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Eighth Semester B.E. Degree Examination, Jan./Feb. 2023 Power System Operation and Control

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. What are the operating states of a power system? Explain them in brief with a block diagram. (06 Marks)
- b. Explain the various components of SCADA system with the help of its general configuration. (10 Marks)

OR

- 2 a. What are the different ways to connect master station with RTUs in SCADA systems? (07 Marks)
- b. What are the constraints in unit commitment for obtaining its solution? Explain in detail. (09 Marks)

Module-2

- 3 Explain the general algorithm for hydrothermal scheduling using discrete time interval method with the mathematical formulation of objective function through discretization and the solution procedure. (16 Marks)

OR

- 4 a. A steam plant and a hydro plant supply a load of 500MW for 12 hrs and 300MW for 12 hrs in a day. The characteristics of the thermal plant are given by, $F(P_{GT}) = 0.06P_{GT}^2 + 40P_{GT} + 100$ Rs/hr. The characteristics of the hydro plant are given by, $Q(P_{GH}) = 0.003P_{GH}^2 + 0.5P_{GH}$ m³/sec. The value of γ is 80. Find the scheduling of power and the total discharge. Also determine the daily operating cost of the thermal plant and the quantity of water used daily by the hydro plant. Make the computations neglecting losses. (08 Marks)
- b. Two generators rated 200MW and 400MW are operating in parallel. The droop characteristics of their governors are 4% and 5% respectively from no load to full-load. The speed set points are such that the generators operate at 50Hz when sharing the full load of 600MW in proportion to their ratings. i) If the load reduces to 400MW, how it is shared? At what frequency will the system operate? ii) Now, if the speed changers are reset such that the load of 400MW is shared at 50Hz in proportion to their rating. What are the no load frequencies now? Take a base power of 100MW. (08 Marks)

Module-3

- 5 Develop a mathematical model of a complete ALFC loop by using its individual components model. (16 Marks)

OR

- 6 a. Explain in detail the frequency bias tie-line control to obtain the block diagram of AGC for a two-area system. (08 Marks)
- b. Consider two control areas as 50Hz interconnected systems. The connected load is 15000MW in area 1 and 30000MW in area 2. The generations in area 1 and 2 are 14000MW and 31000MW respectively. For both areas, $D = 1.0\text{pu}$ and $R = 5\%$ on the ratings as base. Area 1 has a spinning reserve of 1000MW spread over a generation of 5000MW generation capacity and area 2 has a spinning reserve of 1000MW spread over a generation of 10000MW generation capacity. Determine the steady state frequency, generation and load of each area and the line power for the loss of load of 1000MW in area 1 with no supplementary control. (08 Marks)

Module-4

- 7 a. Obtain a state space model for a two-area system with AGC. (12 Marks)
- b. Two areas of equal capacity of 2500MW, speed regulation $R = 3\text{Hz/pu MW}$ and $H = 5\text{sec}$ are connected by a tie-line of capacity 250MW and operating at 45° . Find the frequency of the line power oscillations. (04 Marks)

OR

- 8 a. Derive an approximate relation between the voltage at the receiving end and the reactive power in a simple source-load inter connector in terms of short-circuit length. (08 Marks)
- b. Explain in details the various methods of voltage control by reactive power injection. (08 Marks)

Module-5

- 9 a. What are the three major functions of system security? Explain them in detail. (08 Marks)
- b. Define; i) Generation-shift sensitivity factors and ii) Line-outage distribution factors. Using these factors, explain the contingency analysis for generator outages and line outages with a flow chart. (08 Marks)

OR

- 10 a. How to determine the state estimate using linear least-squares estimation method? What is a DC state estimator? Derive its model equation. (08 Marks)
- b. State and explain the issues in state estimation in detail. (08 Marks)

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