Dynamic Analysis and Controls of Automatic Transmissions

AUTO 563

Shushan Bai
GM Powertrain
Know Each Other

- Your name, work experiences, academic background and etc.
- Your expectation to the course.
<table>
<thead>
<tr>
<th>Session</th>
<th>Date</th>
<th>Topic</th>
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<tbody>
<tr>
<td>1</td>
<td>Jan. 8</td>
<td><strong>Introduction to the world of automatic transmissions</strong>&lt;br&gt;Static analysis of planetary gear trains&lt;br&gt;Torque ratio and speed ratio analysis using algebraic method, level diagram method and matrix method.</td>
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<td>2</td>
<td>Jan. 15</td>
<td><strong>Gear shift mechanics</strong></td>
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<td>3</td>
<td>Jan. 22</td>
<td><strong>Simulation of dynamic systems in SIMULINK</strong></td>
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<td>4</td>
<td>Jan. 29</td>
<td><strong>Dynamic modeling and analysis of planetary gear trains:</strong>&lt;br&gt;Dynamic modeling of simple planetary gear sets and planetary gear trains. Generic dual clutch model to simulate gear shifting.</td>
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<td>5</td>
<td>Feb. 5</td>
<td><strong>Hydraulic control systems and simulation models:</strong>&lt;br&gt;Proportional pressure control solenoid, pressure regulating valve, hydraulic actuator, pulse width modulated (PWM) solenoid, clutch control system, and overall hydraulic control system.</td>
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<td>7</td>
<td>Feb. 19</td>
<td><strong>Midterm preparation and final project kickoff</strong></td>
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<td>8</td>
<td>Feb. 26</td>
<td><strong>Midterm exam</strong></td>
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<td>9</td>
<td>Mar. 5</td>
<td><strong>Winter Break (no class).</strong></td>
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<td>10</td>
<td>Mar. 12</td>
<td><strong>Presentation of final project proposal</strong></td>
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<td>11</td>
<td>Mar. 19</td>
<td><strong>Shift scheduling system and integrated powertrain control:</strong>&lt;br&gt;Performance, drivability and fuel economy. Shift map based and AI based shift-scheduling system. Integrated powertrain control.</td>
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<td>12</td>
<td>Mar. 26</td>
<td><strong>Electronically controlled torque converter clutch:</strong>&lt;br&gt;Control strategies, stability and response, disturbance rejection. <strong>Friction launch control</strong>&lt;br&gt;Mechanization of friction launch clutches: DCT, MTA. Control strategies.</td>
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<td>13</td>
<td>Apr. 2</td>
<td><strong>Belt CVT ratio and torque capacity control</strong></td>
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<td>14</td>
<td>Apr. 9</td>
<td><strong>Torsional vibration damper and centrifugal pendulum vibration absorber</strong></td>
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<td>15</td>
<td>Apr. 16</td>
<td><strong>Dual clutch transmission (DCT) and controls</strong></td>
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<td>16</td>
<td>Apr. 23</td>
<td><strong>Final project preparation</strong></td>
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<td><strong>Presentation of final project.</strong></td>
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Class Expectation: active involvements, learning through discussions
Grading Police:
2 home works before the midterm (25%)
Midterm (25%)
Final Project (50%)

Will consider curve the grade if necessary
• Matlab/Simulink is used throughout the course for modeling and simulation of transmissions and control systems.
• Matlab/Simulink is not a prerequisite, and there will be tutorial sessions.
• If you are not familiar with Matlab/Simulink, it is a plus if you do some self teachings before hand.

http://www.mathworks.com/academia/student_center/tutorials/
http://www.engin.umich.edu/class/ctms/
• No regular office hour. If necessary could meet by appointment.

• Feel free to email me if you need any help.
  ✓ sbai@umich.edu
  ✓ shushan.bai@gm.com
Final Project Essentials

- Group work is highly encouraged (3 to 4 members per group)
- Project has to be built off of topics and techniques introduced in the class.
- A list of suggested final projects will be provided, it is highly recommended to chose from the list.
- Professional work is expected
  - Project approval presentation and peer review
  - Written project report
  - Oral project presentation
  - Literature search
- Written report format (5-7 pages with references sited)
  - Abstract
  - Purpose
  - Literature search
  - Discussion
    - Physical system description
    - Control description
    - Approach to modeling
    - Model description
    - Simulation Results
    - Major areas of discovery
    - Conclusion/Recommendations
- Presentation 15 min with Power Point (off campus students provide voice over Power Point)
- Projects will be eligible for an A+ by meeting the above requirements and:
  - Demonstrating modeling and simulation skills above those demonstrated in class.
  - Selection of an innovative or topical system to work on
  - Teaches something above and beyond the formal class content