Menoufiya University
Faculty of Engineering
Shebin El-Kom

Electrical Engineering Dept.
Management and Operation of Power Systems - ELE 511

Time Allowed: 3 hours
Date: 16/8/2020
Total Marks: 100

Answer the following questions:

Question 1: (20 Marks)
(a) List 6 constrains on unit commitment problem.
(b) Why do power systems have spinning reserves?
(c) State the control methods used with AC generators, and mention the role of each of them.
(d) Define: "economic dispatch", "incremental fuel cost" and "spinning reserve"

Question 2: (20 Marks)
The cost characteristics of three units in a plant are:
$C1 = 500 + 5.3\ P_1 + 0.005\ P_1^2$ ($/MWhr)
$C2 = 400 + 5.5\ P_2 + 0.007\ P_2^2$ ($/MWhr)
$C3 = 200 + 5.8\ P_3 + 0.008\ P_3^2$ ($/MWhr)
The generation limits in MW are:
$200 \le P_1 \le 480$
$150 \le P_2 \le 370$
$100 \le P_3 \le 250$
(a) Draw the cost characteristics curve of the third unit.
(b) Draw the incremental fuel cost curves for the three units.
(c) Determine the optimal dispatch and the total cost when the total load is 1000 MW in $/hr. Neglect transmission losses.

Question 3: (15 Marks)
Incremental fuel costs in $/MWhr for a plant consisting of two units are given by
$\lambda_1 = 0.0078\ P_1 + 8.0$, $\lambda_2 = 0.0095\ P_2 + 6.4$
Assume that both units are operating at all times , that total load varies from 250 to 1300 MW , and that maximum and minimum loads on each unit are to be 650 and 100 MW , respectively.
(a) Calculate the incremental fuel cost of the plant and the allocation of load between units for the minimum cost of various total loads.
(b) Determine the saving in fuel cost in $/hr for the economic distribution of a total load of 850 MW between the two units compared with equal distribution of the same total load.

Question 4: (15 Marks)

The transmission loss coefficients B_{mn}, expressed in MW^{-1} of a power system network having three plants are given by

B =

$$\begin{matrix} 0.0002 & -0.00001 & -0.00001 \\ -0.00001 & 0.0001 & -0.00003 \\ -0.00001 & -0.00003 & 0.0003 \end{matrix}$$

Three plants supply powers of 200 MW, 150 MW and 250 MW respectively into the network. Calculate:

(a) The transmission loss.

(b) The incremental transmission losses and penalty factors of the plants.

Question 5: (15 Marks)

The following are data pertaining to three units in a plant.

Unit 1: Min = 150 MW, Max= 600 MW

$C_1 = 5610 + 79.2\ P_1 + 0.01562\ P_1^2$ Rs/hr

Unit 2: Min = 100 MW, Max= 400 MW

$C_2 = 3100 + 78.5\ P_2 + 0.0194\ P_2^2$ Rs/hr

Unit 3: Min = 50 MW, Max= 200 MW

$C_3 = 936 + 95.64\ P_3 + 0.05784\ P_3^2$ Rs/hr

Using the priority-list method, determine combination of units that should be run to supply a load of 750 MW most economically.

Question 6: (15 Marks)

Two thermal generating units have a total load of 800 MW. Their speed-governing characteristics are as follow:

$$f_1 = 61.6 - 0.004P_{g1} \quad \text{and} \quad f_2 = 61.8 - 0.006P_{g2}$$

(a) Determine the loading of each unit and the system frequency.

(b) If it is required that the system to run at 60 Hz while the unit 2 is loaded with 300 MW only, what is the supplementary control action to be applied to the unit 1?

Good Luck

Prof. Dr. Ragaey Saleh