ECE6610PD
POWER ELECTRONIC CONVERTERS: DESIGN AND APPLICATIONS
Fall 2021

COURSE INSTRUCTOR:

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Teaching Assistant:
TBD

Live Lectures Schedule:
TBD

Study Material:

- Detailed lecture slides will be made available for download from LEARN before live lectures.
- Other related materials will also be made available to participants, when appropriate.

Lectures:

- There will be 12 3-hour lectures in the course.

Marking Scheme:

- Written final exam: 60%
- Assignments: 40%

SUMMARY:

This course covers a wide range of topics in power electronics including: power semiconductor devices (an overview), power converter topologies for ac-to-dc, dc-to-dc, dc-to-ac and ac-to-ac conversions, multi-converter and multi-level converter topologies, control techniques in power converters, modeling and controller design of power converters, applications of power converters, implementation aspects of power converters (snubber circuits, gate/base-drive circuits, thermal management, and series/parallel combinations of switches), and computer simulation of power electronic systems.

OBJECTIVES:

- Understand the operating characteristics of power semiconductor devices.
- Learn about topologies, control techniques, and applications of power converters.
- Learn about modeling, controller design and implementation aspects of power converters.
- Learn to use a standard power electronic simulation package.

MAJOR TOPICS:

1. **Power Semiconductor Devices**
2. **Power Converter Topologies, Control Techniques and Applications**
3. **Modeling, Controller Design and Implementation Aspects of Power Converters**

DETAILED PLAN: 12 LECTURE SESSIONS

Topics	No. of Lecture Sessions	Sub-Topics
Introduction to Power Electronics	**1 Week 1**	• Evolution and Scope • Application Examples • Waveform Quality • Input and Output Low-Pass Filters
Power Semiconductor Devices and Computer Simulation of Power Electronic Systems	**1 Week 2**	• Diode • SCR (Thyristor) • Controllable Switches • Introduction to Wide-Band-Gap Devices • Switch Losses • Introduction to Power Electronic Circuit Simulation using PSIM

Power Converters: Topologies, Design, Modeling and Control Techniques	**1 Week 3**	• Line-Frequency Diode Rectifiers ◊ Single-Phase and Three-Phase Diode Rectifiers ◊ Applications
	2 Week 4 & Week 5	• Line-Frequency Phase-Controlled Converters ◊ Single-Phase & Three-Phase Phase-Controlled Converters ◊ Applications
	2 Week 6 & Week 7	• Switch-Mode DC-to-DC Converters ◊ Topologies ◊ Control Techniques: Hysteresis, Pulse-Width Modulation, Phase-Shift Modulation ◊ Modeling ◊ Controller Design ◊ Applications
	3 Week 8, Week 9 & Week 10	• DC-to-AC Converters (Inverters) ◊ Voltage- and Current-Sourced Converter Topologies ◊ Control Techniques: Hysteresis, Pulse-Width Modulation, Square-Wave Control, Selective Harmonic Elimination, Space Vector Modulation ◊ Modeling ◊ Multi-Converter and Multi-Level Converter Topologies ◊ Applications
Implementation Aspects of Power Converters	**2 Week 11 & Week 12**	• Snubber Circuits and soft switching • Thermal Management • Gate/Base-Drive Circuits • Series and Parallel Switch Combinations

REFERENCES:

1. Mohan, Undeland and Robbins, *Power Electronics: Converters, Applications, and Design*, 3rd Edition, John Wiley & Sons, Inc., 2003. (main)
2. D.W. Hart, *Power Electronics*, McGraw Hill, 2011. (supplementary)
3. M.H. Rashid, *Power Electronics: Circuits, Devices, and Applications*, 3rd Edition, Pearson-Prentice Hall, 2003. (supplementary)
4. R.S. Ramshaw, *Power Electronics Semiconductor Switches*, 2nd. Edition, Chapman & Hall, 1993. (supplementary)
5. Conference and Journal papers.

PREREQUISITES:

- Basic understanding of circuit analysis and control theory
- Familiarity with electric machines and power systems