitation can occur in a generator connected to a series-Compensated transmission line. (8)

(ii) Explain about any two methods that can be used for enhancing transient stability.(8)