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Question Paper Code : 11232

M.E./M.Tech. DEGREE EXAMINATIONS, APRIL/MAY 2023.

Second Semester

Power Systems Engineering

PS 4202 – POWER SYSTEM DYNAMICS

(Regulations 2021)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the schematic diagram of a synchronous generator.
2. Define the physical interpretation of dq0 transformation.
3. Draw the block diagram of the simulation for excitation systems.
4. Mention the electrical analog of the hydraulic turbine.
5. Define rotor angle stability.
6. Show the block diagram of the SMIB configuration represented by the classical Model.
7. Give the equations in a common reference frame of multi-machine.
8. List the function of controllers used in small signal stability analysis.
9. Give the stabilizer limits.
10. Compare the delta omega and delta P-omega stabilizer.

PART B — (5 × 13 = 65 marks)

11. (a) Draw the schematics of the stator and rotor circuits of a synchronous machine and develop the basic equation of the stator and rotor of a synchronous machine. Draw all the necessary illustrations.

Or

(b) Discuss with neat figures and derivations on use of Park's Transformation for 3 phase to 2 phase transformation in synchronous machine analysis.

12. (a) Discuss the elements of the excitation system in detail. Also, explain the various control and protective scheme of the excitation system.

Or

(b) Using the block diagram shown in Fig (1) calculate: (i) The lowest value of the droop (R) for which the speed control is stable; and (ii) The value of R for which the speed control is critically damped. The H constant of the generator is 5.0s and the water starting Time Tw= 4.0s.

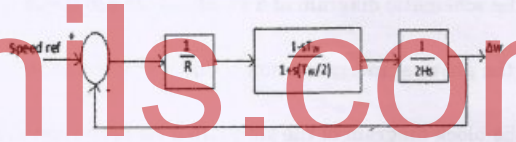

Fig (1)

13. (a) Derive the stability analysis using state space approach for single machine infinite bus system and discuss on how system instability can be identified for any Bus short circuit.

Or

(b) Discuss the effect of field flux linkage variation on power system stability. Draw the supporting diagram.

14. (a) Draw and explain the block diagram representation with exciter and AVR.

Or

(b) Briefly Illustrate the formation of a system state matrix for a two-machine system with classical models.

15. (a) Discuss the role of power system stabilizers for the enhancement of small signal stability.

Or

(b) Explain the following:

(i) Phase lead compensation (7)

(ii) Excitation control design (6)

PART C — (1 × 15 = 15 marks)

16. (a) Using the d-q variable model of a synchronous machine with rotor having field winding and one q-axis winding. Discuss the procedure to compute the steady-state values. Also compute δ_i, e_d, e_q, i_d, i_q, i_{1q}, i_{fd}, e_{fd}, ψ_{fd}, ψ_{1q}, T_e for the generator parameters given as: $L_{ad} = L_{aq} = 1.66$, $L_l = 0.15$, $R_a = 0.003$, $L_{fd} = 0.165$, $R_{fd} = 0.00006$, $L_{1q} = 0.7252$, $R_{1q} = 0.00619$. Assume that the generator is delivering rated MVA at 0.8 (lag) at PF rated voltage and the effect of saturation is neglected.

Or

(b) Describe the mathematical modeling for single reheat tandem Compound steam turbine.