CDS 202 - Geometry of Nonlinear Systems
Winter 2004

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Lectures
MWF 8:30-10, 125 Steele

Course description  CDS 202. Geometry of Nonlinear Systems. 9 units (3-0-6); second term.
Prerequisites: CDS 201 or AM 125 a. Basic differential geometry, oriented toward applications
in control and dynamical systems. Topics include smooth manifolds and mappings, tangent and
normal bundles. Vector fields and flows. Distributions and Frobeniuss theorem. Matrix Lie groups

Lecture format and schedule  CDS 202 will meet twice per week, on average, with the schedule
adjust to match the availability of the instructor. The first class meeting of the “week” (which
might be on Monday, Wednesday, or Friday) will give an overview of the material to be covered.
Homework and reading assignments will be handed out at this lecture. The second meeting will be
a class discussion of the homework for the week, with students expected to be able to discuss how
they would approach the problems. The homework set for the week will be due at the first lecture
of the following week. The course schedule will be maintained on the class homepage.

Class homepage  Information on the class is available via the class homepage:
http://www.cds.caltech.edu/~murray/cds202

All course handouts and other administrative data about the course are available via the class
homepage.

Grading  The final grade will be based on homework and a final exam.

- Homework: 75%
  There will be 8 one-week problem sets, due in class. Late homework will not be accepted
  without prior permission from the instructor.

- Final exam: 25%
  The final will be handed out the last day of class and is due back at the end of finals week.
  Open book, time limit to be decided.

If your score on the final is higher than the weighted average of your homework and final, your
final will be used to determine your course grade.
Homework and exam policy  Collaboration on homework assignments is encouraged. You may consult outside reference materials, other students, the TA, or the instructor. All solutions that are handed should reflect your understanding of the subject matter at the time of writing.

No collaboration is allowed on the final exam.

Course Text and References  The following texts will be used for this course:


Boothby is available in the Caltech bookstore. Abraham, Marsden, and Ratiu is available online, via the course homepage.

The following books may also be helpful:


Course outline  The following is a tentative outline of the material to be covered this term. Some topics may be omitted due to time limitations.

<table>
<thead>
<tr>
<th>Week</th>
<th>Topics</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introductory comments, point set topology</td>
<td>AMR Ch 2</td>
</tr>
<tr>
<td>2</td>
<td>Manifolds, mappings, tangent space</td>
<td>B3.1–3</td>
</tr>
<tr>
<td>3</td>
<td>Immersions, submersions</td>
<td>B3.4–3.5</td>
</tr>
<tr>
<td>4</td>
<td>Inverse function theorem, transversality</td>
<td>B2.6, AMR 3.5</td>
</tr>
<tr>
<td>5</td>
<td>Tangent bundle, vector fields</td>
<td>B4.1–4</td>
</tr>
<tr>
<td>6</td>
<td>Distributions, Frobenius theorem</td>
<td>B4.7–8</td>
</tr>
<tr>
<td>7</td>
<td>Lie groups and Lie algebras</td>
<td>B3.6–7, B4.6–7, AMR S-1</td>
</tr>
<tr>
<td>8</td>
<td>Tensor fields</td>
<td>B5.1–5.3</td>
</tr>
<tr>
<td>9</td>
<td>Exterior forms</td>
<td>B5.6–8</td>
</tr>
<tr>
<td>10</td>
<td>Integration on manifolds</td>
<td>B5.9–10</td>
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</tbody>
</table>