In their full expression, aircraft dynamics possess astounding complexity, and it is a tribute to the ideas developed by aviation's pioneers that a relatively simple understanding can often be obtained, leading to clear insights and design principles. While these concepts are not inherently difficult, they do lie outside most common experience, and they depend on new nomenclature and strange notation that can seem overwhelming at first. It is only through diligent and careful use of this new language that the underlying simplicity can be grasped and conveyed on exams; mastery of the language of aircraft dynamics is perhaps the most important predictor for success in the course.

The course has been designed to develop a conceptual grasp of the key ideas below, and to demonstrate proficiency in wielding these concepts to solve problems, construct and validate simulations, and to explain behaviors and results obtained. In particular, technical writing and reasoning skills are stressed in assignment solutions and examinations. The key learning objectives are:

Vector mechanics

- Vector representation
- Coordinate frame transformation, DCM
- Relative motion, frame derivatives
- Velocity rule

How aircraft dynamics models are created and what the terms mean

- 3D rigid body translational model
  - Kinematics
  - Dynamics, external forces
  - Effects of wind
- 3D rigid body rotational model
  - Kinematics, Euler angle attitude representation
  - Dynamics, Euler moment equations, external moments
- External forces and moments
  - Aerodynamic effects
  - Control effects
  - Steady flight conditions, trim states

How aircraft dynamics models are simulated

- State space models
- Matlab integration
- Good coding and commenting habits

How dynamical behavior is understood and specified

Linearization

Decoupling

Stability derivatives

Modal solutions

Stability characterizations

Modal specifications

How feedback control is designed to meet behavioral objectives

Sensor selection, control structure

Effects on mode eigenvalues

Course Components

Material and concepts are introduced and student mastery is evaluated using several mechanisms throughout the course:

Reading – The textbook provides the essential basis for the course, including the concepts, terminology, notation, methods, and examples used to convey the course topics. Specific reading assignments will be given covering key sections of the book; some book sections are not covered in the course. Some supplementary material will also be provided.

Lectures – These are intended to emphasize key ideas and methods that make the material easier to grasp. They are therefore a counterpart to the reading, not a replacement. The value of lectures is dependent on your participation in them. Passive “watching” will provide little benefit. Active note taking is critical to developing first-hand familiarity with the notation, terminology, and methods, and to gaining comfort in using them. Questions are encouraged during lectures, and will be prompted often. Professor Lawrence will lecture primarily for the first half of the course, and Professor Ahmed will lecture primarily for the second half.

Assignments – These provide first-hand experience employing the reading and lecture material. They consist of analysis and computation exercises, simulation development, and simulation use to address aircraft stability and control design problems. Assignments will be carried out in small groups, with a single solution graded and a single initial assignment grade for the group. Individual assignment grades may differ from the group grade, depending on peer evaluations of group member’s contributions to the assignment. Please see the **Assignment_Format Peer_Eval_Grading** documents for details. Students are expected to use these assignments and the associated group learning opportunities to strengthen their **individual** mastery of the subject.

Proper presentation of engineering work is important throughout the ASEN curriculum, as in professional life thereafter, and students are expected to properly describe what was done and explain results using graphical and written descriptions based on the precise terminology and notation introduced in the course.

4. Examinations- Midterm exams will be given during lecture periods. The final exam is scheduled according to University policy. Exams are the primary means of assessing individual proficiency and in determining grades in the course. Assignments are group-oriented and designed to develop proficiency in order to do well individually on exams. Accordingly, group work cannot substitute for individual assessments. See the grading policy below. Any type of collaboration or copying on an exam constitutes a breach of professional ethics and will result in an F for the course. An honor code violation or accusation report will also be filed. **There will be a statute of limitations on when exam grades can be corrected: midterm exam scores must be corrected before the next exam.**

6. Deadlines -

If your Individual Work (IW) grade is **a C or better** then your Final Score is computed as the weighted average of the Individual Work (IW) and Group Work scores (GW). This formula is

FS = 0.6*IW + 0.4*GW,

which is equivalent to an overall breakdown:

If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at