

Designing 2nd Courses (Entry-Level Graduate Courses) in Power Electronics based on the UMN-Developed Undergraduate Curriculum

Topics covered in Undergraduate course in Power Electronics based on UMN-developed curriculum

1. Switch-mode DC-DC Converters:
Switching power pole, DC-DC Converters switching analysis in DC Steady state, DCM operation, etc.
2. Designing Feedback controllers in Switch-mode DC Power Supplies
Dynamic average representation, linearization, controller design, peak-current mode control etc.
3. Rectification of utility input and power factor correction
Distortion and power factor, diode rectifier bridge front-end, single-phase PFC, Control of PFC etc.
4. Magnetic circuit concepts and Switch-Mode DC power supplies
Magnetic circuits, transformer isolated DC-DC Converters, Area-product method of magnetics design
5. Synthesis of DC and Low-Frequency Sinusoidal AC voltages for motor drives and UPS
Bi-directional switching power pole, Single-phase & three-phase inverters, synthesis of low frequency AC, etc.
6. Thyristor converters

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Summary of Group Discussion:

- Knowledge of the undergraduate course in power electronics is assumed
- Central theme for the course based on current curriculum: Application based or converter based with applications added as appropriate
- Design of power electronic components to be included – semiconductor terminal characteristics, gate drives, snubber circuits, magnetics design, thermal management
- Course project should be included to give students a practical design and laboratory experience

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Summary of Group Discussion: (contd.)

- Specialized applications such as charge pumps, energy harvesting can also be mentioned
- Topics that can be covered in graduate courses in electric drives or power systems such as inverters, FACTs to be excluded
- Soft-switching in dc-dc converters in this course to be covered in detail using examples of converters
- Digital control, control systems can be discussed but it is assumed that students will be taking separate courses on these topics
- Students should be exposed to one or more circuit simulation tools