MASTER OF ELECTRICAL ENGINEERING 1ST YEAR 2ND SEMESTER EXAMINATION 2019

POWER SYSTEM OPERATION

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

Answer all the questions

1. a) What do you mean by Incremental Fuel Cost Characteristics of a thermal generating unit? With necessary derivation show its significance in the most economic dispatch of units of a thermal power plant. Mention how the most economic dispatch condition is influenced by the capacity limits of the units. Write down an algorithm for direct solution of such dispatch problem and mention under what condition the solution algorithm is applicable. Also mention the limitations of the method if any. 10

   b) The cost characteristics of two units of a thermal power station are as follows 10

   $C1 = 515\ P1 + 10\ P1^2 + 1800$ Rs/hr
   $C2 = 425\ P2 + 2.5\ P2^2 + 1000$ Rs/hr
   Capacity limits of the units are
   $0 \leq P1 \leq 100$ MW ; $0 \leq P2 \leq 150$ MW
   If the load is to be shared most economically, calculate the output of the two units when the plant loads are 30 MW, 120 MW and 200 MW. Also calculate the plant lambda in each case.

2. a) With necessary derivation show that the incremental cost of received power for the units in a power system should be equal when they are on most economic dispatch under the condition that the transmission loss cannot be ignored. Discuss the physical significance of incremental transmission loss and penalty factor. 10

   b) Explain the terms 'Base Point' and 'Participation Factor', and discuss their roles in real-time economic dispatch. 10

3. Develop the transfer function model of the LFC mechanism of a single-area power system and there from derive the expression for steady-state frequency deviation following a step change in load under free governor operation. Also show that an appropriate adjustment in the speed changer settings of the governors can remove the error. 20

4. a) Develop the transfer function model of a tie-line connecting two power system areas and hence deduce the expressions for steady-state deviations in frequency and tie-line flow in a two-area power system following a step load change in any one of those areas. 10

   b) Two 50 Hz power systems having capacities of 500 MVA and 1000 MVA respectively are connected by a tie-line and have the following parameter values on their respective capacity base. 10

   $R = 0.01$ pu and $B = 1.0$ pu

   Calculate the steady-state change in frequency and tie-line power following a sudden drop of 50 MW load in the 1st area. The symbols have their usual significance.

5.	a) Discuss in details the unit commitment problem and its solution by dynamic programming.	10
	b) Develop a mathematical formulation of short-term hydro-thermal scheduling problem and discuss a method of its solution	10