ELEC-E8412 **Power Electronics**
Exercise No 07 23.11.2023

Problem 1:

A buck-boost converter circuit has the following parameters:

V_{in} =24 V, D =0.65, R =7.5 Ω, L=50 µH, C =200 µF, f_{sw} =100 kHz.

Determine

a) **V_{out}** $V_o = \frac{V_{in}*D}{1-D}$

b) Average, maximum, and minimum inductor currents.

$$I_{avg} = \left(\frac{V_{in}*D}{(1-D)^2*R}\right), \quad \Delta I_L = \left(\frac{V_{in}*DT}{L}\right), \quad I_{min} = I_{avg} - \frac{\Delta I_L}{2}, \quad I_{max} = I_{avg} + \frac{\Delta I_L}{2}$$

Problem 2:

A buck-boost converter circuit has the following parameters:

V_{in} =12 V, D =0.6, R =10 Ω, L=10 µH, C =20 µF, f_{sw} =200 kHz.

Determine

a) V_{out}
b) Average, maximum, and minimum inductor currents.
c) Average value of input current

$$V_{in} * I_{in(avg)} = \frac{V_o^2}{R} = \left(\frac{(V_{in} * D)^2}{(1 - D)^2 * R}\right)$$

Problem 3:

A square-wave inverter has a dc source of 125 V, an output frequency of 50 Hz, and an RL series load with R=12 Ω and L=35 mH. Determine

a) expression for load current
b) rms load current
c) average source current

$$i_o(t) = \begin{cases} \frac{V_{in}}{R} + (\mathrm{I}_{min} - \frac{V_{in}}{R})e^{-t/\tau} & 0 < t < \frac{T}{2} \\ \frac{-V_{in}}{R} + (\mathrm{I}_{max} + \frac{V_{in}}{R})e^{-(t-\frac{T}{2})/\tau} & \frac{T}{2} < t < T \end{cases}$$

$$\mathrm{I}_{max} = -\mathrm{I}_{min} = \frac{V_{in}}{R}\left(\frac{1-e^{-T/2\tau}}{1+e^{-T/2\tau}}\right)$$

$$I_{rms} = \sqrt{\frac{1}{T}\int_0^T i^2(t)\,d(t)} = \sqrt{\frac{2}{T}\int_0^{T/2} \left[\frac{V_{dc}}{R} + \left(I_{min} - \frac{V_{dc}}{R}\right)e^{-t/\tau}\right]^2 dt}$$