CBCS SCHEME

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15EE81

Eighth Semester B.E. Degree Examination, Dec.2023/Jan.2024
Power System Operation and Control

Time: 3 hrs. Max. Marks: 80

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

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Explain in detail the operating status of a power system with the help of a neat diagram along with its classification. **(08 Marks)**

b. Discuss in detail the common communication channels for SCADA in power systems and users of power system SCADA. **(08 Marks)**

OR

2 a. With the help of a flow chart, explain forward dynamic programming method for unit commitment in power systems. **(08 Marks)**

b. What are the preventive and emergency control measures that are commonly used in power system operation and control? **(08 Marks)**

Module-2

3 a. Explain a general algorithm for hydrothermal scheduling to determine the water discharge at various intervals to minimize the cost of thermal generation and to meet the operating constraints and dependent variables of the hydro plant. **(08 Marks)**

b. A steam plant and a hydro plant supply a load of 500 MW for 12 hours and 300 MW for 12 hours in a day. The thermal plant characteristics are given by:

$F(P_{GT}) = 0.06\,P_{GT}^2 + 40\,P_{GT} + 100$ unit cost/hour

The hydro plant characteristic is given by $Q = 0.003\,P_{GH}^2 + 0.5\,P_{GH}$ m^3/second

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 water used daily by the hydroplant. Obtain the schedule by neglecting losses. **(08 Marks)**

OR

4 a. With the help of a neat diagram, explain the basic control loops of a generator from the point of AGC along with its commonly used terms. **(08 Marks)**

b. Two identical machines 1 and 2 have droop characteristics with 5% and 2% speed regulation respectively. They share an initial load of 100 MW equally operating at nominal frequency. If now there is an increase of 35 MW in the load, how would the additional load be shared? State any assumption made. **(08 Marks)**

Module-3

5 a. With suitable necessary diagram, explain the mathematical model for governor, generator and load model of ALFC. **(08 Marks)**

b. A single area consists of two generators as follows:

G_1 : 200 MW, R = 4% (on machine base)

G_2 : 400 MW, R = 5% (on machine base)

They are connected in parallel and share a load of 600 MW in proportion to their rating at 50 Hzs, 200 MW of load is tripped. What is the generation to meet the new load if D = 0? What is the frequency at new load? Repeat for D = 1.5. **(08 Marks)**

OR

6 a. With the help of a block diagram, derive an expression for Tie-line control with primary speed control when the load changes in area 1. **(08 Marks)**

b. Consider two 50 C/S interconnected systems. The connected load is 15,000 MW in area 1 and 30,000 MW in area 2. The generations are 14,000 MW and 31,000 MW respectively. D = 1.0 and R = 5% for both areas. Area 1 has a spinning reserve of 1000 MW spread over a generation of 5000 MW capacity and area 2 has a spinning reserve of 1000 MW spread over 10,000 MW. Determine the steady state frequency generation and load of each area and tie-line power for loss of load of 1000 MW in area 1 with no supplementary control. **(08 Marks)**

Module-4

7 a. Explain state-space model for a two-area system along with state equation in matrix form. **(08 Marks)**

b. Two area 1 and 2 are interconnected. The capacity of area 1 is 1500 MW and area 2 is 500 MW. The incremental regulation and damping torque coefficient for each area its own base are 0.2 P.U and 0.9 P.U respectively. Find the steady-state frequency change in steady-state tie-line power for an increase of 60 MW in area 1. The nominal frequency is 50 C/S. **(08 Marks)**

OR

8 a. Explain the dependence of voltage control on reactive power along with one line diagram, phasor diagram for lagging and leading current. **(08 Marks)**

b. Three generating station are connected to a common bus bar X as shown in Fig.Q8(b). For a particular system load, the line voltage at the bus bar falls by 2 KV. Calculate the reactive power injection required to bring back the voltage to the original value. All P.U. values are on a 500 MVA base.

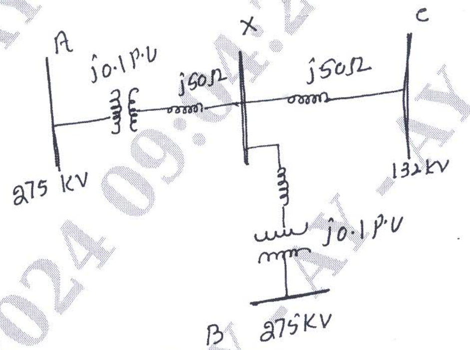

Fig.Q8(b) **(08 Marks)**

Module-5

9 a. Explain the contingency analysis with the help of a flow chart from the point of power system reliability and security. **(08 Marks)**

b. Consider the network as shown in Fig.Q9(b), find the power flow in the lines.

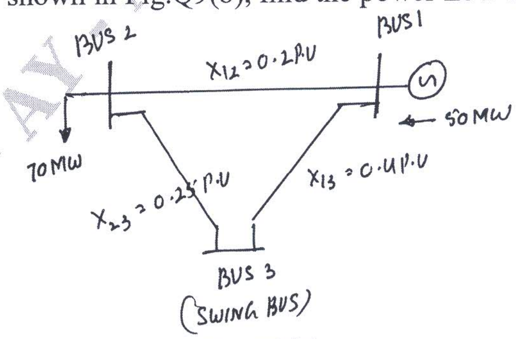

Fig.Q9(b) **(08 Marks)**

OR

10 a. Discuss in detail the other issues in state-estimation of power systems. **(08 Marks)**

b. For the Fig.Q10(b) shown estimate the state of the system given by nodal voltage V_1 and V_2 and the voltage ε across the voltage source.

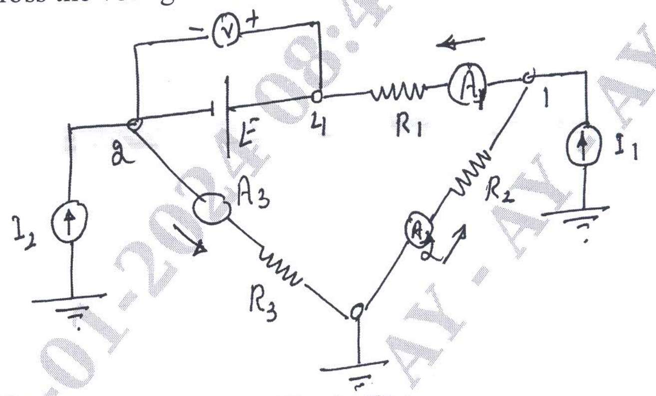

Fig.Q10(b)

Assume for simplicity that all the resistance are 1 Ω. Let the current be measured in the direction indicated. The meter readings are as follows:

$A_1 = 0.9$ A, $A_2 = -3.0$ A, $A_3 = 0.85$ A, $V = 1.2$ V **(08 Marks)**

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