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

DETAILED PLAN: 12 LECTURE SESSIONS

<table>
<thead>
<tr>
<th>Topics</th>
<th>No. of Lecture Sessions</th>
<th>Sub-Topics</th>
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| 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

<table>
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<tr>
<th>Week</th>
<th>Topics</th>
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<tbody>
<tr>
<td><strong>1 Week 3</strong></td>
<td>• Line-Frequency Diode Rectifiers ◊ Single-Phase and Three-Phase Diode Rectifiers ◊ Applications</td>
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<tr>
<td><strong>2 Week 4 &amp; Week 5</strong></td>
<td>• Line-Frequency Phase-Controlled Converters ◊ Single-Phase &amp; Three-Phase Phase-Controlled Converters ◊ Applications</td>
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<tr>
<td><strong>2 Week 6 &amp; Week 7</strong></td>
<td>• Switch-Mode DC-to-DC Converters ◊ Topologies ◊ Control Techniques: Hysteresis, Pulse-Width Modulation, Phase-Shift Modulation ◊ Modeling ◊ Controller Design ◊ Applications</td>
</tr>
<tr>
<td><strong>3 Week 8, Week 9 &amp; Week 10</strong></td>
<td>• 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</td>
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### Implementation Aspects of Power Converters

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<th>Week</th>
<th>Topics</th>
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<tr>
<td><strong>2 Week 11 &amp; Week 12</strong></td>
<td>• Snubber Circuits and soft switching • Thermal Management • Gate/Base-Drive Circuits • Series and Parallel Switch Combinations</td>
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### REFERENCES:

5. Conference and Journal papers.

### PREREQUISITES:

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