ELE864 Electric Drives
Course Outline

Prerequisite
ELE 504, ELE 531, ELE 532, MTH 514, ELE 635, ELE 637, ELE 639, MEC 511 and (ELE 538 or COE 538)

Course Organization
This course consists of three hours of lecture every week and two hours of laboratory every other week.

Course Material
Text

References

Course Description
A course on the analysis and design of electric motor drives. Major topics include: rectifier drives, chopper drives, voltage controller drives, slip energy recovery drives, voltage source inverter drives, current source inverter drives, cycloconverter drives. The course focus is on the analysis of the steady state operation of drive systems that allows the specification of suitable converters and machines for the speed and position control system encountered. Transient operation is discussed but not studied in detail. Important concepts are illustrated with laboratory experiments.

Course Objectives
At the end of this course, the successful student will be able to:
1) To analysis motor drive system performance using concept of various engineering knowledge (1c)
2) To design the motor drive system based on the engineering requirements (4a)
3) To be familiar with system modeling and simulation (2b)
4) To be familiar with power converters and DSP code generation (5c)
5) To be familiar with drive system experiment and data analysis (5b)

Course Evaluation
- Theoretical component
  Mid-term Examination 30%
  Final Examination 45%
- Laboratory component
  1) Measurement of DC motor parameters 5%
  2) DC motor drive system design and simulation 10%
  3) DC motor drive experiment 10%
Notes: In order to achieve a passing grade, the student must achieve an average of at least 50% in both theoretical and laboratory components. All the required course specific written report will be assessed not only on their technical or academic merit, but also on the communication skills exhibited through these reports.

Lecture Topics

1. **Introduction (chapters 1) 3 hrs**
   1.1 Electric machines
   1.2 Power converters
   1.3 Controllers
   1.4 Load

2. **DC Motor Drives (chapters 2, 3 and 4)**
   2.1 Modeling of DC Machines 3 hrs
   2.1.2 DC motor operation
   2.1.2 Model of DC motors
   2.1.3 Operating modes in DC motor drives
   2.1.4 Electronically - commutated DC motor drives
   2.2 Power converters for DC motor drives 6hrs
   2.2.1 Phase controlled DC motor drives
   2.2.2 Chopper controlled DC motor drives
   2.3 Designing feedback controllers for motor drives 3hrs
   2.3.1 Control objective
   2.3.2 Control structure
   2.3.3 Control design
   2.3.4 Example of a controller design

3. **Induction Motor Drives (chapters 5, 6, 7 and 8)**
   3.1 Operating principles of induction motors 3 hrs
   3.1.1 Equivalent circuit
   3.1.2 Measurement of parameters of induction motors
   3.1.3 Steady-states operation of induction motors
   3.2 Power converters for induction motor drive 2 hrs
   3.2.1 Voltage source inverters
   3.2.2 Current source inverters
   3.2.3 Cycloconverters
   3.3 Induction motor drives: speed control 11 hrs
   3.3.1 Stator-voltage control
   3.3.2 Slip-energy recovery speed control
   3.3.3 Frequency-controlled induction motor drives
   3.3.4 Vector-controlled induction motor drives

4. **Synchronous Motor Drives (chapters 9)**
   4.1 Operating principles of synchronous motors 2 hr
   4.1.1 Equivalent circuit
   4.1.2 Steady-states operation of synchronous motors
   4.2 Synchronous motor drives 6 hrs
4.2.1 Vector control of synchronous motors
4.2.2 Control strategies
4.2.3 Permanent-magnetic brushless DC motor

Laboratory Schedule

<table>
<thead>
<tr>
<th>Lab</th>
<th>Topics</th>
<th>Even week #</th>
<th>Odd Week #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tutorial</td>
<td>Lab orientation</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Lab class</td>
<td>Lab orientation</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Measurement of dc motor parameters</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Lab class</td>
<td>DC motor drive system design and simulation</td>
<td>4 and 6</td>
<td>5 and 7</td>
</tr>
<tr>
<td>Tutorial</td>
<td>Power converter and DSP programming</td>
<td>8</td>
<td>9</td>
</tr>
<tr>
<td>Lab class</td>
<td>Motor drive system experiment</td>
<td>10 and 12</td>
<td>11 and 13</td>
</tr>
</tbody>
</table>