Economic Dispatch:

Consider a three generator system of the following data table:

	The fuel cost are:
$H_1 = 510.0 + 7.21\,P_1 + 0.0142\,P_1^2$ MBtu/hr.	Unit 1: fuel cost = 1.1 Rs/MBtu $150 \leq P_1 \leq 600$
$H_2 = 310.0 + 7.85\,P_2 + 0.0194\,P_2^2$ MBtu/hr.	Unit 2: fuel cost = 1.0 Rs/MBtu $100 \leq P_1 \leq 400$
$H_3 = 78.0 + 7.97\,P_3 + 0.0048\,P_3^2$ MBtu/hr.	Unit 3: fuel cost = 1.0 Rs/MBtu $50 \leq P_1 \leq 200$

We wish to determine the economic operating point for these three units when delivering a total of 850 MW.

Solution:

③ Calculation of short circuit currents:

$$H_1 = 510.0 + 7.21 P_1 + 0.00142 P_1^2 \quad \text{MBtu/hr}.$$

$$H_2 = 310.0 + 7.85 P_2 + 0.00194 P_2^2 \quad \text{MBtu/hr}.$$

$$H_3 = 780 + 7.97 P_3 + 0.0048 P_3^2 \quad \text{MBtu/hr}.$$

Unit 1: fuel cost = 1.1 €/MBtu $\quad 150 \leq P_1 \leq 600$.

Unit 2: fuel cost = 1.0 €/MBtu $\quad 100 \leq P_1 \leq 400$.

Unit 3: fuel cost = 1.0 €/MBtu $\quad 50 \leq P_3 \leq 200$.

Total power = 850.

$F_1 = H_1 \times$ Fuel cost$_1$

$F_2 = H_2 \times$ fuel cost$_2$

$F_3 = H_3 \times$ fuel cost$_3$

$$\text{Total PP} = P_1 + P_2 + P_3 = 850 \quad \text{———} \; (1)$$

⇒ lambda iteration method (langrange multiplier).

$$\frac{dF_1}{dP_1} = \frac{dF_2}{dP_2} = \frac{dF_3}{dP_3} = \lambda.$$

⇒ for optimal generation and scheduling.

$$\left.\begin{aligned} \frac{dF_1}{dP_1} &= 7.92 + 0.003124 P_1 = \lambda. \\ \frac{dF_2}{dP_2} &= 7.85 + 0.00388 P_2 = \lambda \\ \frac{dF_3}{dP_3} &= 7.97 + 0.00964 P_3 = \lambda \end{aligned}\right\} \text{put all of them to zero to find maxima.}$$

$$P_1 = \frac{\lambda - 7.92}{0.003124}.$$

$$P_2 = \frac{\lambda - 7.85}{0.00388}.$$

$$P_3 = \frac{\lambda - 7.97}{0.00964}.$$

⇒ Put all of this in total power equations.

$$\frac{\lambda - 7.92}{0.003124} + \frac{\lambda - 7.85}{0.00388} + \frac{\lambda - 7.97}{0.00964} = 850.$$

$$\lambda = \frac{850 + 5385.6706}{681.57}.$$

$$\boxed{\lambda = 9.148 \text{ €/MWHr.}}$$

$P_1 = 393.08$ MW.

$P_2 = 334.5$ MW.

$P_3 = 122.2$ MW