Problem 9 Power Systems and Power Electronics
SOLUTIONS

Solution to Power systems problem part 9A

$$\frac{dC(P_1)}{dP_1} = 0.5(20 + 0.16P_1) = \lambda$$

$$\frac{dC(P_2)}{dP_2} = 0.1(2 + 0.2P_2) = \lambda$$

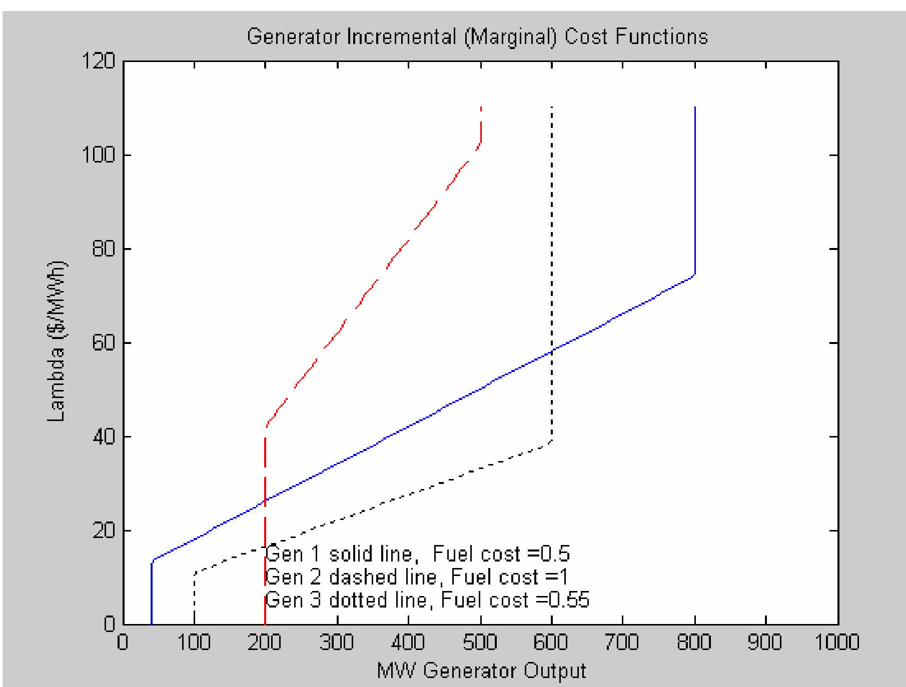
$$\frac{dC(P_3)}{dP_3} = 0.55(10 + 0.1P_3) = \lambda$$

$$P_1 + P_2 + P_3 = 1200.$$

Solution: Solve the above four equations for $P_1, P_2, P_3,$ and λ

answer is

P1 = 400 MW
P2 = 200 MW unit is at its low limit
P3 = 600 MW unit is at its high limit
Margin cost (Lambda) at solution is 42 $/MWHr



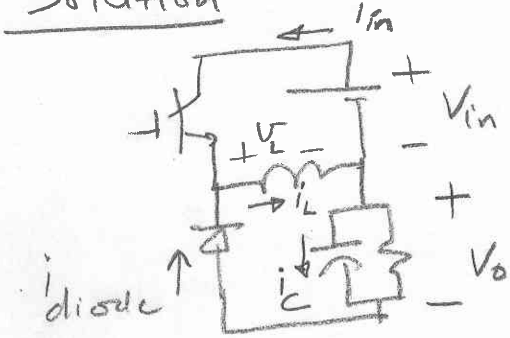
Problem 9:

(b) Power Electronics Problem

A Buck-Boost dc-dc converter is operating in dc steady state under the following conditions: $V_{in} = 5V$, $V_o = 12V$, $P_o = 24W$, and $f_s = 250\,kHz$. In the inductor current, peak-to-peak ripple $\Delta I_{L,pp} = 1.5A$. Assume ideal components and the output filter capacitor to be very large such that $v_o(t) \simeq V_o = 12V$. Calculate the value of the inductor L, and draw and completely label the waveforms for (a) the voltage across the inductor, (b) the input current, (c) the current through the diode, and (d) the current through the output filter capacitor.

$T_s = 4\mu s$

Solution



$$\frac{V_o}{V_{in}} = \frac{D}{1-D} = \frac{12}{5}$$

$$\therefore 5D = 12 - 12D$$

$$\text{or} \quad D = \frac{12}{17} = 0.706$$

$$\Delta I_{L,pp} = \frac{V_{in} D T_s}{L} = 1.5A$$

$$\therefore L = \frac{5 \times 0.706 \times 4\mu}{1.5} = 9.41\mu H$$

$$I_{in} = \frac{P_o}{V_{in}} = 4.8A, \quad I_o = \frac{P_o}{V_o} = 2A$$

$$I_L = I_{in} + I_o = 6.8A$$