Ref No. Ex/PG/ELE/PE/T/114E/2025

M.E.ELECTRICAL ENGINEERING 1ST YEAR 1ST SEMESTER EXAMINATION 2025

POWER SYSTEM OPERATION

Part I

Time: Three Hours Full Marks: 100 (50 marks for this part)

Answer any two questions

1(a). In the context of load-frequency control, develop the transfer function block diagram of the generator load model. Assuming that the transfer function block diagram of speed governing system is represented by speed governor regulation R, gain K_{sg} and time constant T_{sg} , and the block diagram of turbine consists of gain K_t and time constant T_t , show the complete transfer function block diagram of single-area load frequency control system, and therefrom deduce the expression for the steady-state frequency deviation and change in generation following a step load change. Explain the effect of load damping factor on these two quantities. Also show that proper adjustment of speed changer setting can nullify the frequency deviation. 18

(b). Explain the terms 'Base Point' and 'Participation Factor', in the context of real-time economic dispatch. 7

2(a). Develop the transfer function model of a tie-line connecting two power system areas and show how the load-frequency control transfer function models of the two areas can be connected to develop the two-area load-frequency control model. Deduce the expressions for steady-state frequency deviation and tie-line power deviation for step load changes in the two areas. Discuss the significance of ACE in the context of two-area load-frequency control. 15

(b). Two 50 Hz power system areas having capacity of 1200 MVA and 600 MVA are connected by a tie-line. The governor regulation and load damping factor are 5% and 1% respectively for both areas with respect to their individual capacities. Calculate the steady-state change in frequency and tie-line flow following a sudden drop in load of 50 MW in the second area. Also calculate the change in generation in each area. 10

3(a). Discuss in details the unit commitment problem and justify the use of dynamic programming for its solution. Also show, with the relevant flow-chart, how dynamic programming is used for this problem. 15

(b). Explain why proper short-term hydro-thermal scheduling is important for power systems consisting of both thermal and hydro generation. Develop a mathematical formulation of this scheduling problem and discuss a method for its solution. 10

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M.E. ELECTRICAL ENGINEERING FIRST YEAR FIRST SEMESTER EXAM 2025

POWER SYSTEM OPERATION

Time: Three Hours **Full Marks: 100**

(50 Marks for each part)
Use a separate Answer Script for each Part

PART-II

Answer any three questions

2 marks reserved for well-organized answers

1. i) Show that the effect of transmission loss can be represented by a penalty factor in economic load dispatch. 8

   ii) Determine the optimal dispatch of generation for the three thermal plants having the following cost functions in Rs/ hr: 8

   $C_1 = 400 + 6.8P_1 + 0.002P_1^2$, $C_2 = 300 + 6.7P_2 + 0.003P_2^2$, $C_3 = 100 + 7.2P_3 + 0.005P_3^2$

   Assume that the load is 750MW.

   The real power loss is given by $P_L = 0.00002P_1^2 + 0.00006P_2^2 + 0.0001P_3^2$

   Considering the initial value of λ as 8 show calculations upto 2nd iteration.

2. i) Explain why bad data may creep in while monitoring a power system network. 4

   ii) Discuss how presence of bad data is detected using hypothesis testing. 4

   iii) Draw and explain the flowchart for estimating the state variables from the line power flow estimator. 8

3. i) Explain the maximum likelihood criterion for state estimation. 4

   ii) Consider a circuit where two resistances are connected in parallel with a dc voltage source. Estimate the value of the source from the ammeter readings connected in series with each resistance using maximum likelihood estimation technique. Assume that the standard deviation of the errors of the ammeters are known. 8

   iii) What do you understand by redundancy and redundancy factor in state estimation of power system? 4

4. i) What do you understand by *B* coefficients in connection with economic load dispatch? 4

   ii) Explain how security assessment is done in energy control center. 4

   iii) Explain the purpose of automatic generation control in energy control center. 4

   iv) What you understand by network model building in energy management system? 4