These are straightforward drill design problems. There are no unique answers. Just follow the design steps.

EE 360A: Power Electronics

Semester II, 2023-24

Assignment 3

Submission due: 18:00 hours, Feb 27, 2024.

For all problems in this set, you may liberally use the datasheets uploaded on MookiT.

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1. A buck-boost converter is operating in CCM, and feeds a load which demands a voltage of 5 V and an output power anywhere in the range [10 W, 25 W]. If the supply voltage varies in the range [3.8 V,6.3 V] find the minimum inductance value of the inductor required. Design the inductor if the switching frequency is 50 kHz. Use a ferrite core core and copper wires. (**5+10**)
2. An inductor is to be used in a boost converter and is required to have the following features.
   125 mH, $\hat{I}$ =1 A, I_{rms} =500 mA.
   If the converter is switched at 100 kHz, design the inductor with ferrite core and copper wires.
3. An isolation transformer for laboratory measurements is to be made. Maximum load on the transformer is not expected to exceed 1 kVA. The input voltage is 230 V, 50 Hz (sinusoidal) and the output voltage is required to be of the same magnitude and waveshape. Design the transformer using CRGO core and copper wires. (**15**)
4. A 2-winding transformer with the following ratings has to be designed.
   750 VA, 230/115 V, 50 Hz, 1-phase.
   Using CRGO core and copper wire, design the transformer.

1. $R_{max} = 2.5\Omega$; $D \in [50/113, 50/88]$

$K_{crit} \in \left[(38/88)^2, (63/113)^2\right]$

For CCM, $L \geq \frac{R_{max}T}{2}\left(\frac{113}{63}\right)^2 \simeq 81\ \mu H$

$I_{L,max} = \frac{5}{(38/88)} A = 11.6 A$ (@ D = 50/88)

$I_{L,rms} = 11.6\sqrt{1 + \frac{1}{3}\left(\frac{3.8}{81\mu} \times \frac{1}{2} \times \frac{50}{88} \times \frac{1}{50k} \times \frac{1}{11.6}\right)^2}$

$\simeq 11.6 A$

$A_p = 81 \times 10^{-6} \times 11.6^2 = k_w B_m \hat{J} A_p \times 10^{-6}$

$k_w = 0.3$; For ferrites, you may choose $B_m = 0.2T$

For copper wire, may use $\hat{J} = 5 A/mm^2$

[Now go ahead & follow the design steps & converge]