

Name=

Team=

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Show your work and note the formulae!

EE468/568
Module III Problem Set
Spring 2023

Instructions

- This problem set is a take-home exam and is due Tuesday 24/05, no later than Noon.
- Please scan and email your completed solutions to me.
- Please work on this problem set individually.
- Problem 1 is 50 points, problems 2 and 3 are 25 points each.
- Show your work, formulae, graphs, etc.

1. (50 points) (P7.12) Design an LCL filter for a single phase inverter with unipolar sinusoidal SPWM switching pattern at 10 KHz and a fundamental frequency of 60 Hz. The inverter feeds a resistive load of $100\ \Omega$ from 600 volt DC source. The operating conditions provide a modulation index of $m= 0.8$ and the maximum resonant frequency f_r is selected to filter out the harmonics. (The modulation index m is similar to duty cycle in PWM.)

Design Objectives: (Sketch your design)

- (a) The voltage across the filter must be less than 5% (See examples 7.4 and 7.5 – Equation 7-20)
Find a maximum value for the sum of the two inductors, then pick L_{f1} to be 75% and L_{f2} 25% of the total.
- (b) Repeat for filter voltage drop of less than 4%. In this case, find the filter capacitor value to set the resonant frequency at 500 Hz.

Hints

- Ignore the capacitor's impact on the fundamental component of the current.
- The R_f value could be assumed as $1\ \Omega$, or even virtual. Ignore it.
- The RMS value of the output voltage is $V_o = \frac{mV_{dc}}{\sqrt{2}}$. Now, find I_o .

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2. (25 points) (P8.13) A 220 V DC motor runs at an average of 750W. The power source is a three-phase half-wave rectifier from a 460 volt, line to line, at 60 HZ through a three-phase step-down transformer. Calculate the DC-bus capacitor value to keep the ripple within 10% of the output voltage.



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3. (25 points) (P8.14) A three-phase full-wave rectifier is supplied from 208 VLL at 60 Hz. The load resistance is $30\ \Omega$.

- (a) Calculate the average output voltage and voltage ripple. [No DC-bus capacitor]
- (b) If the output voltage ripple is controlled within 14 volts, calculate the value of the DC-bus capacitor and the output power P_o .

Hint: Examples 8.7, 8.8

