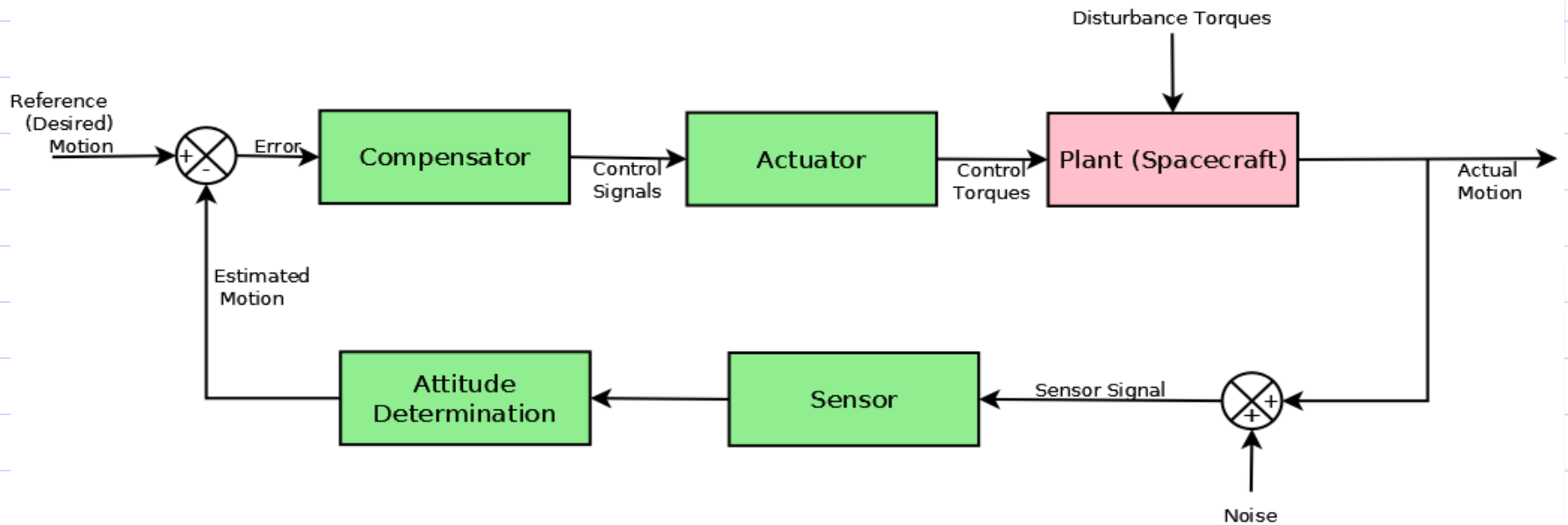# ESS 5010

Spacecraft Dynamics and Control
H. Chesser (CSEB 1012U)

Course Outline

Course Delivery

- Three lecture hours per week
  - Broken up into 1.5 hour slots – suggested times are T, R 13:00 – 14:30
  - Some exercises with STK
- Assignments – STK and Matlab, some written work
- Final Project

Reading

- **Textbook (required)**
  - *Space Vehicle Dynamics and Control*, 2nd edition, Bong Wei, AIAA, 2008, ISBN-13: 978-1-56347-953-3 (available in bookstore and as e-book through library – from on/off campus see [Knovel Engineering eBooks](#))

- **Other (optional)**
  - *Elements of Space Technology*, Meyer, R., Elsevier, 1999, ISBN 978-0-12-492940-1 (e-book)
  - *Feedback Control of Dynamic Systems*, 5th edition, Gene Franklin, J. D. Powell, Abbas Emami-Naeini, Prentice Hall, 2006, ISBN-10: 0131499300 (PHY 4550 textbook)
  - *Orbital Mechanics for Engineering Students*, Curtis, H., Elsevier Aerospace Engineering Series, 2005, ISBN-10: 0 7506 6169 0 (ENG/PHY 4110 textbook)

Assignments

- Assignments assume access to STK and Matlab (or Octave)

  - Matlab is available in the Eng Lab, Steacie library (021) and a student version is available for purchase

  - Octave is an option, STK plugin scripts can also be developed in VBscript, Perl or Python

- STK is available in the Eng Lab, Steacie library (021) and can be installed on your own computer (with license access via VPN)

Course Assessment

Mark Component	Weighting
Theory Assignments	30%
Matlab Assignments	30%
Final Project	40%
TOTAL	100%

Approximate Lecture Schedule

DATE	LECTURE TOPIC	READING	Assignment
Week 1 - 1 (Sep 13) - 2	**Attitude Kinematics**, Review of Coord Transforms Euler Angles, Euler Parameters, Quaternions	Wei, 5.1, 5.2 Wei, 5.3, 5.4	
Week 2 - 1 (Sep 20) - 2	Kinematic Equations Angular Momentum, Inertia	Wei, 5.5 Wei, 6.1, 6.2, 6.3	
Week 3 - 1 (Sep 27) - 2	**Open Loop Dynamics** - Euler's Equation Spinning spacecraft - Axisymmetric Motion	Wei, 6.4, 6.5 Wei, 6.7, 6.8	Assignment 1 Due
Week 4 - 1 (Oct 4) - 2	Gyrostats – Dual spin 3-axis stabilization	Wei, 6.12 Wei, 6.11	
Week 5 - 1 (Oct 11) - 2	Fall Reading Week No Classes		
Week 6 - 1 (Oct 18) - 2	**Attitude Control,** Spinning Spacecraft – Spin Up Spin Maneuver Review, Control Concept Review	Wei, 7.1.2 Wei, 7.1.3-7.1.5, 2.1 - 2.3	Programming Assignment 1 Due Oct 19th
Week 7 - 1 (Oct 25) - 2	State Space Control State Space	Wei, 2.5 Wei, 2.4	
Week 8 - 1 (Nov 1) - 2	State Space Attitude Control Inertial Pointing	Wei 7.3	Assignment 2 Due
Week 9 - 1 (Nov 8) - 2	Inertial Pointing Control, Attitude Control, Momentum Mgmnt **Attitude Disturbances** – Gravity Gradient, SRP, Drag	Wei 7.3, 7.4 Wei 6.10.1, 14.3.3	
Week 10- 1 (Nov 15) - 2	**Attitude Actuators** – Magnetorquers, thrusters Reaction Wheels	Meyer, 6.5, Wei 7.7 Meyer, 6.5.2, Wei 7.4	
Week 11 - 1 (Nov 22) - 2	**Attitude Sensors –** Star sensors, horizon sensors Gyros, IMUs, Magnetometers	Meyer, 6.4	Programming Assignment 2 Due
Week 12 - 1 (Nov 29) - 2	**Attitude Determination (Intro) -** State Estimation Theory State Estimation Example		
Week 13 - 1 (Dec 6) - 2	**Attitude Control Application –** MOST talk (Lee)		Assignment 3 Due
Exam Period			Programming Assignment 3 Due