

**MECHANICAL ENGINEERING PROGRAM**  
**ABET COURSE SYLLABUS**

**ME 441: Single Track Vehicle Design (4) Elective**

<b>Course Description:</b> (2013-15 Catalog)	Design of single track vehicles, including handling characteristics, ergonomics and human power, strength and stiffness considerations, braking and suspension. Laboratory focus on designing a single track vehicle, including fabrication of a handling prototype. 3 lectures, 1 laboratory.
<b>Prerequisite Courses:</b>	ME 318, ME 329, or consent of instructor
<b>Prerequisites by Topic:</b>	Mechanical Vibrations, Intermediate Design
<b>Textbook:</b> (and/or other required material)	None
<b>References:</b>	Lords of the Chainring, Bill Patterson Bicycling Science 3 <sup>rd</sup> Edition, Wison, MIT Press High-Tech Cycling 2 <sup>nd</sup> Edition, Edmond Burke, Human Kinetics Bicycle Design, Mike Burrows, Open Road The Stability of Bicycles, J. Lowell, H.D. McKell, American Journal of Physics Dec. 1982.
<b>Course Coordinator/Instructor:</b>	Andrew Davol, Professor, Mechanical Engineering
<b>Course Learning Outcomes:</b>	The student will be able to: <ol style="list-style-type: none"><li>1. Construct a complete free body diagram of a single track vehicle and use this to develop the appropriate equations of motion.</li><li>2. Develop, use, and interpret results from numerical simulations of a single track system involving coupled ordinary differential equations.</li><li>3. Evaluate the effects of geometry changes on the controllability of a single track vehicle.</li><li>4. Justify appropriate geometry and gearing choices for a human powered single track vehicle.</li><li>5. Design vehicle frame for strength and stiffness considerations.</li></ol>

<b>Relationship of Course to MECHANICAL ENGINEERING Program Outcomes:</b>												
<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>	<i>h</i>	<i>i</i>	<i>j</i>	<i>k</i>	<i>l</i>	<i>m</i>
<b>H</b>	<b>L</b>	<b>H</b>	<b>L</b>	<b>H</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>H</b>	<b>M</b>	<b>H</b>	<b>H</b>	<b>H</b>

**Topics Covered:**

1. Control Spring and Sensitivity for Design
2. Lowell and Mckell Model (Hands free stability)
3. Patterson Control Model (Stability with rider intention)
4. Ergonomics – Joint Loads
5. Ergonomics – Human Power Output
6. Ergonomics – Power Consumption
7. Ergonomics – Gearing
8. Frame Design – External Loads
9. Frame Design – Materials
10. Frame Design – Joints
11. Frame Design – Internal Loads
12. Frame Design – Finite Element Analysis
13. Braking
14. Suspension
15. Front Suspension
16. Rear Suspension

**Laboratory Projects:**

Various single track vehicles are ridden to get a physical feel of the parameters discussed in lecture. A single track vehicle is designed with consideration of all aspects discussed in lecture and a handling prototype is built and ridden to demonstrate the handling qualities of the proposed design. Techniques for accurately measuring all necessary geometry are demonstrated.

**Class/Lab Schedule:**

Three 50-minute lectures per week; One 170-minute lab per week.

**Contribution of Course to Meeting the Professional Component:**

- |   |                  |
|---|------------------|
| (a) College-level mathematics and basic sciences: | 0 credits        |
| (b) Engineering Topics:<br>Design?                | 4 credits<br>yes |
| (c) General Education:                            | 0 credits        |
| (d) Other:  | 0 credits        |

**Prepared by:** Davol

**Date:** 5/9/14

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