Star Program Assignment

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- The first two parts are given to help you efficiently conduct your research project. If you are not convinced, please refer to: http://keysan.me/okst/ :)
- We want you to contribute to theoretical parts as well, or at least understand it, not just improve your practical skills on using some software.
- Go step-by-step in your assignment. If you got stuck, please do not hesitate to consult us. You can always send e-mails, or drop by to PowerLab offices to talk in person.
- Try to show your progress and get feedback from us during the assignment. Do not wait until you have a "final" version. Github is a good way to show your progress.
- We encourage you to work with your friends, share ideas and help each other. They are NOT your opponents. After all, Research League is a team !

1. Version Control

- Learn about version control. You may refer to: http://keysan.me/presentations/is500/version_control.html
- Get a Github account, follow https://github.com/ozank and https://github.com/mesutto/
- Download Sourcetree (https://www.sourcetreeapp.com/)
- Create your first repository and make your first commits
- **Use Github to reveal your progress during this assignment**

2. Research Tools

- Get a Mendeley account (https://www.mendeley.com/) and follow https://www.mendeley.com/profiles/mesut-ugur1/ and https://www.mendeley.com/profiles/ozan-keysan/
- Download Mendeley to your computer and add papers of your interest to a folder you created
- Check the properties (taking notes, highlighting etc.)
- **Use Mendeley to reveal your research progress during this assignment**

3. Join to PowerLab Maillist - Seminars

- Please visit PowerLab web page (http://power.eee.metu.edu.tr/)
- Join to the PowerLab maillist (http://power.eee.metu.edu.tr/join-us/)
- Attend to the PowerLab Seminars (http://power.eee.metu.edu.tr/seminars/) and workshops

4. Research Topic

- Add the following papers to your mendeley folder and study them throughout this assignment.
    - Wang, J., Li, Y., & Han, Y. (2015). Integrated Modular Motor Drive Design With GaN Power FETs. *IEEE Transactions on Industry Applications*, *51*(c), 3198–3207. http://doi.org/10.1109/TIA.2015.2413380
    - Ouyang, Z., & Andersen, M. a. E. (2014). Overview of Planar Magnetic Technology—Fundamental Properties. *IEEE Transactions on Power Electronics*, *29*(9), 4888–4900. http://doi.org/10.1109/TPEL.2014.2283263
- Prepare a brief presentation (10 minutes long) related to the papers.

5. Challenge

In passive diode bridge rectifiers, LC (inductive-capacitive) filters are used on the DC link to filter out the harmonic components injected by the rectifier. In this assignment, you are asked to design the inductor of this LC filter physically.

- Learn about three-phase diode bridge rectifiers and their filter circuit configuration.
- The specifications of the inductor are as follows:
    - Inductance: 3 mH
    - DC current: 23 A
    - AC current (300 Hz): 13 A peak-to-peak
    - Efficiency requirement: 99 %
    - Maximum temperature rise: 50 ^{0}C
    - Core peak flux density: 0.5 Tesla
    - Maximum fill factor: 0.4
    - Maximum winding current density: 4 A/mm^2
    - Core should be selected from Magnetics' catalog: https://www.mag-inc.com/getattachment/Design/Design-Guides/2015-Magnetics-Powder-Core-Catalog.pdf?lang=en-US
- You will follow the following procedure:
    - Select a suitable core
    - Calculate number of turns
    - Select a suitable winding
    - Calculate fill factor - verify
    - Check the change in permeability and re-calculate the number of turns
    - Determine DC and AC flux densities - verify
    - Calculate core loss, copper loss and efficiency - verify
    - Calculate temperature rise - verify
    - Calculate leakage inductance
- Inductor design procedures usually need a few iterations. Whenever any parameter requirement is not met, change something else (the selected core, number of turns etc.), and follow the same procedure.
- It is highly advised to use a software such as MATLAB for the design procedure. Performing an iterative design using paper and pen can be painful.