

## Compliant Motion Systems – Draft Syllabus

### Topics by week:

Week	Topic
1	Introduction to Compliant Motion Systems
2	Mathematical Tools to describe nonlinear behavior
3	Concepts of Stability, Introduction to Lyapunov Theory
4	Advanced Stability Theory
5	Concept of Non-Collocation, and Internal Dynamics of Compliant Motion Systems
6	Flexibility through Lumped Elements <ul style="list-style-type: none"><li>- Linear Cases</li><li>- Feedback Linearization for Non-Linear Cases</li></ul>
7	Command Shaping Techniques
8	Midterm Exam
9	Flexibility through Distributed Elements <ul style="list-style-type: none"><li>- Modelling, Modal Analysis, examples of command shaping</li><li>- Case: Single Flexible Link</li></ul>
10	Adaptive Modelling Approaches <ul style="list-style-type: none"><li>- Case: Reduced Order Modelling for Distributed Flexibility</li></ul>
11	Backstepping Control <ul style="list-style-type: none"><li>- Case: Compressible transmission</li></ul>
12	Variable Compliance Actuators <ul style="list-style-type: none"><li>- Case: Compliance in Human Locomotion</li></ul>
13	Soft Actuation <ul style="list-style-type: none"><li>- Case: Pneumatic Manipulators</li></ul>
14	Further Case Studies <ul style="list-style-type: none"><li>- Series Elastic Actuation</li><li>- Space Robotics</li></ul>

### Recommended Materials:

- Applied Nonlinear Control, Jean-Jacques E. Slotine & Weiping Li
- Handbook of Robotics, 3<sup>rd</sup> Ed., Ch. 13, Alessandro De Luca, Wayne Book
- Various research articles/materials

### Assessment Method:

- **Midterm Exam:** 30 %
- **Final Exam:** 30 %
- **Assignments:** 40 %

### Notes:

- Final Exam will be take-home, and students will be expected to make a presentation about their solutions on the exam date.
- There will be six assignments in total.