

Syllabus

Aero Eng 351

ASTRODYNAMICS

Spring 2012

	Week
I. Mathematics/Dynamics Refresher	
A. Vectors and products	1
B. Newton's laws, particle dynamics	1
II. Two-Body Problem	
A. Potentials and integrals	2
1. Constants of the motion	
2. Orbit equation	
B. Conic-section geometry, two-body orbits	2,3
1. Elliptical, circular	
2. Parabolic	
3. Hyperbolic	
III. Keplerian Orbital Mechanics	
A. Coordinate systems	4
B. Orbital elements	4
C. Position and velocity	4,5
D. Kepler's equation, position and time	5
E. Orbit determinations	5,6
1. Orbital elements from \mathbf{r} and \mathbf{v}	
2. \mathbf{r} and \mathbf{v} from the elements	
REVIEW	6
1st Hourly Exam: in class	
IV. Orbital Maneuvers	
A. Earth orbit characteristics	7
1. Low-altitude	
2. High-altitude	
B. Hohmann transfers	7
C. Inclination (plane) change	8
D. Non-Hohmann, combined orbit transfers	8,9

E.	Non-ideal orbital effects	9
	1. Earth oblateness	
	2. Atmospheric drag	
	3. Lunisolar corrections	
	4. Solar radiation	
V.	Rocket Performance	
	A. Rocket Equation	10,11
	B. Propulsion systems	
	C. Multi/parallel-stage vehicles	
VI.	Extraterrestrial Trajectories	11,12
	A. Patched-conic concept	
	1. Sphere of influence	
	2. Launch phasing	
	B. Cis-lunar trajectories	
	REVIEW	12
2nd Hourly Exam: in class		
	C. Interplanetary Orbits	13,14
	1. Spheres of planetary influence	
	2. Launch windows	
	3. Departure/arrival timing	
	4. Departure/arrival hyperbola and energetics	
VII.	Ballistic Missiles	14,15
	A. Sub-orbital flight; fundamental equations	
	1. Free-range angle equation	
	2. Flight-path angle equation	
	B. Examples	
	REVIEW	15

Final Exam

Course References

1. Roger R. Bate, Donald D. Mueller, Jerry E. White *Fundamentals of Astrodynamics*, (Dover Publications, New York, 1971) [required course text]
2. William E. Wiesel, *Spaceflight Dynamics*, (McGraw-Hill, New York, 1989)

3. R. H. Battin, *An introduction to the mathematics and methods of astrodynamics*, (AIAA education series, AIAA, Reston, 1999)
4. John P. Vinti, *Orbital and Celestial Mechanics*, (AIAA education series, AIAA, Reston, 1998)
5. Robert M. L. Baker, Jr. and Maud W. Makemson, *An Introduction to Astrodynamics*, (New York, Academic Press, 1967)
6. K. J. Ball and G. F Osborne, *Space Vehicle Dynamics*, (Oxford Univ Press, London, 1967)