EP 393 – Spaceflight Dynamics
Embry-Riddle University
Fall 2011

Instructor: M. Anthony Reynolds
email: reynodb2@erau.edu
web: http://faculty.erau.edu/reynolds/ep393 (or Blackboard)
phone: (386) 226-7752
office: Lehman 313
office hours: M-Th, 4:00-5:00, Fri 10:00-11:00, Lehman 313

Required text:	*Orbital Mechanics for Engineering Students, 2ed*, by Curtis Chapters 1-6, 8	
Recommended:	*Mechanics*, by Symon –	QC 125 .S98 1971
	Solar System Dynamics, by Murray & Dermott –	QB 500.5 .M87 1999
	Orbital Mechanics, by Logsdon –	TL 1050 .L59 1998

Percentage system:		*Grading scale*:	
1 final project	20%	A	90% –
3 tests	60% (20% each)	B	75% – 89%
Problem sets	20%	C	60% – 74%
		D	50% – 59%

Course Description: Basic topics in analytical dynamics, two body orbits and the initial value problem, the two body orbital boundary value problem, Earth coverage and space mission geometry, non-Keplerian effects, orbital maneuvers and rendezvous, and interplanetary transfer. Fundamentals of ascent flight mechanics, launch vehicle selection, fundamentals of entry flight mechanics, and the associated thermal control problem. **Prerequisites**: ES 204.

Learning Outcomes:

1. Solve orbital initial value problems.
2. Solve orbital boundary value problems.
3. Analyze transfer maneuvers, rendezvous problems, and interplanetary transfers.
4. Design orbits for Earth coverage and remote sensing.

RULES

1. Arrive on time; depart on time.
2. Take notes, and bring calculator to each class.
3. No eating, no cell phones.

Final Project

Numerical calculation of restricted three-body problem.
Due Date: Thu 8 Dec.

Tests

One-hour; closed book; closed notes.
Tools: pen or pencil, calculator, equation sheet.
Dates: Thu 29 Sep, Thu 3 Nov, Thu 1 Dec.

Problems

Must be neat and stapled.
Due Dates: every Tuesday.
Graded on completeness, correctness and effort.

All assignments are due at the *beginning* of class on the due date, after which they will be considered late and the score will be reduced by 50%. After the beginning of the *next* class period, they will not be accepted.

Code of Behavior

In order for learning to take place, we all must act with civility (formal politeness) and respect (polite consideration, courtesy) toward each other. My responsibilities include coming to class prepared and on time, and evaluating you in a fair and impartial manner. Your responsibilities include coming to class prepared and on time, not disrupting the class (for example, talking without being called on, eating, reading newspapers, sleeping, shuffling papers, talking on cell phones, etc.), and treating your fellow students as colleagues (see the Student Handbook). Violations of this code can result in your removal from the class.

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* This syllabus incorporates all existing University policies, especially those sections of the *Student Handbook* pertaining to academic integrity, civility, and respect. *

General study habits

Repetition is critical for creating long-term memories. A good method for learning is the following sequence: read, listen, write, re-read, re-write, practice, and review. The textbook should be read THREE times: read once before class, read deeply (at least) once after class, and once as a review. In addition, you do not read textbooks as you would the newspaper. You must work through the examples, all mathematical steps should be confirmed, and you should write notes in the margins (it is your book, you can write in it!).

Notes

Taking notes during lecture is important – but you must review and re-copy those notes after class (within a few hours) for them to be useful. Notes that are never reviewed are less than worthless: they give you a false sense of security. It is important that you get into the habit studying every day.

Problem Solving

Solving problems is **critical** to your success in this course. An excellent method to prepare for the exams is to attempt problems at home in an exam-type environment. That is, once you have solved a group of problems, put aside the solutions and pretend that they are questions on an exam – attempt to solve them again, but without any help. Solve problems according to the following rules of coherence and readability:

- Describe *briefly*, but in clear and complete sentences, the basic principles used to solve the problem and explain the basic equations that are used in the solution [DO NOT simply rewrite the question].
- If a physical situation is discussed in the problem, draw an appropriate diagram.
- Identify in words, or by clear references to the diagram, all the symbols you use.
- Work through the problem symbolically, getting a simplified symbolic answer, and only substitute numbers (if appropriate at all) at the very end.
- If you obtain an explicit numerical solution, comment on whether the value you get is reasonable.
- Put boxes around your final answers.
- Write up the problem sets neatly.

Do not simply copy another student's work, and do not simply copy from the solutions manual, but I recommend that you form study groups and work together. This can help you through difficult sections and problems. I encourage you to discuss, argue, arm-wrestle, and finally master the problems. However, I expect you to write up your solutions individually, showing your own insights.

Study Groups

I strongly suggest that you form study groups. "For most individuals, learning is most effectively carried out via social interactions." (Ed Redish)

SCHEDULE

Part 1. Mechanics review, the two-body problem, 2D orbits, time

READING:
Curtis, Sections 1.4-1.7, 2.1-2.12, 3.1-3.4

Problem Set #1	Due Tue 9/6	Ch 1: 9, 10, 11, 12, 14, 15; Ch 2: 1, 2
Problem Set #2	Due Tue 9/13	Ch 2: 7, 8, 10, 11, 18, 19, 20, 21, 23
Problem Set #3	Due Tue 9/20	Ch 2: 24, 30, 31, 35, 37, 38, 39, 40, 41
Problem Set #4	Due Tue 9/27	Ch 2: 47; Ch 3: 1, 2, 5, 6, 7, 8, 13 (EC: 3.4, R1)

Exam #1 – Thu 9/29

Part 2. 3D orbits, coordinate systems and orbit determination

READING:
Curtis, Sections 3.5-3.6, 4.1-4.8, 5.1-5.2, 5.4-5.8

Problem Set #5	Due Tue 10/11	Ch 3: 14, 15, 16, 17, 18; Ch 4: 1
Problem Set #6	Due Tue 10/18	Ch 4: 3, 4, 6, 7, 8, 9, 10
Problem Set #7	Due Tue 10/25	Ch 4: 14, 18, 19, 21, 23, 24, 25, 27
Problem Set #8	Due Tue 11/1	Ch 5: 1, 2, 8, 9, 10, 11, 12, 13, 14, 15

Exam #2 – Thu 11/3