PROBLEMS

18.1 The boost converter of Fig. 18.5 is replaced by a buck-boost converter. Inductor energy storage has negligible influence on the low-frequency components of the converter waveforms. The average load power is P_{load}. The dc output voltage is V and the sinusoidal ac input voltage has peak amplitude V_M.

(a) Determine expressions for the duty cycle variations $d(t)$ and the inductor current variation $i(t)$, assuming that the converter operates in the continuous conduction mode.

(b) Derive the conditions for operation in the continuous conduction mode. Manipulate your result to show that the converter operates in CCM when R_e is less than $R_{e,crit}(L, T_s, v_g(t), V)$, and determine $R_{e,crit}$.

(c) For what values of R_e does the converter always operate in CCM? in DCM?

(d) The ac input voltage has rms amplitude in the range 108 V to 132 V. The maximum load power is 100 W, and the minimum load power is 10 W. The dc output voltage is 120 V. The switching frequency is 75 kHz. What value of L guarantees that the converter always operates in CCM? in DCM?